



Aviation Investigation Final Report

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|--------------------------------|--------------------------------------|-------------------------|-------------|
| Location: | Ft. Lauderdale, Florida | Accident Number: | ERA12FA127 |
| Date & Time: | December 28, 2011, 09:51 Local | Registration: | N877G |
| Aircraft: | Cessna 650 | Aircraft Damage: | Substantial |
| Defining Event: | Flight control sys malf/fail | Injuries: | 8 None |
| Flight Conducted Under: | Part 91: General aviation - Personal | | |

Analysis

The crew stated that the preflight examination, takeoff checks, takeoff roll, and rotation from runway 26 were "normal." However, once airborne, and with the landing gear down and the flaps at 20 degrees, the airplane began a roll to the right. The captain used differential thrust and rudder to keep the airplane from rolling over, and as he kept adjusting both. He noted that as the airspeed increased, the airplane tended to roll more; as the airspeed decreased, the roll would decrease. The captain also recalled thinking that the airplane might have had an asymmetrical flap misconfiguration. Both pilots stated that there were no lights or warnings. As the airplane continued a right turn, runway 13 came into view. The captain completed a landing to the right of that runway, landing long and in the grass with a 9-knot, left quartering tailwind. The airplane then paralleled the runway and ran into an airport perimeter fence beyond the runway's end.

The cockpit voice recorder revealed that the crew initially used challenge and reply checklists and that after completing the takeoff checklist, engine power increased. About 7 seconds after the first officer called "V1," the captain stated an expletive, and the first officer announced "positive rate." During the next 50 seconds, the captain repeated numerous expletives, an automated voice issued numerous "bank angle" warnings, and the first officer asked what he could do, to which the captain later told him to declare an emergency. There were no calls by either pilot for an emergency checklist nor were there callouts of any emergency memory items.

Each of the airplane's wings incorporated four hydraulically-actuated spoiler segments. The outboard segment, the roll control spoiler, normally extends in conjunction with its wing aileron after the aileron has traveled more than about 3 degrees, and extends up to 50 degrees at full control wheel rotation.

When the airplane was subsequently examined in a hangar, hydraulic power was applied to the airplane via a ground hydraulic power unit, and the right roll spoiler elevated to 7.9 degrees above the flush wing level. Multiple left/right midrange turns of the yoke, with the hydraulic ground power unit both on and off, resulted in the roll spoiler being extended normally, but still returning to a resting position of 7.8 to

7.9 degrees above the flush position. When the yoke was turned full right and left, whether the aileron boost was on or off, both wings' roll spoilers extended to their full positions per specifications; however, once the full deflection testing was completed, the right roll spoiler returned to 6.1 degrees above the flush position. A final yoke turn resulted in the roll spoiler being elevated to 5.5 degrees.

The right wing roll spoiler actuator was subsequently examined at the airplane manufacturer, and the roll spoiler was found to jam. The roll spoiler actuator was disassembled, but no specific reason(s) for the jamming were found. The roll spoiler parts were also examined and no indications of why the actuator may have jammed were found.

According to the flight manual, if any of the spoiler segments should float, moving the spoiler hold-down switch to "Spoiler Hold Down" locks all spoiler panels down. The roll control spoilers may then be used in the roll mode by turning on the auxiliary hydraulic pump. Also, an "Aileron/Spoiler Disconnect" T-handle is available to release the tie between the ailerons and the roll control spoilers in the event of a jam in either system. When used, the pilot's yoke controls only the ailerons, and the copilot's yoke controls only the roll control spoilers.

Although the jamming of the right spoiler initiated the event, the crew's proper application of emergency procedures should have negated the adverse effects. Memory items for an uncommanded roll include moving the spoiler hold-down switch to the "on" position, which was not done; the spoiler hold-down switch was found in the "off" position. (The captain thought that he may have had an asymmetrical flap configuration; however, if an asymmetry had been the initiating event, the flap system would have been automatically disabled and the flap segments would have been mechanically locked in their positions.)

The aileron/spoiler disconnect T-handle was found pulled up, which the crew indicated had occurred when the first officer's shoe hit it as he evacuated the airplane. While pulling the aileron/spoiler disconnect T-handle would have been appropriate for a different emergency procedure to release the tie between the ailerons and the roll control spoilers in the event of a jam in either system, it would have actually hindered the captain's attempts to control the airplane in this case because it would have disconnected the left roll spoiler from the captain's yoke, making it more difficult to counter the effects of the displaced right roll spoiler. Although the crew indicated that the t-handle was pulled during the first officer's exit of the airplane, its position, safety cover, and means of activation make this unlikely. In addition, precertification testing of the airplane showed that even with the right roll spoiler fully deployed, as long as the pilot had the use of the left roll spoiler in conjunction with that aileron, the airplane should have been easily controlled.

