Aviation Investigation Final Report

Location:	Debary, Florida	**Incident Number:**	ERA13IA114
Date & Time:	January 13, 2013, 18:18 Local	**Registration:**	N662QS
Aircraft:	Cessna 560XL	**Aircraft Damage:**	None
Defining Event:	Flight control sys malf/fail	**Injuries:**	4 None
Flight Conducted Under:	Part 91 subpart k: Fractional		

Analysis

The flight departed uneventfully and was climbing to their planned cruise altitude. As the airplane climbed through FL350 at a rate of 1,000 feet per minute (fpm) and with the autopilot engaged, the airplane pitched nose-down and entered a 400-fpm descent. The flight crew then disconnected the autopilot, assumed manual control of the airplane, and leveled at FL350. Both crewmembers noted that "excessive" force was required to change the pitch of the airplane, and subsequently notified air traffic control of the situation. The crew then requested a descent, and noted that both trim and manual elevator control inputs would result in an exaggerated pitch response from the airplane. Upon descending through FL180, the crew felt that something "broke loose" and the elevator controls began to respond normally. The crew subsequently re-engaged the autopilot and continued to the planned destination uneventfully.

Post-incident examination of the airplane revealed that several of the fuselage bilge drain holes were partially or totally obstructed, allowing water to accumulate within the bilge and in areas adjacent to elevator control cables and pulleys. Several of the pulleys exhibited evidence of saturation with moisture, and two of the pulleys' bearings had seized completely and displayed evidence that the control cable had subsequently worn their grooves. Additionally, seals designed to limit the entry of moisture within the tail area were not trimmed according to the published installation procedure. As a result of the findings of the investigation, the airframe manufacturer and operator each implemented a revised inspection and cleaning program to ensure the proper drainage of moisture from the tailcone and fuselage bilge areas.

Probable Cause and Findings

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

An accumulation of debris in the airplane's bilge and tailcone areas that prevented accumulated moisture from properly draining. The accumulated moisture subsequently froze the elevator control pulley(s) and cable(s), resulting in the reported flight control stiffness.

Findings

Environmental issues	Debris/dirt/foreign object - Effect on equipment
Environmental issues	Water/moisture - Effect on equipment
Personnel issues	Installation - Maintenance personnel
Aircraft	Elevator control system - Malfunction
Aircraft	Frames (main fuselage) - Related maintenance info

Factual Information

History of Flight

Enroute-climb to cruise	Flight control sys malf/fail (Defining event)

On January 13, 2013, at 1818 eastern standard time, the flight crew of a Cessna 560XL, N662QS, operated by NetJets Aviation, Inc., experienced in-flight stiffness of the elevator controls while climbing through FL350 near Debary, Florida. Both airline transport pilots and both passengers were not injured, and the airplane was not damaged. Instrument meteorological conditions prevailed, and the airplane was operating on an instrument flight rules flight plan. The flight originated from St. Lucie County International Airport (FPR), Fort Pierce, Florida at 1752, and was destined for Dekalb-Peachtree Airport (PDK), Atlanta, Georgia. The personal flight was conducted under the provisions of Title 14 Code of Federal Regulations Part 91, Subpart K.

The flight departed from FPR uneventfully and was climbing to a planned cruise altitude of FL380. Just prior to entering a cloud layer at FL320, the flight crew activated the engine and wing anti-ice systems, as well as the pneumatic tail de-ice system. As the airplane climbed through FL350 at a rate of 1,000 feet per minute (fpm) and with the autopilot engaged, the airplane pitched nose-down and entered a 400-fpm descent. The flight crew then disconnected the autopilot, assumed manual control of the airplane, and leveled at FL350.

Both crewmembers noted that "excessive" force was required to change the pitch of the airplane, and subsequently notified air traffic control of the situation. The crew then requested a descent, and during the descent noted that the manual and electric pitch trim systems appeared to function normally; but that both trim and manual elevator control inputs would result in an exaggerated pitch response from the airplane. Upon descending through FL180, the crew reported that something "broke loose" and the elevator controls began to respond normally. The crew subsequently re-engaged the autopilot and continued to PDK uneventfully.

