



# Aviation Investigation Final Report

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<b>Location:</b>	Wichita, Kansas	<b>Accident Number:</b>	CEN15FA425
<b>Date &amp; Time:</b>	September 25, 2015, 15:50 Local	<b>Registration:</b>	N301JA
<b>Aircraft:</b>	Cessna T310Q	<b>Aircraft Damage:</b>	Destroyed
<b>Defining Event:</b>	Flight control sys malf/fail	<b>Injuries:</b>	1 Fatal
<b>Flight Conducted Under:</b>	Part 91: General aviation - Personal		

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## Analysis

The commercial pilot was departing on a personal cross-country flight in the airplane. During initial climb after takeoff, witnesses saw the airplane suddenly pitch down into a rapid descent that continued to ground impact. Postaccident examination revealed that the elevator trim pushrod was attached to the trim tab but not attached to the trim tab actuator. The bolt, nut, and cotter pin securing the elevator trim tab pushrod to the actuator were missing and not recovered. Examinations of the elevator and the pushrod revealed that the pushrod became jammed aft of the forward elevator spar creating an abnormally large trim tab up (nose down) condition.

Measurements taken from an exemplar airplane of the same make and model as the accident airplane indicated that the elevator trim tab deflection with the pushrod jammed aft of the forward elevator spar would be over three times the normal maximum trailing-edge-up deflection. The airplane nose-down pitching moment at this increased deflection would create a forward force on the control yoke that a pilot would likely not be able to overcome.

Following the accident, the manufacturer issued a service bulletin that required the hardware securing the elevator trim pushrod be replaced and specified the hardware to be used. Subsequently, the Federal Aviation Administration issued an airworthiness directive that required compliance with the service bulletin.

Although the pilot's toxicology results were positive for ethanol in muscle tissue, when detected only in the muscle tissue, ethanol is likely from a source other than ingestion. No medications or illicit drugs were found that could pose hazards to flight safety.

## Probable Cause and Findings

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

The separation of the attachment hardware connecting the elevator trim tab pushrod to the elevator trim actuator, which resulted in the elevator trim tab jamming in a position outside the limits of normal travel and a subsequent loss of airplane control.

## Findings

<b>Aircraft</b>	Elevator tab control system - Malfunction
<b>Aircraft</b>	Elevator tab control system - Inoperative
<b>Aircraft</b>	Pitch control - Attain/maintain not possible
<b>Aircraft</b>	Pitch control - Capability exceeded

## Factual Information

### History of Flight

<b>Initial climb</b>	Flight control sys malf/fail (Defining event)
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On September 25, 2015, about 1550 central daylight time, a Cessna T310Q airplane, N301JA, experienced a flight control malfunction during takeoff initial climb and impacted the ground near Wichita, Kansas. The commercial pilot was fatally injured, and the airplane was destroyed. The airplane was registered to Celestial Knights, LLC, and operated by the pilot under the provisions of 14 Code of Federal Regulations Part 91 as a personal flight. Visual meteorological conditions prevailed for the flight, and an instrument flight rules (IFR) flight plan had been filed. The flight originated at Wichita Dwight D Eisenhower National Airport (ICT), Wichita, Kansas, and was destined for Centennial Airport (APA), Denver, Colorado.

According to witnesses, the airplane appeared to be flying normally, and then it suddenly pitched down and entered a rapid descent. The descent angle was described by witnesses as "greater than 45 degrees" and "50 to 70 degrees." The witnesses reported hearing both engines at "full throttle" during the descent. The airplane impacted the ground on the east side of Cowskin Creek about 2 nautical miles northeast of ICT.