Probable Cause and Findings

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

The crew's failure to use proper emergency procedures during an uncommanded right roll after takeoff, which led to a forced landing with a quartering tailwind. Contributing to the accident was a faulty right roll spoiler actuator, which allowed the right roll spoiler to deploy but not close completely.

Findings

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| Personnel issues | Use of checklist - Flight crew |
| Environmental issues | Tailwind - Effect on operation |
| Aircraft | Drag control actuator - Malfunction |

Factual Information

History of Flight

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| Initial climb | Flight control sys malf/fail (Defining event) |
| Emergency descent | Landing area overshoot |
| Landing-landing roll | Runway excursion |

HISTORY OF FLIGHT

On December 28, 2011, about 0951 eastern standard time, a Cessna 650, N877G, was substantially damaged when it impacted an airport perimeter fence while returning for landing at Fort Lauderdale Executive Airport (FXE), Fort Lauderdale, Florida. The two crewmembers and six passengers were not injured. The airplane had just taken off from FXE in visual meteorological conditions on an instrument flight rules flight plan to Teterboro Airport (TEB), Teterboro, New Jersey. The personal flight was operating under the provisions of 14 Code of Federal Regulations Part 91.

According to the first officer, the takeoff roll and rotation from runway 26 were "normal," but once airborne, the airplane began rolling to the right. Positive-rate climb was called, but the landing gear remained down and the flaps remained at 20 degrees. The first officer noticed that the captain was having "extreme" difficulty in rolling the airplane level, but eventually accomplished it through rudder and asymmetric thrust. As the right turn brought the airplane around to runway 13, the captain was able to land long, but the airplane then left the runway and impacted the airport perimeter fence. The first officer also noted that there were no warning lights or advisories in the cockpit during the event.

According to the captain, the preflight examination of the airplane was "normal," as were the pre-takeoff checks, including the ailerons and all flight control surfaces. After taking off and obtaining a positive rate of climb, the captain found that he needed a "little left control," and the airplane started a slow right turn which he could not stop. The captain then found that he needed differential thrust and rudder to keep the airplane from rolling over, and as he kept adjusting both, another runway came into view, and he completed the landing.

In a follow-up telephone interview, the captain further stated that as the airspeed increased, the airplane tended to roll more. He recalled thinking that the airplane might have had a flap misconfiguration, but there were no lights or warnings. As he reduced power, the right wing would start to come back up, and as he added differential thrust to maintain altitude, airspeed would increase and the right wing would then fall again. The captain found himself going through the same series of actions over and over again to maintain flight, and as he did so, he saw that the airplane was gradually lining up with runway 13 through the right window. As the airplane came around toward the runway, the captain felt that he only had a "one time shot," and did the best he could to get the airplane onto the runway.

The first officer and a passenger estimated that the maximum roll angle approached 90 degrees of bank.

According to air traffic control radio transmissions,

At 0948:47, the airplane was cleared for takeoff.

At 0950:51, a voice from the airplane stated "got an emergency return."

The tower controller then gave the airplane the winds, and the voice said, "say again," to which the controller stated use caution, cleared to land, runway three one is open.

There were no further transmissions from the airplane.

The airplane was equipped with a cockpit voice recorder that was auditioned at the NTSB Recorders Laboratory. According to the specialist's factual report, the recording began at 0902, with one of the crew members on the telephone discussing technical details of the flight management system. The passengers arrived at 0932.

After passenger arrival, the crew briefed the flight, including speeds of "twenty two, twenty three, and one thirty three" along with a single engine climbout speed of 165 knots.

At 0936:57, the crew began to perform checklists to start both engines, followed shortly thereafter by a taxi clearance to runway 26. During the ensuing taxi, the crew verified taxi routings while performing the taxi checklist in a challenge-response manner.

At 0944:39, as part of the checklist, the first officer stated, "speed brake, spoiler levers." After a "snapping sound," the captain responded about 12 seconds later with, "check...comin' up on the right T-R...after left T-R...check,"

At 0945:11, the captain began to brief the takeoff and departure, followed by his noting that the aileron boost was on.

