National Transportation Safety Board
Aviation Accident Final Report

Location:	Shaver Lake, CA	**Accident Number:**	WPR13FA037
Date & Time:	11/10/2012, 1920 PST	**Registration:**	N700EM
Aircraft:	CESSNA 421C	**Aircraft Damage:**	Substantial
Defining Event:	Unknown or undetermined	**Injuries:**	2 Fatal
Flight Conducted Under:	Part 91: General Aviation - Personal		

Analysis

The private pilot departed about 90 minutes after sunset in the high-performance multiengine airplane on the cross-country flight. The climb and level off at cruise altitude were uneventful and, based on the radar data, appeared to have been accomplished with the use of the autopilot. The cruise altitude of 27,000 feet was the highest the airplane had been flown in recent history, and the highest altitude it had been operated at with the pilot flying. The pilot made a routine radio exchange with air traffic control personnel shortly after levelling for cruise. Five minutes later, the airplane, with no further radio transmissions, rolled to the right and rapidly descended 10,000 feet, where it subsequently broke apart.

Both wings, along with the horizontal stabilizer and elevators, separated during the breakup sequence. Analysis of their fracture surfaces, along with the debris field distribution and radar data, revealed that the breakup sequence was most likely inadvertently induced by the pilot, as he attempted to recover control of the airplane during the dive.

The airplane sustained extensive thermal damage after ground impact, and examination of the engine components, surviving primary airframe components, the cabin heater, and the autopilot system remnants did not reveal any mechanical malfunctions or failures that would have precluded normal operation. There was no evidence of bird strike, inflight fire, or that the engine fire extinguisher system had been activated.

The airplane was flying toward an uninhabited mountain range and a largely unpopulated desert area at the time of the upset. The moon had set, and the pilot would have had limited reliable external visual cues should the airplane have experienced a failure of either the flight instruments or autopilot. The pilot was instrument rated, however the majority of his flight experience was garnered in aircraft equipped with modern "glass cockpit" avionics, as opposed to the traditional flight instruments installed in the accident airplane (which he had recently purchased).

The airplane was equipped with a dual vacuum pump system, which drove the primary flight instruments and, in turn, the autopilot. One of the vacuum pumps had failed on the previous flight, and the pilot was unable to get it repaired in time for the accident flight. The dual nature

of the vacuum system allowed for flight with a single failed pump, however failure of the remaining pump or associated vacuum system components would have left the pilot to hand fly the airplane, using backup flight instruments, at an altitude perilously close to the limit of the airplane's flight envelope (the maximum altitude was 30,200 feet). Examination revealed that the second pump was most likely operational; however, fire damage precluded an accurate assessment of the operability of the remaining vacuum system components. Although operation of the airplane did not require adherence to a minimum equipment list, the airplane's FAA Master Minimum Equipment List stated that one of the vacuum pumps can be inoperative, provided the airplane is operated under VFR and not operated at night. Given the pilot's overwhelming experience with "glass cockpit" instruments, as opposed to the traditional type in the accident airplane, along with the failure of one of the vacuum pumps, he should have reconsidered making the flight, particularly during night conditions.

The airplane had experienced multiple anomalies with the autopilot and vacuum system prior to the accident flight. Maintenance records indicated that these discrepancies had been resolved; however, damage to the airplane precluded a substantive confirmation of their operation. Additionally, an oversight by an avionics repair facility 1 week before the accident resulted in the airplane's pitot/static system being inadvertently tested and certified to 20,000 feet, rather than the airplane's service ceiling of 30,200 feet. The relevance of this finding, if any, could not be determined.

The airplane was equipped with a supplemental oxygen system; however, maintenance records indicated that the pilot's mask, while operational, had degraded. Additionally, the mask had been relocated to a position behind the pilot's seat, which would have been hard to reach in the event of a rapid decompression. Ultimately, the NTSB was unable to determine the cause of the rapid descent because of the postcrash damage to the airplane systems and components.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The pilot's failure to regain airplane control following a sudden rapid descent during cruise, which resulted in an in-flight breakup. Contributing to the accident was the pilot's decision to make the flight with a failed vacuum pump, particularly at high altitude in night conditions.