AIRCRAFT INFORMATION

The incident airplane was manufactured in 2002, and its most recent phase inspection was completed on January 13, 2013 at an airframe total time of 8,990 hours of operation.

Following incidents in 2010 and 2011 (see NTSB cases ERA11IA184 and CEN11IA087), the airframe manufacturer issued two mandatory service bulletins that detailed the procedures for installing drain holes in the lower aft portion of the fuselage. These drains were implemented in order to provide a path for accumulated moisture from the aft tailcone area to exit. A seal was also added to reduce the amount of water entering the tailcone stinger. In April 2012, both service bulletins were incorporated into a Federal Aviation Administration (FAA) Airworthiness Directive (AD), AD 2012-06-01. Review of maintenance records for the incident airplane revealed that the Service Bulletins and Airworthiness Directive were complied with shortly after each of their respective issuances.

About that time, the operator also implemented a one-time procedure (TC-5XL-53-110306) to inspect and clean each of the fuselage bilge drains. The procedure directed maintenance technicians to inspect for the presence of debris that would clog the drains and for the presence of stains that would indicate the presence of previous standing water. The inspection began at the aft canted bulkhead, near fuselage frame station (FS) 573, and proceeded forward to the fuselage drain located a fuselage station FS373. The procedure was completed on the incident airplane in May 2011.

TESTS AND RESEARCH

Field Examination

Two days after the event, the airplane was examined while on the ground at PDK. Utilizing the fuselage drain inspection and cleaning procedure developed by the operator, the empennage of the airplane was examined. The examination documented the following at each respective fuselage station drains:

FS573 No obstructions, some grass noted.

FS550 Drain 50% obstructed, tidal mark observed 5 inches above lowest point of belly on aft side of frame.

FS544 Drain 100% obstructed, tidal mark at 8 inches on aft side of frame with evidence of forward spillage, 1/4-inch of standing water.

FS528 No obstructions, other debris noted in general area, tidal staining exceeded height of frame.

FS512 Drain 40% obstructed, 1/2-inch tidal mark.

FS496 Drain 100% obstructed.

FS479 Drain 100% obstructed, 1 1/2-inch tidal mark.

FS462 Debris accumulation to within 1/8-inch of control cable cutout, other minor accumulation of debris to the right and left, standing water noted.

FS460 Drain 100% obstructed with standing water to 1/4-inch, at control cable cutout.

FS449 Elevator cable pulley mounting location. Pulleys appeared visibly saturated with water with beads of water present.

FS421 Drain 60% obstruction, 1/4-inch tidal mark.

In preparing the airplane for return to service, the operator performed additional inspections of the elevator control system including a function check of each elevator cable pulley. The mechanics performing the inspections subsequently found that the pulleys installed at FS528 were not free to rotate, and that their bearings had seized. The pulleys from FS528, water-saturated pulleys from FS449, a pulley from FS438, along with a sample of the debris found obstructing some of the fuselage drains were forwarded to the NTSB Materials Laboratory for further examination.

The mechanics further noted that the tailcone stinger seals, which were installed in compliance with Cessna Service Bulletin SB650XL-53-16 in order to reduce the amount of water entering the stinger, were not trimmed to overlap in accordance with the service bulletin.

Laboratory Examination

The pulleys recovered from FS528, FS449, and FS438 were examined in the NTSB Materials Laboratory, and compared with new exemplar pulleys provided by the airframe manufacturer. The left pulley recovered from FS528 displayed partial staining of its phenolic material, with a distinct line separating the stained and non-stained areas. Both FS528 pulleys' grooves displayed a shiny, smooth appearance. The bearings of the pulleys were not free to rotate, and exhibited radially oriented stains emanating from the bearing on both sides. Deposits that could be removed with a fingernail were also noted around the bearing seals. The bearings were subsequently disassembly, and the interior bearing balls and races exhibited corrosion.