At 0948:36, the airplane was cleared for a departure from runway 26 with a right turn to 315 degrees. The first officer acknowledged the takeoff clearance and the crew executed the last checklist before takeoff. As part of the checklist, the first officer called out "control lock and controls," to which the captain responded, "okay, it's off."

At 0949:45, the captain stated, "here we go," which was followed by the sound of increased engine noise. Shortly thereafter, the first officer confirmed power, engine instruments, and airspeed alive.

At 0950:07, the first officer called out "90 knots," followed 3 seconds later by two low frequency thumps about 0.6 seconds apart.

At 0950:15, "V1" was announced.

At 0950:23, the captain stated an expletive, followed 1 second later by the first officer calling "positive rate."

During the next 50 seconds, until airplane touchdown, the following was stated with an occasional overlap:

- Captain repeated expletive.
- First officer asked what was going on.
- Captain repeated expletive.
- Automated voice announced, "Bank angle."
- First officer stated, "Say again," and asked what he could do.
- Automated voice announced, "Bank angle."
- Captain repeated expletive.
- Automated voice announced, "Bank angle."
- Captain repeated expletive.
- Automated voice announced, "Bank angle."
- Captain stated, "let go, let go, let go."
- Automated voice announced, "Sink rate, pull up."
- A sound of two high frequency beeps about 0.25 seconds apart.
- Automated voice announced, "Pull up, don't sink."
- Captain stated, "Declare an emergency, declare an emergency,"
- Automated voice announced, "Don't sink, bank angle."
- The first officer made a radio call declaring an emergency and the intent to return to the airport.
- Automated voice announced, "Bank angle, bank angle."
- A sound of two high frequency beeps about 0.25 seconds apart.
- Automated voice announced, "Bank angle."
- The tower controller made an unintelligible transmission to the airplane, plus the winds.
- At this point, about 0950:58, the background noise decreased.
- Automated voice announced, "Terrain, terrain, too low, terrain...too low, terrain."
- The first officer asked the tower to say again.
- The tower controller made an unintelligible response, in part mentioning runway 31 and "caution."
- The captain exclaimed, "Emergency, call emergency."
- Automated voice announced, "Too low, terrain."
- The captain exclaimed, "Call emergency."
- Automated voice announced, "Bank angle, bank angle."

At 0951:13, there were sounds similar to airplane touchdown followed by intermittent thumps. Eight seconds after touchdown, there was an increased sound of rushing air and engine noise.

At 0951:24, and for the next 11 seconds, there were multiple sounds of rattles, snaps and clunks.

About 0951:47, there was a rapid decrease in background noise, coincident with the sound of a single chime.

At 0951:49, the crew announced the evacuation, and the captain stated, "I had no control."

Surveillance video at the airport captured the majority of the last part of the flight. It showed that the airplane descended to the ground in a left-wing-low flight attitude before it rolled to the right and landed on the grass to the right of runway 13 in a right-wing-low flight attitude. The airplane crossed a taxiway and continued through the grass until it went through an airport perimeter chain link fence and struck the far side of a shallow drainage ditch. There was no fire.

PERSONNEL INFORMATION

The captain, age 57, held an airline transport pilot certificate with airplane multi-engine and single engine land ratings. He also had a single engine sea rating, and ratings for the Cessna 500, Cessna 560XL, and Cessna 650. In addition, he held a flight instructor certificate for single and multiengine airplane and instrument airplane. The captain reported 14,950 hours of total flight time with 190 hours in make and model; 7 hours of which were in the previous 30 days.

The first officer, age 64, held an airline transport pilot certificate with airplane multi-engine and single engine land, rotorcraft-helicopter, and instrument helicopter ratings, and ratings for the Cessna 500, Cessna 560XL, and Cessna 650, among others. He also held a flight instructor certificate for multiengine airplanes. The first officer reported 19,000 hours of total flight time with 100 hours in make and model.

According to a representative of an aircraft maintenance firm, the firm was interested in putting the airplane on its operating certificate; however, at the time of the accident, there was no written contract or preliminary agreement. The firm provided the captain's resume to a representative of the owner, who in turn made the decision to contract with the captain. The captain then provided the first officer for the owner.

Confirmation of the arrangement was requested from the operator, the operator's attorney, and the captain with no replies received.