Findings

Aircraft	Directional control - Not attained/maintained (Cause) Aircraft structures - Capability exceeded (Cause) Indicating/recording systems - Incorrect service/maintenance
Personnel issues	Aircraft control - Pilot (Cause) Decision making/judgment - Pilot (Factor) Scheduled/routine maintenance - Maintenance personnel
Environmental issues	Dark - Response/compensation

Factual Information

HISTORY OF FLIGHT

On November 10, 2012, about 1920 Pacific standard time, a Cessna 421C, N700EM, impacted terrain following an in-flight breakup near Shaver Lake, California. The private pilot/registered owner was operating the airplane under the provisions of 14 Code of Federal Regulations Part 91. The pilot and passenger sustained fatal injuries. The airplane sustained substantial damage during the accident sequence, and was partially consumed by postimpact fire. The cross-country flight departed Salinas Municipal Airport, Salinas, California, at 1837, with a planned destination of Eppley Airfield, Omaha, Nebraska. Visual meteorological conditions prevailed, and an instrument flight rules (IFR) flight plan had been filed.

The pilot was the son of the passenger. Both had spent the weekend attending a driving academy at the Laguna Seca Raceway, having arrived in the accident airplane earlier in the week. According to the pilot's wife, they had encountered strong headwinds during the outbound flight from Omaha, and had decided to take advantage of tailwinds for the return flight that night, rather than stay in a hotel. The pilot planned to return his father to Omaha, and then fly to his residence in Missouri the following day.

Radar and voice communication data provided by the Federal Aviation Administration (FAA) revealed that prior to departure, the pilot was given an IFR clearance to Omaha, and that during his interaction with clearance delivery personnel he read back the clearance correctly. A few minutes after departing Salinas the airplane was cleared to fly direct to the Panoche VORTAC (co-located very high frequency omnidirectional range (VOR) beacon and tactical air navigation system). The airplane followed a direct course of 60 degrees; reaching Panoche at a mode C reported altitude of 17,200 feet, about 14 minutes later. The airplane continued on that course, reaching the Clovis VOR at 1912, coincident to attaining the pilots stated cruise altitude of 27,000 feet. The pilot reported leveling for cruise, and flying direct to Omaha. The sector controller reported that the pilot should fly direct to the Coaldale VOR and then to Omaha, and the pilot responded, acknowledging the correction.

For the next 5 minutes, the airplane continued at the same altitude and heading, with no further transmissions from the pilot. The airplane then began a descending turn to the right, with a final mode C reported radar target recorded 60 seconds later. During that period, it descended to 22,600 feet, with an accompanying increase in ground speed from about 190 to 375 knots. For the remaining 6 minutes, a 6.5-mile-long cluster of primary targets (no altitude information) was observed emanating from the airplane's last location, on a heading of about 150 degrees. Following the initial route deviation, the air traffic controller made five attempts to make contact with the pilot with no success.

Throughout the climb and cruise portion of the flight, the airplane flew directly to the assigned waypoints with minimal course variation, in a manner consistent with the pilot utilizing the autopilot.

PERSONNEL INFORMATION

Review of FAA airman records revealed that the pilot held a private pilot certificate with ratings for airplane single-engine land, multiengine land, and instrument airplane. He held a third-class medical certificate issued on July 18, 2010, with no limitations or waivers.

An examination of the pilot's logbook indicated a total flight experience of 637.7 hours since his first training flight in July 2010, through to his most recent logbook entry dated October 26, 2012. His initial training was conducted primarily in the Diamond DA-40, following which he purchased a Mooney M20TN in January 2011. Over the next 16 months, he flew exclusively in the Mooney amassing a total of 410.7 flight hours. The Mooney was equipped with a Garmin G1000 Integrated Flight Deck, "Glass Cockpit", which included a primary and multifunction flight display.