The pulleys recovered from FS449 appeared uniformly darker in color than the pulleys from FS528 and the exemplar pulleys, and also felt damp when handled. The bearings rotated smoothly contained grease. The dampness was swabbed from both pulleys and examined using Fourier-Transform Infrared Spectroscopy and found to be water and an unidentified silicon-based product.

Examination of the obstructing debris sample revealed the presence mostly unknown fibrous material with gray, black, orange, and red filaments. Also present were beetles, a rivet shank, other rivet pieces with shank, a portion of rubber seal, a cotter pin, a portion of a nylon wire tie, a washer, and a piece of twisted lock wire.

ADDITIONAL INFORMATION

Following the incident, the operator updated their approved aircraft inspection program to incorporate a recurring fuselage bilge drain inspection and cleaning every 300 flight hours. The airframe manufacturer also drafted an update to the Cessna Model 560XL Maintenance Manual introducing a visual inspection and cleaning of the tailcone and bilge areas that would recur at 600 hour/12 calendar months or 1,200 hours/24 calendar months.

Pilot Information

Certificate:	Airline transport	**Age:**	54
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 1 With waivers/limitations	**Last FAA Medical Exam:**	October 17, 2012
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	November 19, 2012
Flight Time:	9431 hours (Total, all aircraft), 593 hours (Total, this make and model), 3138 hours (Pilot In Command, all aircraft), 66 hours (Last 90 days, all aircraft), 16 hours (Last 30 days, all aircraft), 2 hours (Last 24 hours, all aircraft)		

Co-pilot Information

Certificate:	Airline transport	**Age:**	46
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Right
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	
Instrument Rating(s):	Airplane; Helicopter	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 1 Without waivers/limitations	**Last FAA Medical Exam:**	August 2, 2012
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	November 19, 2012
Flight Time:	7107 hours (Total, all aircraft), 3017 hours (Total, this make and model), 3607 hours (Pilot In Command, all aircraft), 103 hours (Last 90 days, all aircraft), 50 hours (Last 30 days, all aircraft), 2 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Cessna	**Registration:**	N662QS
Model/Series:	560XL	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Transport	**Serial Number:**	560-5262
Landing Gear Type:	Tricycle	**Seats:**	9
Date/Type of Last Inspection:	August 29, 2012 AAIP	**Certified Max Gross Wt.:**	20200 lbs
Time Since Last Inspection:		**Engines:**	2 Turbo fan
Airframe Total Time:	8990 Hrs as of last inspection	**Engine Manufacturer:**	Pratt and Whitney Canada
ELT:	C91A installed, not activated	**Engine Model/Series:**	PW545A
Registered Owner:	NETJETS SALES INC	**Rated Power:**	3804 Lbs thrust
Operator:	NetJets Aviation, Inc.	**Operating Certificate(s) Held:**	Fractional ownership
Operator Does Business As:		**Operator Designator Code:**	DXTK

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Night/dark
Observation Facility, Elevation:	SFB,55 ft msl	**Distance from Accident Site:**	7 Nautical Miles
Observation Time:	17:53 Local	**Direction from Accident Site:**	355°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	10 knots / None	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	130°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.12 inches Hg	**Temperature/Dew Point:**	23°C / 16°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Fort Pierce, FL (FPR)	**Type of Flight Plan Filed:**	IFR
Destination:	Atlanta, GA (PDK)	**Type of Clearance:**	IFR
Departure Time:	17:52 Local	**Type of Airspace:**	

Wreckage and Impact Information

Crew Injuries:	2 None	**Aircraft Damage:**	None
Passenger Injuries:	2 None	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	4 None	**Latitude, Longitude:**	28.883054,-81.308609(est)

Administrative Information

Investigator In Charge (IIC):	Diaz, Dennis
Additional Participating Persons:	Gordon Smith; FAA/FSDO; Columbus, OH Paul McClaskey; NetJets Aviation; Columbus, OH John Greier; NetJets Aviation; Columbus, OH Mark C Nye; NJASAP; Columbus, OH Jeff Quigley; NJASAP; Columbus, OH Robert Van Sise; NJASAP; Columbus, OH Andrew Hall; Cessna; Wichita, KS
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