AIRPORT INFORMATION

Runway 13 was 4,000 feet long and 100 feet wide. An airport perimeter fence was located about 650 feet beyond the departure end of the runway.

AIRCRAFT INFORMATION

The airplane was recently acquired by the owner, and a memorandum of delivery dated December 1, 2011, indicated the "full and satisfactory delivery and acceptance" on that date. At that time, the airframe hours were 5,608.3, landings were 4,487, and the left and right Garrett engines had accumulated 5,509.5 hours and 5,418.3 hours respectively.

An aircraft flight log indicated that after delivery, the airplane was flown once on December 18, 2011, and twice on December 19, 2011, for a combined total of 5.6 hours.

A review of maintenance records indicated that the original Cessna factory right roll spoiler actuator was installed on the airplane. There were no maintenance records found that related to the right roll spoiler actuator.

- Ailerons -

According to the flight manual,

"The ailerons are mechanically cable-controlled and hydraulically powered in normal operation. Direct cable actuation is maintained in the event of hydraulic system failure. If a control problem is encountered, hydraulic pressure to the ailerons can be shut off by a switch on the center pedestal or by a cam operated switch on the aileron power actuator, which activates at a predetermined control force."

- Spoilers -

According to the flight manual,

"Each wing incorporates four hydraulically actuated spoiler segments. The outboard segment is called the roll control spoiler and operates with the aileron. After approximately 3.5 degrees of up aileron movement the spoiler moves up. At full aileron, the spoiler travels 50 degrees. The middle two segments operate as speed brakes and are controlled by an infinite positioning lever on the pedestal.

In case any of the spoiler segments should float up, the airplane range could be reduced as much as 5 percent, so a spoiler hold-down system is provided. Turning the spoiler hold-down switch to SPOILER HOLD DOWN locks all spoiler panels down. The roll control spoilers may then be used in the roll mode by turning on the auxiliary hydraulic pump.

Floating of spoilers or speed brakes may be annunciated by illumination of the SPOILERS UP and SPEED BRAKE annunciators respectively.

An AILERON/SPOILER DISCONNECT handle is provided on the rear portion of the pedestal to release the tie between the aileron and the roll control spoiler in the event of a jam in either the aileron system or the roll control spoiler system. When disconnected, the pilot's wheel controls only the ailerons and the copilot's wheel controls only the roll control spoilers; consequently, the location of the jam will determine whether the pilot or copilot will control the airplane.

The roll spoilers (panels 1 and 8) are...mechanically controlled and hydraulically powered. The roll spoilers operate in conjunction with the ailerons and augment their roll control function.

Lateral control is provided by the combined actuation of the ailerons and the roll control spoilers (outboard segments). Full control wheel rotation results in +12.5, -12.5 degrees travel of the ailerons and 0 to 50 degrees up travel of the roll spoilers. Roll control spoiler movement starts after ailerons have traveled more than approximately 3 degrees.

A manual disconnect [red T-]handle [shielded by a plastic cover that has is hinged on the forward side, and must be lifted to reach the T-handle,] is available to the pilots (center pedestal) in the event of a system jam of either the aileron or the roll control system. When the disconnect handle has been activated, the pilot has control of the ailerons and the copilot has control of the roll control spoilers, whichever is operational. Reconnection of the ailerons and roll control spoilers is not possible in flight.

Lateral control of the airplane is normally by means of a hydraulic power cylinder through the crossover quadrant assembly between the ailerons and roll control spoilers. An AIL BOOST OFF annunciator light advises the pilot of loss of aileron power."

- Pre-Certification In-Flight Spoiler Malfunction Testing -

The following is excerpted from a Cessna flight test results paper (Report FT650-13) prepared on June 16, 1982, in regards to meeting FAR 25.671 requirements for control system (spoiler) malfunctions:

"The spoiler failure was simulated by commanding (at the actuator) the #8 [right] spoiler to the full up position and holding the spoilers down with the spoiler hold down switch. When the spoiler hold down

was removed, the #8 spoiler went full deflection and the #1 spoiler was enabled as a normal roll spoiler....

The aircraft was...slowed from 350 knots through stick shaker speed (102 KCAS) with the failed #8 spoiler. Twenty degrees of flaps were extended at 180 knots and landing flaps and gear were extended at 140 knots....

A roll rate of 25 degrees/second could be produced at 115 KCAS with flaps at 20 degrees and gear extended, and 30 degrees/second with flaps fully extended and gear extended....