### Pilot Information

<b>Certificate:</b>	Commercial; Private	<b>Age:</b>	46, Male
<b>Airplane Rating(s):</b>	Single-engine land; Multi-engine land	<b>Seat Occupied:</b>	Left
<b>Other Aircraft Rating(s):</b>	Glider	<b>Restraint Used:</b>	Unknown
<b>Instrument Rating(s):</b>	Airplane	<b>Second Pilot Present:</b>	
<b>Instructor Rating(s):</b>	None	<b>Toxicology Performed:</b>	Yes
<b>Medical Certification:</b>	Class 2 With waivers/limitations	<b>Last FAA Medical Exam:</b>	June 23, 2015
<b>Occupational Pilot:</b>	No	<b>Last Flight Review or Equivalent:</b>	
<b>Flight Time:</b>	470 hours (Total, all aircraft)		

The pilot held a commercial pilot certificate with airplane multi-engine land, airplane single-engine land, glider, and instrument airplane ratings. No pilot logbooks were recovered during the investigation. The pilot's most recent Federal Aviation Administration (FAA) second-class medical certificate was issued on June 23, 2015, with the limitation: "must wear lenses for distant, have glasses for near vision." On his medical certificate application, the pilot reported that he had about 470 total hours of flight time.

## Aircraft and Owner/Operator Information

<b>Aircraft Make:</b>	Cessna	<b>Registration:</b>	N301JA
<b>Model/Series:</b>	T310Q Q	<b>Aircraft Category:</b>	Airplane
<b>Year of Manufacture:</b>	1972	<b>Amateur Built:</b>	
<b>Airworthiness Certificate:</b>	Normal	<b>Serial Number:</b>	T310Q-0611
<b>Landing Gear Type:</b>	Retractable -	<b>Seats:</b>	6
<b>Date/Type of Last Inspection:</b>	May 8, 2015 Annual	<b>Certified Max Gross Wt.:</b>	
<b>Time Since Last Inspection:</b>		<b>Engines:</b>	Reciprocating
<b>Airframe Total Time:</b>	187.7 Hrs as of last inspection	<b>Engine Manufacturer:</b>	Continental Motors
<b>ELT:</b>		<b>Engine Model/Series:</b>	TSIO-520-B12B
<b>Registered Owner:</b>	On file	<b>Rated Power:</b>	
<b>Operator:</b>	On file	<b>Operating Certificate(s) Held:</b>	None

According to FAA records, the six-seat airplane, serial number T310Q0611, was manufactured by the Cessna Aircraft Company (now Textron Aviation). The FAA issued its original airworthiness certificate on October 16, 1972, and the airplane was registered to the pilot on September 26, 2014. According to aircraft maintenance records, the last annual inspection was completed on May 8, 2015, at a recorded tachometer time of 187.7 hours.

## Meteorological Information and Flight Plan

<b>Conditions at Accident Site:</b>	Visual (VMC)	<b>Condition of Light:</b>	Day
<b>Observation Facility, Elevation:</b>	KICT,1340 ft msl	<b>Distance from Accident Site:</b>	2 Nautical Miles
<b>Observation Time:</b>	20:53 Local	<b>Direction from Accident Site:</b>	141°
<b>Lowest Cloud Condition:</b>	Scattered / 6000 ft AGL	<b>Visibility</b>	10 miles
<b>Lowest Ceiling:</b>	Broken / 8000 ft AGL	<b>Visibility (RVR):</b>	
<b>Wind Speed/Gusts:</b>	/	<b>Turbulence Type Forecast/Actual:</b>	/ None
<b>Wind Direction:</b>		<b>Turbulence Severity Forecast/Actual:</b>	/
<b>Altimeter Setting:</b>	30.05 inches Hg	<b>Temperature/Dew Point:</b>	29°C / 14°C
<b>Precipitation and Obscuration:</b>	No Obscuration; No Precipitation		
<b>Departure Point:</b>	Wichita, KS (ICT )	<b>Type of Flight Plan Filed:</b>	IFR
<b>Destination:</b>	Denver, CO (APA )	<b>Type of Clearance:</b>	IFR
<b>Departure Time:</b>		<b>Type of Airspace:</b>	Class C

The 1553 recorded weather observation at ICT, included calm winds, visibility 10 miles, scattered clouds at 6,000 ft , broken ceiling at 8,000 ft, broken ceiling at 12,000 ft, broken ceiling at 15,000 ft, temperature 29&ordm;C, dew point 14&ordm;C; barometric altimeter 30.06 inches of mercury.