He received flight training for both complex and high performance airplanes in the Mooney on January 27, 2011. His initial multiengine flight training occurred in a Piper PA34-200 during the 2 day period from May 31, through to June 1, 2012, during which time he amassed 8.4 hours of flight time. His checkride occurred the following day, and for the next 11 days he accumulated an additional 15.7 hours of dual flight training in the accident airplane. During this period, he completed the required training for pressurized aircraft capable of high altitude operations, as well as accomplishing an instrument proficiency check. He flew a total of 79 flights in the accident airplane leading up to the accident, for a total flight time of 102 hours.

His total flight time for all aircraft in actual instrument meteorological conditions was 142 hours (29.8 in the accident airplane), with 38.8 in simulated conditions. The accident airplane was equipped with conventional flight instruments, and according to a mechanic familiar with the airplane, the pilot had planned on upgrading it to include a "glass cockpit."

AIRPLANE INFORMATION

The pressurized, multiengine airplane, serial number 421C1010 was manufactured in 1980. Maintenance logbooks were not available for examination. As such, maintenance history was compiled utilizing copies of the logbooks provided by the airplane's previous owner, as well as work orders provided by the various repair facilities that had maintained the airplane since its purchase by the accident pilot on June 8, 2012.

The records revealed a total airframe time of 5,118.0 hours at the last annual inspection (Hobbs hour meter time of 623.8), which was completed on February 8, 2012.

The airplane was equipped with two Continental Motors Incorporated (CMI) GTSIO-520-N turbocharged engines, with serial number 234166R installed on the left, and 808359R on the right side. Both engines were overhauled by RAM Aircraft LP; the left engine was overhauled in April 2011, and had accrued 139.5 hours at the last annual inspection. The right engine was overhauled in January 2006, and had accrued 748.2 hours at the time of the annual inspection. Both engines were equipped with three-blade McCauley constant-speed propellers.

The last recovered logbook entry indicated maintenance was performed during the period from October 29, 2012, through to November 7, 2012, at a Hobbs hour meter time of 755.8. The work orders generated during that period documented the replacement of the cabin heater as well as the pilot reporting the following discrepancy items:

"Intermittently at a hi rate of descent, the altitude hold didn't capture. He [pilot] had to move the pitch modifier to make it capture. When disengaging from altitude hold the aircraft pitches up, he disengages.

...IFR cert due, one shop spent a day repairing leaks, another said it still leaks. The pilot checked operation pressurized and unpressurized, no change.

...Check altitude information to both transponders."

The discrepancies were addressed with the overhaul of the encoding altimeter, rewiring of both the transponder encoding altimeter and the GPS receiver input/output data lines, and the repair of the autopilot control unit and pitch actuator.

The maintenance facility also repaired loose hoses and fittings throughout the pitot/static system, and performed an altimeter system test and inspection through to 20,000 feet in accordance "FAR 43 Appendix E, Paragraph B". According to a representative from Cessna, the airplane had a service ceiling of 30,200 feet. When asked why the altimeter test was not performed up to the airplanes service ceiling, the president of the maintenance facility stated that it was most likely an oversight.

Fueling records provided by Jet West LLC, located at Salinas Airport established that the airplane was serviced with the addition of 173 gallons of 100-octane low-lead aviation fuel just prior to departure on the day of the accident. The general manager of Jet West reported that multiple aircraft had been serviced with fuel from the same dispenser following the accident, and none had reported encountering any difficulties.

METEOROLOGICAL INFORMATION

The pilot received both a weather briefing, and filed a flight plan utilizing the ForeFlight software application on his iPad.

The closest aviation weather observation station was located at Madera Municipal Airport, Madera, California (KMAE), which was 42 miles west-southwest of the accident site. The elevation of the weather observation station was 255 feet mean sea level (msl). An aviation routine weather report (METAR) was recorded at 1853 PST. It reported calm wind, visibility 10 miles, skies clear, temperature 06 degrees C, dew point 02 degrees C, altimeter 31.17 inches of mercury.