The last hardover was commanded on approach to landing and the approach continued through the landing. The wind given by the tower was 50 degrees adverse crosswind at 22 knots. Approach speed was 125 KCAS. Throughout the hardovers the failed spoiler was easily controlled with aileron and rudder....

The spoiler hold down function was found to be a satisfactory way of dealing with spoiler hardover....

Probable control malfunctions on the Model 650 have minor effects on control system operation and are capable of being readily counteracted by the pilot."

- Flaps -

According to the flight manual,

"The trailing edge flaps are mechanically controlled and driven by an electric power unit through ballscrew actuators and flex-drive shafts. The flaps are in three segments on each wing; however, the drive system is designed to preclude the possibility of a split flap condition. If at any time an asymmetrical flap condition occurs, the flap controller disables the system and engages the asymmetry brakes which mechanically lock the flap segments in that position. The asymmetry brakes can only be reset on the ground....A mechanical detent is provided at the 7- and 20-degree position of the flap lever."

- Emergency Procedures -

According to the flight manual, for:

"Uncontrolled Airplane Roll:"

The emergency checklist memory items are as follows (first four procedures are memory items):

1. AP/TRIM/NWS Disengage Switch – Press.
2. Control Wheel – STOP ROLL – APPLY OPPOSITE ROLL CONTROL.

IF ROLL NOT ARRESTED

3. Spoiler Hold Down Switch – ON.

IF ROLL STILL NOT ARRESTED

4. Auxiliary Hydraulic Power – OFF.

For "Jammed Roll Control System:"

1. AP/TRIM/NWS Disconnect Switch – PRESS
2. Pilot and Copilot Control Wheels – RELEASE
3. Aileron/Spoiler Disconnect T-Handle – PULL
4. Pilot and Copilot Control Wheels – VERIFY ROLL RESPONSE

NOTE

The pilot's control wheel will operate the ailerons and the copilot's control wheel will operate the roll control spoilers when the T-handle is pulled. The use of rudder pedal input will aid in lateral controllability.

CAUTION

Inadvertent movement of the copilot's control wheel could cause a roll spoiler to extend.

5. Auxiliary Hydraulic Power – OFF
6. Spoiler Hold-down Switch – ON
7. Land as soon as possible – Refer to Normal Procedures, BEFORE LANDING

METEOROLOGICAL INFORMATION

Weather, recorded at the airport at 0953, included clear skies, visibility 10 statute miles, wind from 350 degrees true at 9 knots, temperature 16 degrees C, dew point 6 degrees C, and an altimeter setting of 30.18 inches Hg.

WRECKAGE AND IMPACT INFORMATION

The airplane came to rest entangled in the airport perimeter beyond the departure end, and to the right of runway 13 with the nose landing gear bent aft. NTSB did not initially respond to the scene, and the airplane was moved to a hangar.

The airplane was subsequently examined in the hanger with NTSB oversight where leading edge wing damage, a slice through the top outer skin and ribs of the cabin, and the nose wheel bent back into the pressure hull with compromised hydraulic lines were documented. Although the captain's yoke pedestal was jammed against the seat, control continuity was confirmed from the cockpit to all flight control surfaces. The flaps were found in the 20-degree position, and all four spoilers on each wing were initially flush with the wing.

The plastic shielded Aileron Spoiler Disconnect "red T-handle" was observed in the "Pulled" or "Disconnected" position. When asked if he or the copilot pulled the aileron/spoiler disconnect T-handle, the captain stated that he didn't, as he was trying to control the airplane. He also didn't recall seeing the first officer do it in flight either. He did note however, that he thought it possible that the first officer may have hit the T-handle with his shoe when they exited the airplane. The first officer's shoes had

neoprene soles, and one of the soles had been ripped off during the "non-standard" exit. The first officer also stated that he may have hit the disconnect T-handle with his shoe.

The Control Lock was in the "Off" or "Stowed" position. The Rudder Bias was "Off." The Spoiler Hold Down switch was "Off." The Aileron Boost switch was "Off." The Speed Brake lever was full aft. The Spoiler Lever was forward. The Speed Brake Position gauge was 0%. The Secondary Trim switch was "Off" and the switch guard was closed.

The hydraulic lines in the nose well were subsequently capped, and 3,000 pounds of pressure to the hydraulic system were supplied via a hydraulic ground power unit. When the hydraulic pressure was supplied, the right wing roll spoiler (the outermost of the four spoilers, located next to the aileron) extended upwards 7.9 degrees.