## Airport Information

<b>Airport:</b>	Wichita Dwight D Eisenhower Na ICT	<b>Runway Surface Type:</b>	Concrete
<b>Airport Elevation:</b>	1331 ft msl	<b>Runway Surface Condition:</b>	Dry
<b>Runway Used:</b>	1R	<b>IFR Approach:</b>	None
<b>Runway Length/Width:</b>	7301 ft / 150 ft	<b>VFR Approach/Landing:</b>	None

## Wreckage and Impact Information

<b>Crew Injuries:</b>	1 Fatal	<b>Aircraft Damage:</b>	Destroyed
<b>Passenger Injuries:</b>		<b>Aircraft Fire:</b>	None
<b>Ground Injuries:</b>	N/A	<b>Aircraft Explosion:</b>	None
<b>Total Injuries:</b>	1 Fatal	<b>Latitude, Longitude:</b>	37.677776,-97.459999

Impact marks at the accident site were consistent with a steep nose-down, right-wing-low attitude, with the right wingtip striking the ground first. The fuselage and wings came to rest on the west side of the creek in an inverted position with the right wing folded under the fuselage section. The fuselage from the aft baggage compartment through the tail section was intact but exhibited substantial impact damage. The fuselage forward of the aft baggage compartment through the cabin compartment was substantially damaged. The right and left engines were underwater, imbedded in the soil at the bottom of the creek. The right and left propeller assemblies, a section of the left wing including the left main landing, and the nose landing gear were found underwater in the creek bed. The landing gear actuator was found in the fully retracted position.

The right elevator remained partially attached to its attachment points. The elevator was separated spanwise outboard of the elevator trim tab, and the inboard portion of the elevator was distorted. The trim tab remained attached to the elevator at its hinge. The elevator trim pushrod was found attached to the trim tab but not attached to the trim tab actuator. The bolt, washer, castellated nut, and cotter pin securing the elevator trim tab pushrod to the actuator were missing. The elevator trim actuator remained attached to its attachment point on the horizontal stabilizer and was extended about 5/8 inch, which corresponded to a position outside its normal limits.

Flight control cable continuity was established for the rudder, right aileron, and elevators. The left aileron, all trim systems, and the right and left flaps exhibited control cable overload separations.

The engines were recovered from the creek bed, rinsed with water, and examined on-scene. The engine examinations revealed no evidence of preimpact anomalies or malfunctions.

The left engine's propeller flange was distorted. All six of the propeller bolts remained with the propeller flange, and the bolt threads contained remnants of the propeller hub threads. The propeller flange was manually rotated, and crankshaft and camshaft continuity were confirmed to the pistons. The left engine's magnetos were separated from their respective mounting pads but remained attached to the engine via the ignition harness. All of the ignition terminal ends remained attached to their respective sparkplugs. The magnetos and ignition harness were removed as were the top sparkplugs for each cylinder. The top sparkplugs were covered with mud, water, and oil. After being rinsed with freshwater, each electrode displayed a normal worn condition when compared to the Champion Aviation Service Manual (AV6-R). No internal, pre-accident anomalies were observed with the magnetos. The cylinders were photographed internally with a borescope. Each cylinder contained mud and water from the creek and exhibited normal combustion deposits. No preaccident anomalies were noted with the cylinders, valves, valve seats, rockers, or springs.

The engine-driven fuel pump was attached to the back of the engine and its drive coupling remained intact. Manual rotation of the drive coupling while installed in the driveshaft resulted in rotation of the driveshaft with a gritty feel to the rotation, but no binding was noted. The fuel pump was disassembled, and no preaccident anomalies were noted with any of the internal components. The throttle body/fuel metering unit remained attached to the engine via the fuel line between the fuel pump and the metering unit. The metering unit fuel inlet filter was removed and no obstructions or blockage were noted, but mud and dirty water were observed. The metering unit was disassembled, and no preaccident anomalies were noted with the internal components. The fuel manifold valve was disassembled, and aviation gasoline, mud and water were noted in the manifold. No pre-accident anomalies were noted with the diaphragm, plunger, spring, or screen.