An infrared image taken by the Geostationary Operational Environmental Satellite number 15 (GOES-15) at 1930, depicted clear skies over the route of flight.

A National Weather Service model sounding for 27,000 feet over the accident site indicated wind from the north-northwest at 122 knots, and a temperature of -35 degrees C.

There were no SIGMETs (Significant Meteorological Information) or Convective SIGMETs issued for California during the accident period; an AIRMET (Airmen's Meteorological Information) for occasional moderate turbulence between 18,000 and 41,000 feet was current for the route and accident site. No specific pilot reports were noted in the vicinity of the accident site.

According to the United States Naval Observatory, sunset in Salinas occurred at 1701, with the end of Civil twilight following at 1728. Moonset occurred at 1446, with moonrise at 0404 the following day. At the time of the accident, both the Sun and the Moon were more than 15 degrees below the horizon and provided no illumination.

WRECKAGE AND IMPACT INFORMATION

The Town of Shaver Lake was located on the western foothills of the Sierra Nevada Mountain Range, within the confines of the Sierra National Forest, at an elevation of about 5,600 feet.

The main wreckage, which consisted of the cabin, inboard wings, both engines, tailcone, and vertical stabilizer, came to rest inverted on a heading of about 125 degrees within a rocky outcropping, located about 1 mile southeast of the town. The site was at an elevation of about

5,700 feet, and surrounded by trees ranging in height from 50 to 150 feet; none of the trees sustained damage. The entire lower portion of the main cabin was consumed by fire from the footwell through to the rear bulkhead. The inboard right wing and engine nacelle sustained vertical crush damage, and remained partially attached to the cabin. The left inboard wing was partially consumed by fire through to the left engine nacelle, which sustained similar vertical crush damage.

A ballistics trajectory analysis was performed on the primary radar targets by specialists within the NTSB Vehicle Performance and Operational Factors divisions. The results of the analysis revealed that the debris field most likely continued on a southeast heading, at least 6 miles beyond the location of the main wreckage, and into heavily wooded terrain.

Utilizing this data, the Fresno County Sheriff Search and Rescue Department, along with the NTSB investigator-in-charge (IIC) conducted 4 days of search activities during the period from November 13 to December 2, 2012. During that time, the left and right wings outboard of the engine nacelle were located 2,500 and 3,200 feet respectively from the main wreckage. The right elevator tip and left horizontal stabilizer aft spar were located 1,000 and 1,700 feet further downrange. Sections of composite wing fragments along with rudder rib and skin sections were located 4.5 miles beyond the main wreckage the following week during a patrol conducted by the Forest Service. Another patrol discovered a section of the outboard right wing skin 2 miles beyond the main wreckage on March 13, 2013. All located debris was confined within a 1,500-foot-wide corridor on a heading of 150 degrees from the main wreckage.

MEDICAL AND PATHOLOGICAL INFORMATION

A postmortem examination was conducted by the Fresno County Coroner. The cause of death was reported as the effect of blunt force and thermal injuries.

Toxicological tests on specimens recovered from the pilot were performed by the FAA Civil Aerospace Medical Institute. The results were negative for all screened drug substances and ingested alcohol. Refer to the toxicology report included in the public docket for specific test parameters and results.

TESTS AND RESEARCH

Full reports for all of the following examinations are contained within the public docket.

Engines

Both engines were examined by the IIC and representatives from CMI and RAM Aircraft shortly following recovery, and then disassembled and examined at the facilities of CMI in Mobile, Alabama. No anomalies were noted that would have precluded normal operation.