Multiple initial left-right applications of the flight controls, with the hydraulic ground power unit both on and off, resulted in the roll spoiler being extended normally, but returning to a resting position of 7.8 to 7.9 degrees above the flush position.

When the yoke was turned full right, the right roll spoiler extended 49.5 degrees, which was within published specifications. The yoke was turned full left and the left roll spoiler extended 49.9 degrees which was also within published specifications. The same results were observed with the aileron boost "On." After the full deflection tests, the right roll spoiler returned to 6.1 degrees above the flush position, and a final aileron movement test resulted in the roll spoiler being open at 5.5 degrees.

The speed brakes and ground spoilers were actuated without any anomalies noted and within published specifications.

The left and right roll spoiler mechanical cables were measured for tension, and found to be within published specifications.

In preparation for confirmation of proper rigging, an attempt was made to secure the right roll spoiler bell crank with an alignment pin. As the pin contacted the bell crank, the bell crank snapped into a different position which then lowered the roll spoiler to the flush position. The bell crank and the hydraulic actuator for the right roll spoiler were retained for further examination.

TESTS AND RESEARCH

- Right Roll Spoiler Hydraulic Actuator -

On January 24, 2012, the right roll spoiler hydraulic actuator was removed from the aircraft by a Cessna Mechanic from the Orlando Citation Service Center under the supervision of an FAA inspector. The inspector forwarded the actuator to a representative of the Wichita FAA Aircraft Certification Office for further testing and analysis by Cessna Engineering.

On February 7, 2012, the right roll spoiler hydraulic actuator (9914155-19, serial number: 2641) was examined at the Wichita Citation Service Center under FAA oversight. Also attending were representatives of the U.S. subsidiary of the actuator's Japanese manufacturer, Nabtesco Corporation.

As summarized in Cessna report 11-CSST, and as confirmed by an FAA official, "the right roll spoiler hydraulic actuator (PN 9914155-19, serial number: 2641) was....removed from the shipping box and placed on a hydraulic test bench. The actuator linkage arm return spring tension was measured using a linear gauge. The measured force was approximately 1-2 lbs. Approximately 1,000 psi of hydraulic pressure was applied to the actuator and the linkage arm was actuated several times to eliminate any air trapped in the system. During this 'set-up' of the system, the actuator was extended and retracted several times. Approximately 3,000 psi was then applied to the actuator and the linkage arm was moved to extend the actuator. The actuator extended normally. When the actuator linkage arm was released, the return spring failed to provide enough force to smoothly return the linkage arm to the retracted position. The movement of the linkage arm appeared 'sticky.' The linkage arm was moved several more times and the actuator extended and retracted normally until eventually the actuator jammed. At this point, the actuator arm could not be moved and the investigative group decided to disassemble the actuator."

During the disassembly, no large contaminants were found, and a "little chip" was with the hydraulic fluid when the check valve (medium blue plug) was pulled. Disassembly of the actuator also revealed that three gear teeth were fractured; however, it was felt that the damaged gear teeth would not have been in the normal range of travel.

Also during disassembly, a check valve ball became separated from the rest of the assembly and could not be relocated by the participants.

The testing protocol was subsequently duplicated by Cessna on another hydraulic actuator with no anomalies noted with that actuator.

- Hydraulic Fluid -

A sample of hydraulic oil from the actuator was submitted to a laboratory within Cessna for examination and identification of particulate contamination.

"The oil was filtered through a 0.8 micron membrane, washed with 2-propanol, dried and then examined under scanning electron microscope (SEM) and energy-dispersive x-ray spectroscopy (EDS) with elemental mapping.

The major constituents in the particulate debris were carbon, oxygen, silicon, cadmium and potassium, with lesser presence of aluminum, iron, sodium and copper. The largest particles were approximately 0.007 inches across with most particles being approximately 0.001 inch or less in size."

- Additional Spoiler Examination –

The parts were subsequently forwarded to Nabtesco facilities in Japan via the Japan Transport Safety Board (JTSB) for further examination. JTSB oversight was provided during the examination, which was also attended by the Cessna primary accident investigator. The examination of the parts did not reveal any additional insight as to the previous on-wing and follow-up jamming observations.