The left propeller hub was fractured, and only two of the three blades were recovered with remnants of the hub remaining attached to one of the blades. The two blades displayed S-bending, and both were twisted toward low pitch.

The right engine's propeller flange was distorted; five of the six propeller bolts remained with the propeller flange; and the bolt threads contained remnants of the propeller hub threads. The propeller flange was manually rotated, and crankshaft and camshaft continuity were confirmed out to each piston. The right engine's magnetos were separated from their respective mounting pads and only the right magneto was recovered from the creek bed. No internal, preaccident anomalies were observed with the right magneto. All of the ignition terminal ends remained attached to their respective sparkplugs. The ignition harness remnants were removed as were the top sparkplugs for each cylinder. The top sparkplugs were covered with mud, water, and oil. All electrodes displayed a normal worn condition when compared to the Champion Aviation Service Manual (AV6-R). The cylinders were photographed internally with a borescope. Mud, water, and combustion deposits consistent with normal operation were noted within each of the cylinders. No preaccident anomalies were noted with the cylinders, valves, valve seats, rockers, or springs.

The engine-driven fuel pump was attached to the backside of the engine. The drive coupling was intact, and rotation of the drive coupling while installed in the driveshaft resulted in rotation of the driveshaft with no binding noted. The fuel pump was disassembled, and no preaccident anomalies were noted with any of the internal components. The throttle body/fuel metering unit remained attached to the engine nacelle. The metering unit fuel inlet filter was removed, and no obstructions or blockage was noted, but mud and dirty water were observed. The metering unit was disassembled, and no preaccident anomalies were noted with the internal components. The fuel manifold valve was disassembled, and aviation gasoline, mud and water were noted in the manifold. No preaccident anomalies were noted with the diaphragm, plunger, spring, or screen.

The right propeller hub was fractured, and two of the three blades remained attached to the hub. The separated blade was recovered. All of the blades' pitch change links were fractured. All three blades were twisted toward low pitch. One blade displayed heavy S-bending, leading edge gouging, and was bent into a U-shape.

## **Medical and Pathological Information**

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The Regional Forensic Science Center, Sedgwick County, Kansas, conducted an autopsy of the pilot. The cause of death was attributed to "multiple blunt force injuries."

The FAA Bioaeronautical Sciences Research Laboratory, Oklahoma City, Oklahoma, performed toxicology testing on specimens from the pilot. The toxicology results were negative for carbon monoxide, cyanide, and drugs. The toxicology was positive for ethanol detected in muscle tissue, and no ethanol was detected in the liver.

## Tests and Research

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On September 28, 2015, the right elevator, trim tab, and trim actuator were taken to Textron Aviation's laboratory in Wichita, Kansas, where they were examined under the supervision of National Transportation Safety Board (NTSB) investigators. A portion of the elevator's upper skin was removed to examine witness marks on the elevator's leading-edge spar, the trim tab pushrod, and the trim actuator. Witness marks were found on the pushrod, the actuator, and the elevator spar that were consistent with the pushrod moving both fore and aft relative to the actuator. Scrape marks on the aft side of the elevator spar below the guide hole for the trim tab pushrod were consistent with the pushrod's forward (disconnected) end hitting against the spar's aft side after the pushrod separated from the actuator and became trapped behind the elevator spar.

Measurements taken from an exemplar Cessna 310 indicated that, if the pushrod is disconnected from the actuator, the elevator trim tab deflects 39° trailing edge up (TEU) when the forward end of the pushrod is positioned aft of the spar. Additional measurements indicated that, if the pushrod is properly connected, the elevator trim tab deflects about 12° TEU when the actuator is fully extended. The TEU elevator trim tab position pushes down on the elevator's trailing edge, which produces an airplane nose-down pitching moment.