Right Engine

The right engine remained within its bay. The upper cowling was crushed from impact with the ground from the propeller through to the locker area, and had become formed around the upper surfaces of the engine, turbocharger, and air conditioning system. The locker cover remained attached to the nacelle, and sustained charring damage. All ancillary components including the air inlet manifolds, fuel injection lines, both magnetos, aftercooler, and oil filler neck and dipstick, had become crushed against the upper engine surfaces. The turbocharger assembly remained attached to the airframe within its bay, sustaining crush damage to the induction inlet plenum and exhaust outlet stack. The exhaust outlet tailpipe had sustained

crush damage, and had become separated from the turbo exhaust outlet; the ring clamp appeared undamaged, with both its clamping nut and bolt, and braided wire intact. The inlet and exhaust impellors remained interconnected, and could be rotated by hand. All remaining fuel, oil and hydraulic lines within the turbocharger bay were secure at their fittings.

Removal of the lower sparkplugs revealed that the plugs for cylinder number one, three, and five were wet with oil, with two, four, and six exhibiting grey and tan deposits. When compared to the Champion Aviation Check-A-Plug chart (AV-27), plugs one, two, five, and six exhibited worn out–normal signatures, with the remaining plugs exhibiting normal signatures.

Left Engine

The left engine remained within its bay. The upper engine cowling sustained thermal damage in the area above the turbocharger bay, and was crushed along its full length, forming around the upper surfaces of the engine. The lower surface of the engine was covered in black soot. The turbocharger bay sustained extensive thermal damage, which consumed most of the vacuum, fuel, oil, and hydraulic lines. All remaining lines within the turbocharger bay exhibited charring, and fragmented when handled. All unconsumed fittings were finger tight, and no ruptures were noted to any hose braiding. The exhaust pipe had become separated from the turbocharger exhaust outlet; the pipe clamping bolt was not located, and the safety lanyard remained attached but was torn. Examination of the clamping ring revealed that both clamping tabs were bent about 30 degrees relative to their normal plane, with their bolt holes exhibiting cupping and elongation. The lower blades of the turbocharger exhibited inward bending damage, and as such the turbine and assembly impeller could not be rotated.

The fuel cap was in place at the locker tank filler neck. The tank had sustained thermal damage, which consumed the majority of its assembly. All ancillary engine components, including the air inlet manifolds, fuel injection lines, both magnetos, aftercooler, and oil filler neck and dipstick, had become crushed against the upper engine surfaces.

Removal of the lower sparkplugs revealed that the plugs for cylinders number two and four were wet with oil, with one, three, five, and six exhibiting grey and tan deposits. When compared to the Champion Aviation Check-A-Plug chart (AV-27), plugs one, two, four, and six exhibited worn out–normal signatures, with the remaining plugs exhibiting normal signatures.

Airframe

An airworthiness group consisting of engineers from both Cessna Aircraft Company and the NTSB Office of Aviation Engineering convened to examine the wreckage at a storage facility, 1 month following the accident. All of the separated components exhibited fracture features consistent with overstress separation, and no evidence of fatigue was noted. There was no evidence of bird-strike, soot patterns, or inflight fire. There was no evidence consistent with flutter.

The main wreckage of the airplane consisted of the fuselage, vertical stabilizer, center wing section from outboard of the left nacelle to outboard of the right nacelle, the outboard left and right wing sections, a portion of the right horizontal stabilizer rear spar, and the outboard tip section of the left elevator. Notable items not recovered included the left horizontal stabilizer, most of the left elevator, most of the right horizontal stabilizer, the right elevator, and the majority of the rudder.

Outboard Left Wing

The outboard left wing was intact from the engine nacelle to the tip; the flap, speed brake, and most of the aileron were separated. The left wing forward and aft spar upper caps were fractured at the root, and had deformed downward. The forward spar lower cap was fractured and deformed with compression buckling. The aft spar web was deformed to the extent that the lower spar cap had been displaced upward to within several inches of the upper spar cap.

The wing tip exhibited a slight upwards deformation with upper skin buckling. There was an overall slight upward deformation of the wing beginning about 3 feet from the tip. The aileron was not recovered with the exception of the inboard hinge attach bracket, attached to about 25 inches of forward aileron spar. The outboard aileron hinge fitting was intact, and had deformation on the lower wing skin corner with tree debris embedded between the hinge fitting and the lower wing skin. The aileron trim actuator and connecting rod remained attached to the rear spar of wing. Both aileron cables were broken with a splayed appearance consistent with tension overload about 12 inches inboard of the aileron bell crank.