- Right Wing Bell Crank -

The bell crank was taken to Cessna on March 6, 2012 by FAA personnel. According to the examination results:

"The bell crank had a slightly dirty appearance, but did not display any visible damage or corrosion. Some slight wear of the cable groove was noted due to contact with the cable, but this did not appear to be excessive. Press fit into the upper and lower surfaces of the bell crank were two KP3AL bearings. Both of these bearings had a somewhat greasy appearance with some dirt present, however the snap ring and bearing seals appeared to be intact. The lower bearing displayed the ball insertion grooves which are machined into the inner and outer bearing races. The upper and lower KP3AL bearings appeared to rotate freely by hand through approximately 90 degrees of rotation, at which time they could not be made to rotate any further by hand. No effort beyond manual hand pressure was applied to force bearing rotation. Rotation of the upper bearing coincided with rotation of the lower bearing, likely due to frictional contact of both bearing inner races with the NAS43HT3-125 spacer situated between the two bearings.

Supplied with the bell crank was the AN3H27A bolt. The shank of the bolt did not display any significant wear damage. The bolt head displayed some scratching damage."

- Mixer Box Assembly -

Cessna personnel subsequently requested that the airplane's mixer box also be examined. On February 21, 2012 the assembly was removed from the airplane by a Cessna mechanic under FAA oversight. It was then forwarded to Wichita FAA Aircraft Certification Office for further testing and analysis by Cessna Engineering.

On March 12, 2012, the mixer box assembly was examined by Cessna personnel with FAA oversight. Quoted from the examination report:

1. The bell crank did not display any unusual wear or significant corrosion.
2. Rotation of the bell crank bearings by hand in excess of 90 degrees was not possible.
3. The mixer box did not display any unusual wear. The internal mechanism of the mixer box moved easily by hand with no noticeable sticking or binding.
4. The examinations did not reveal anything that could have led to the unexpected partial extension of the right roll spoiler.

ADDITIONAL INFORMATION

The owner/operator was initially granted party status. However, due to the representative's subsequent lack of responsiveness, party status was revoked on August 9, 2013.

Pilot Information

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| Certificate: | Airline transport | Age: | 57 |
| Airplane Rating(s): | Single-engine land; Single-engine sea; Multi-engine land | Seat Occupied: | Left |
| Other Aircraft Rating(s): | None | Restraint Used: | 4-point |
| Instrument Rating(s): | Airplane | Second Pilot Present: | Yes |
| Instructor Rating(s): | Airplane multi-engine; Airplane single-engine | Toxicology Performed: | No |
| Medical Certification: | Class 2 With waivers/limitations | Last FAA Medical Exam: | July 5, 2011 |
| Occupational Pilot: | Yes | Last Flight Review or Equivalent: | |
| Flight Time: | 14950 hours (Total, all aircraft), 190 hours (Total, this make and model), 12870 hours (Pilot In Command, all aircraft), 21 hours (Last 30 days, all aircraft) | | |

Co-pilot Information

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|----------------------------------|---|--|--------------|
| Certificate: | Airline transport; Commercial; Flight instructor; Private | Age: | 64 |
| Airplane Rating(s): | Single-engine land; Multi-engine land | Seat Occupied: | Right |
| Other Aircraft Rating(s): | Helicopter | Restraint Used: | 4-point |
| Instrument Rating(s): | Airplane; Helicopter | Second Pilot Present: | Yes |
| Instructor Rating(s): | Airplane multi-engine | Toxicology Performed: | No |
| Medical Certification: | Class 1 With waivers/limitations | Last FAA Medical Exam: | June 5, 2012 |
| Occupational Pilot: | Yes | Last Flight Review or Equivalent: | |
| Flight Time: | 19000 hours (Total, all aircraft), 100 hours (Total, this make and model) | | |

Aircraft and Owner/Operator Information

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|--------------------------------------|------------------------------|---------------------------------------|-----------------|
| Aircraft Make: | Cessna | Registration: | N877G |
| Model/Series: | 650 | Aircraft Category: | Airplane |
| Year of Manufacture: | 1995 | Amateur Built: | |
| Airworthiness Certificate: | Transport | Serial Number: | 650-7063 |
| Landing Gear Type: | Retractable - Tricycle | Seats: | 12 |
| Date/Type of Last Inspection: | August 19, 2011 AAIP | Certified Max Gross Wt.: | |
| Time Since Last Inspection: | 47 Hrs | Engines: | 2 Turbo fan |
| Airframe Total Time: | 5616 Hrs at time of accident | Engine Manufacturer: | GARRETT |
| ELT: | Installed, not activated | Engine Model/Series: | TFE 731 SER |
| Registered Owner: | CITATION 7063 CORP | Rated Power: | 3500 Horsepower |
| Operator: | CITATION 7063 CORP | Operating Certificate(s) Held: | None |