## Additional Information

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On August 10, 1973, Cessna Aircraft Company issued multi-engine service letter ME73-15, "Inspection and Replacement of Self-Locking Fasteners," which was applicable to the accident airplane. This service letter recommended the replacement of self-locking nuts used in primary and secondary control systems with a self-locking castellated nut and cotter pin.

On February 13, 1978, Cessna Aircraft Company issued multi-engine service letter ME77-34 (Supplement #1), "Trim Control System," which was applicable to the accident airplane. This service letter provided information for conducting a general inspection of the aileron, elevator, and rudder trim systems. The letter specified an inspection procedure that "places particular emphasis on the mounting and security of the trim tab actuator and associated linkage" and stated that the inspection should be



completed at the next 100 hour or annual inspection, whichever came first, and repeated every 100 hours thereafter. The inspection items included "inspect push rod attach bolt at the actuator and trim tab horn for proper safetying of nut with cotter pin."

On August 1, 1979, Cessna Aircraft Company issued multi-engine service letter ME79-28, "Trim Tab Actuator Inspection," which was applicable to the accident airplane. This service letter changed the inspection/lubrication interval for the aileron, elevator, and rudder trim actuators from every 1,500 hours to every 1,000 hours or 3 years, whichever comes first. Inspection/lubrication of a trim actuator requires that it be removed from the airplane, which requires removal of the bolt, nut, and cotter pin that attaches the pushrod to the actuator.

Given the 3-year or 1,000-hour overhaul cycle specified in ME79-28, an overhaul of the elevator trim actuator on the airplane would have been due no later than 2014 . A review of the aircraft logbook of maintenance actions performed from February 2006 through August 2015 revealed no entries of an elevator trim actuator overhaul. Manufacturers' service letters are not mandatory for Part 91 operators; only FAA issued airworthiness directives (AD) require mandatory compliance.

In response to this accident, on February 29, 2016, Textron Aviation issued multi-engine service bulletin MEB-27-02, "Flight Controls – Elevator Trim Push-Pull Rod Hardware Replacement," that required the hardware securing the elevator trim pushrod be replaced in airplane models including the accident airplane model. The service bulletin stated that the hardware replacement "must be accomplished at the next 100-hour or 12-month (annual-type) inspection, whichever occurs first." The service bulletin specified that use of the correct cotter pin (part number MS24665-132) was critical to the installation and warned that the use of a different cotter pin could result in the hardware becoming loose. The attachment hardware of the elevator trim pushrod to the elevator trim tab is visible during preflight inspections, however, inspection of the attachment hardware is not included in Textron Aviation's preflight inspection checklist.

Subsequently, the FAA issued AD 2016-07-24 that required replacement and repetitive inspections of the hardware securing the elevator trim pushrod per MEB-27-02. Initial replacement of the hardware was required within 90 days of the publication of the AD with repetitive inspections of the hardware at every 100-hour or annual maintenance check. The AD explained that, following the loss of the attachment hardware connecting the elevator trim tab actuator to the elevator trim tab pushrod, the elevator tab may jam in a position outside the normal limits of travel and create an unsafe condition that could result in a loss of ability to control the airplane.

Shortly after AD 2016-07-24 was issued, it was superseded by AD 2016-17-08 due to comments received from industry professionals indicating difficulties with the specified bolt installation and requesting revision to the repetitive inspection intervals to coincide with established inspection intervals. Textron Aviation issued Revision 1 to MEB-27-02 to modify the hardware specified. No other changes were made to the service bulletin.

#### Similar Accidents

On May 25, 1988, in West Columbia, South Carolina, a Cessna 402B, N8493A, was involved in a fatal accident after the pilot radioed shortly after takeoff that he was having a problem with the elevator that

required "full back pressure" to keep the nose up (NTSB accident number ATL88FA186). While attempting to return to land, the airplane pitched 70-80° nose down and descended into terrain. A postaccident examination revealed that the bolt securing the elevator trim tab push rod to the actuator was missing. The rod had become wedged inside the elevator, which led to an "extreme tab up" (nose down) condition.