Outboard Right Wing

The outboard right wing was intact from the engine nacelle to the tip. The right wing forward spar upper and lower caps, as well as the aft upper cap were fractured at the root and deformed downwards. The aft spar lower cap was fractured and deformed with compression buckling.

The wing tip was deformed upward approximately 35 degrees with buckling on both the upper and lower skins. There was a tear in the lower wing tip skin approximately 10 inches in length, about 14 inches aft of leading edge and a blue paint transfer on the upper skin about 2-feet from the nacelle with minor surface scratches. The aileron was still attached, and remained stuck in the trailing edge up position. The upper aileron skin had the appearance of pillowing, and being formed over the ribs and stringers of the aileron. The speedbrake was still attached with no visible damage to the actuator and linkage. The flap was attached; the upper wing skin was damaged above the flap, and about the inboard 14 inches was missing.

Horizontal Stabilizer

About 75 inches of the right rear horizontal stabilizer spar was recovered. The aft upper and lower spar caps were compressed and deformed towards each other outboard of the center elevator hinge. The upper cap inboard fracture was deformed upward and aft. The lower spar cap inboard fracture was deformed downward and aft. Both forward spar attach bolts and bushings remained attached to the bulkhead, with both exhibiting features consistent with being pulled aft with deformation to the web localized to the areas surrounding the bolts.

Vertical Stabilizer and Rudder

The vertical stabilizer structure remained attached to the airframe, and was crushed aft and downward. The rudder trim actuator remained attached to the rear spar, and was fractured and damaged. The lower rudder hinge was intact with the rudder attach structure pulled from the rudder. The hinge bolt was found intact. The lower portion of the rudder including a section of the torque tube remained partially attached to the fuselage by the rudder cables. The rudder hinge bolt was found intact and attached to the vertical stabilizer.

Cabin Heater

The heater sustained minimal damage to its outer jacket and remained partially attached to the nose bay frame members. The over-temperature trip-switch was in the depressed (un-tripped) position. The unit was removed and examined at the facilities of Hartzell Engine Technologies

(HET) in the presence of the IIC, and representatives from Cessna and CMI.

A pressure leak test was performed, and the unit exhibited no leaks. The unit was subsequently disassembled and examined, and no anomalies were noted which would have precluded normal operation. All internal components exhibited light sooting, which the HET representative stated was consistent with normal, low-time operation.

Supplemental Oxygen System

The supplemental oxygen canister had become partially detached from the nose bay frame members. Examination revealed that all three fitting lines were attached and tight. The actuation cable fitting sustained impact damage, and as such, an accurate assessment of its position at the time of the accident could not be determined. Within the cabin, the activation control was in the forward (inactive) position. The oxygen supply line was continuous to the forward pressure bulkhead. Aft of the bulkhead, with the exception of the steel portions of the actuator cable, all supply lines and system components were consumed by fire.

The invoice for the airplanes most recent annual inspection stated the following:

"All passengers and crew 02 masks are old, sticky and dry rotted. Recommend replacement.

Action: Customer declined service. Note: Crew mask still serviceable but getting bad."

According to the Cessna 421C Information Manual, the location of the pilot's factory-equipped oxygen mask was in the left armrest stowage compartment, just below the oxygen outlet. The pilot who managed and flew the airplane prior to purchase by the accident pilot, recalled that the mask had been relocated to a stowage compartment behind the pilot's seat.

Vacuum System

A mechanic based at a repair station at Salinas Airport was called by Jet West Aviation on the morning of the accident to examine the airplanes vacuum system. He arrived at noon and spoke to the pilot who reported that the left vacuum system was not working for the outbound flight from Omaha, and that he suspected a vacuum line had been a pinched during the avionics and autopilot maintenance work performed earlier in the week. The pilot had asked Jet West to repair the system when he arrived in California, and he was irritated that it had not been repaired during that time.