Meteorological Information and Flight Plan

| | | | |
|---|----------------------------------|---|------------------|
| Conditions at Accident Site: | Visual (VMC) | Condition of Light: | Day |
| Observation Facility, Elevation: | FXE,13 ft msl | Distance from Accident Site: | 0 Nautical Miles |
| Observation Time: | 09:53 Local | Direction from Accident Site: | |
| Lowest Cloud Condition: | Clear | Visibility | 10 miles |
| Lowest Ceiling: | None | Visibility (RVR): | |
| Wind Speed/Gusts: | 9 knots / | Turbulence Type Forecast/Actual: | / |
| Wind Direction: | 350° | Turbulence Severity Forecast/Actual: | / |
| Altimeter Setting: | 30.18 inches Hg | Temperature/Dew Point: | 16°C / 6°C |
| Precipitation and Obscuration: | No Obscuration; No Precipitation | | |
| Departure Point: | Ft. Lauderdale, FL (FXE) | Type of Flight Plan Filed: | IFR |
| Destination: | Teterboro, NJ | Type of Clearance: | IFR |
| Departure Time: | 09:50 Local | Type of Airspace: | Class B |

Airport Information

| | | | |
|-----------------------------|------------------------------|----------------------------------|--------------------------|
| Airport: | Ft. Lauderdale Executive FXE | Runway Surface Type: | Asphalt |
| Airport Elevation: | 13 ft msl | Runway Surface Condition: | Dry |
| Runway Used: | 13 | IFR Approach: | None |
| Runway Length/Width: | 4000 ft / 100 ft | VFR Approach/Landing: | Forced landing;Full stop |

Wreckage and Impact Information

| | | | |
|----------------------------|--------|-----------------------------|---------------------------|
| Crew Injuries: | 2 None | Aircraft Damage: | Substantial |
| Passenger Injuries: | 6 None | Aircraft Fire: | None |
| Ground Injuries: | N/A | Aircraft Explosion: | None |
| Total Injuries: | 8 None | Latitude, Longitude: | 26.192222,-80.164443(est) |

Administrative Information

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|--|--|
| Investigator In Charge (IIC): | Cox, Paul |
| Additional Participating Persons: | Donald White; FAA/FSDO; Miramar, FL Peter Basile; Cessna Aircraft Corporation; Wichita, KS Robert Cugham; Nabtesco Aerospace; Redmond, WA James Lilley; Windsor Jet Management; Ft. Lauderdale , FL |
| Original Publish Date: | February 13, 2014 |
| Last Revision Date: | |
| Investigation Class: | Class |
| Note: | The NTSB traveled to the scene of this accident. |
| Investigation Docket: | https://data.nts.gov/Docket?ProjectID=82588 |

The National Transportation Safety Board (NTSB) is an independent federal agency charged by Congress with investigating every civil aviation accident in the United States and significant events in other modes of transportation—railroad, transit, highway, marine, pipeline, and commercial space. We determine the probable causes of the accidents and events we investigate, and issue safety recommendations aimed at preventing future occurrences. In addition, we conduct transportation safety research studies and offer information and other assistance to family members and survivors for each accident or event we investigate. We also serve as the appellate authority for enforcement actions involving aviation and mariner certificates issued by the Federal Aviation Administration (FAA) and US Coast Guard, and we adjudicate appeals of civil penalty actions taken by the FAA.

The NTSB does not assign fault or blame for an accident or incident; rather, as specified by NTSB regulation, “accident/incident investigations are fact-finding proceedings with no formal issues and no adverse parties ... and are not conducted for the purpose of determining the rights or liabilities of any person” (Title 49 *Code of Federal Regulations* section 831.4). Assignment of fault or legal liability is not relevant to the NTSB’s statutory mission to improve transportation safety by investigating accidents and incidents and issuing safety recommendations. In addition, statutory language prohibits the admission into evidence or use of any part of an NTSB report related to an accident in a civil action for damages resulting from a matter mentioned in the report (Title 49 *United States Code* section 1154(b)). A factual report that may be admissible under 49 *United States Code* section 1154(b) is available [here](#).