On July 28, 1995, in Wenatchee, Washington, a Cessna 402B, N51816, experienced a "greater than normal" nose-down trim and impacted terrain during an attempted emergency landing, resulting in substantial damage (NTSB accident number SEA95LA159). The operator reported that the elevator trim actuator rod failed during takeoff. A postaccident examination by FAA investigators found the elevator trim pushrod jammed behind the elevator spar. The elevator was in the extreme nose-down position, and the cockpit trim wheel was found in the extreme nose-up trim position. The trim wheel was tested with no effect.

On April 26, 2001, in Del Rio, Texas, a Cessna 402B, N80Q, was involved in a fatal accident after the pilot reported that he would circle the airport a few times "because he was having trouble with his autopilot" (NTSB accident number FTW01FA104). A witness observed the airplane turn onto final and stated that the airplane "suddenly stalled and slammed into the ground from about two hundred feet." During the investigation, the elevator trim tab was found to be in the 28° tab-up position (airplane nose-down). According to the airplane manufacturer's specifications, the maximum tab-up travel limit (when connected) is 5°. The trim tab would not move freely by hand forces and appeared to be jammed. The elevator skin was cut open to observe the trim tab connecting hardware. The clevis end of the trim tab pushrod was wedged against the front spar of the elevator's internal structure. Additionally, the bolt that connected the clevis end of the pushrod to the actuator was missing. After further inspection, neither the bolt nor the nut were found in the cavity of the elevator structure or the surrounding area. The clevis end of the pushrod and the actuator were not damaged, and no impact damage was apparent on the trim tab. The operator's maintenance records showed that the right elevator had been replaced 10 flight hours before the accident.

On November 7, 2001, in Winston Salem, North Carolina, a Cessna M310Q, N7648Q, was involved in a fatal accident after the pilot radioed that he was experiencing oscillations in the airplane's controls (NTSB accident number ATL02FA010). He then radioed that the problem was under control, but shortly after he radioed that he was experiencing a lot of down pressure on the yoke. The airplane crashed shortly after this transmission. The elevator trim tab assembly, the elevator trim tab pushrod, and part of the elevator were cut from the airplane at the crash site and brought back to Cessna's laboratory for examination. The forward end of the pushrod had separated from the actuator. The following observations were made during the examination: (1) the dry, oxidized condition of the pushrod's forward end was consistent with the attaching bolt likely being missing for some time before the crash; (2) rub marks on the opening in the forward elevator spar corresponded to rub marks found on the underside of the pushrod; and (3) the geometry of the disconnected pushrod allowed it to pass behind the forward elevator spar. The observed damage was consistent with the elevator trim tab being in the full TEU position at the time of the crash.

Textron Aviation personnel stated that the company is working with the FAA on a design change to prevent the elevator trim tab pushrod from jamming behind the forward elevator spar in the event that the pushrod becomes disconnected from the actuator. Textron Aviation personnel further stated that,

when the design change is completed, the company plans to issue a service bulletin.

## Administrative Information

<b>Investigator In Charge (IIC):</b>	Liedler, Courtney
<b>Additional Participating Persons:</b>	Bobby Warren; FAA; Wichita, KS Nicole Charnon; Continental Motors Inc; Mobile, AL Earnest Hall; Textron Aviation; Wichita, KS
<b>Original Publish Date:</b>	November 13, 2017
<b>Last Revision Date:</b>	
<b>Investigation Class:</b>	<a href="#">Class</a>
<b>Note:</b>	The NTSB traveled to the scene of this accident.
<b>Investigation Docket:</b>	<a href="https://data.ntsb.gov/Docket?ProjectID=92061">https://data.ntsb.gov/Docket?ProjectID=92061</a>

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](#).