The mechanic opened the cowling for the left engine, and rotated the engine crankshaft via the propeller. The left vacuum pump shear coupling appeared to have failed, and he did not see a corresponding rotation of the pump. He attempted to locate a replacement pump, but the supplier reported that it would take 3 days to arrive. He informed the pilot, who stated that he would forego the repair, and continue with the flight back to Omaha that night.

Postaccident examination revealed that the entire vacuum system within the forward cabin was consumed by fire, with the only remaining identifiable component being the steel channel of the common vacuum manifold. The right-side vacuum system sustained varying degrees of impact damage through to the wing root. Examination of the vacuum pump and its associated lines did not reveal any anomaly that would have precluded normal operation.

The left-side vacuum system sustained considerable thermal damage through to the wing root. All vacuum lines were in their appropriate positions, but crumbled when handled. Fire damage precluded an accurate assessment of the vacuum system's state prior to impact. The vacuum pump sustained thermal damage to its outer casing, causing the shear coupling to become

congealed. The unit was disassembled and the rotor had cracked into four distinct pieces along with two vanes, which had fragmented. The damage was consistent with the prior failure reported by the mechanic.

The Cessna 421C Information Manual states that should one of the vacuum sources fail, "No corrective action is required by the pilot, as the system will automatically isolate the failed vacuum source, allowing normal operation on the remaining operative vacuum pump."

The FAA Master Minimum Equipment List for the Cessna 421C stated that one of the vacuum pumps can be inoperative provided the airplane is operated under VFR, and not operated at night. However, the regulatory basis for this flight was such that the airplane neither had, nor was required to adhere to, a minimum equipment list.

Autopilot

The autopilot components within the cabin were consumed by fire. The only components to survive were the AS-895A altitude sensor, PA-495A actuator, TA-495A actuator, and the CA-550 Computer Amplifier. These components were examined at the facilities of Sigma Tek, Inc. and Mid-Continent Instruments and Avionics in the presence of the NTSB IIC and a representative from Cessna. All surviving components were mostly intact, with the exception of the CA-550 Computer Amplifier, which sustained crush damage separating multiple control modules from the main board. No anomalies were noted to any of the autopilot components that would have precluded normal operation. A tooth from an intermediate gear within the TA-495A actuator (pitch trim actuator) had separated. The actuator was sent to the NTSB Office of Research and Engineering for examination. High magnification analysis found that the gear tooth fracture surface was clean, and displayed surface features and topographies consistent with a bending overstress separation; no indications of preexisting cracking were observed.

According to the Cessna 421C Information Manual, the horizontal situation indicator (HSI), which was installed in the airplane, was a critical component within the autopilot system. The installed HSI was vacuum driven. Further examination of the logbooks revealed multiple entries during the year leading up to the accident dedicated to the repair of the autopilot.

Cabin Pressurization System

The cabin system indicators and controls, as well as the outflow and safety valves, were completely consumed by fire, with only the valve body rings remaining. Impact and fire damage prevented an accurate assessment of the ram dump and cabin pressurization valves and controls. Both the left and right sonic venturi's remained attached to their respective turbocharger manifolds.

Maintenance records for the last annual inspection stated the following with regards to the pressurization system, "Outflow valve extremely dirty. Needs removed, cleaned and reinstalled. Action: Service declined by customer."

Engine Fire Extinguishers

The right engine extinguisher bottle was intact and remained attached to the airframe within the outboard wing root. The gauge indicated a pressure of 300 pounds per square inch, and the unit did not appear to have been activated.

The left extinguisher bottle sustained thermal damage, consuming the service valve and fittings. The unit did not contain a gas charge, and as such, the manifold was subsequently

removed. The squib plug was located loose within the chamber. The bottle cap appeared undamaged, with no indication that the extinguisher had been activated.

ADDITIONAL INFORMATION

Performance Study

A performance study was conducted by a specialist from the NTSB Vehicle Performance Division in an effort to determine the airplanes breakup sequence. The study utilized radar data, winds aloft information, and debris locations, and spanned the last 20 minutes of flight.

Having factored in winds aloft velocity, the mode C reported radar data revealed that about 6 minutes after having leveled off at 27,000 feet, the airplane began a descending right turn to 150 degrees, while accelerating from an airspeed of 220 to 320 knots. The mode C data then ended, and was replaced for the next 6 minutes by a cluster of primary radar targets distributed along a heading of 150 degrees. The wreckage debris path was relatively straight and aligned with both the wind direction (which remained fairly constant from the ground through to 27,000 feet) and the direction of the primary radar target field. A ballistic trajectory program was utilized to resolve a breakup altitude. After multiple iterative calculations, the data consistently converged on an altitude at breakup of 17,000 feet.

A full report is contained within the public docket.

Flight History

The pilot who previously flew and managed the airplane stated that it operated most efficiently at 17,000 feet, and that he had never flown it above 20,000 feet.

The airplane's flight history for the 5 month period that it was owned by the accident pilot was compiled and provided by a commercial flight tracking company. The data revealed that during that period the airplane undertook 72 flights while receiving air traffic control services. During that time, it flew at or above 20,000 feet on nine occasions, reaching a maximum altitude of 24,900 feet on July 21, 2012.

History of Flight

Enroute-cruise	Unknown or undetermined (Defining event) Loss of control in flight
Uncontrolled descent	Attempted remediation/recovery Aircraft structural failure Collision with terr/obj (non-CFIT)

Pilot Information

Certificate:	Private	**Age:**	41
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):	None	**Toxicology Performed:**	Yes
Medical Certification:	Class 3 Without Waivers/Limitations	**Last FAA Medical Exam:**	07/18/2010
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	06/13/2012
Flight Time:	(Estimated) 637.7 hours (Total, all aircraft), 102 hours (Total, this make and model), 629.2 hours (Pilot In Command, all aircraft), 41 hours (Last 90 days, all aircraft), 14.4 hours (Last 30 days, all aircraft), 0 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	CESSNA	**Registration:**	N700EM
Model/Series:	421C	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	No
Airworthiness Certificate:	Normal	**Serial Number:**	421C1010
Landing Gear Type:	Retractable - Tricycle	**Seats:**	8
Date/Type of Last Inspection:	02/08/2012, Annual	**Certified Max Gross Wt.:**	7450 lbs
Time Since Last Inspection:	135 Hours	**Engines:**	2 Reciprocating
Airframe Total Time:	5118 Hours as of last inspection	**Engine Manufacturer:**	CONT MOTOR
ELT:	C126 installed, activated, did not aid in locating accident	**Engine Model/Series:**	GTSIO-520-N
Registered Owner:	On file	**Rated Power:**	375 hp
Operator:	On file	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	**Condition of Light:**	Night
Observation Facility, Elevation:	KMAE, 255 ft msl	**Distance from Accident Site:**	42 Nautical Miles
Observation Time:	1853 PST	**Direction from Accident Site:**	235°
Lowest Cloud Condition:	Clear	**Visibility**	10 Miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	Calm /	**Turbulence Type Forecast/Actual:**	/ None
Wind Direction:		**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	31.17 inches Hg	**Temperature/Dew Point:**	6°C / 2°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Salinas, CA (KSNS)	**Type of Flight Plan Filed:**	IFR
Destination:	Omaha, NE (KOMA)	**Type of Clearance:**	IFR
Departure Time:	1837 PST	**Type of Airspace:**	Air Traffic Control; Class A

Airport Information

Airport:	SALINAS MUNI (SNS)	**Runway Surface Type:**	Asphalt
Airport Elevation:	84 ft	**Runway Surface Condition:**	Dry
Runway Used:	26	**IFR Approach:**	None
Runway Length/Width:	6004 ft / 150 ft	**VFR Approach/Landing:**	None

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Substantial
Passenger Injuries:	1 Fatal	**Aircraft Fire:**	On-Ground
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	2 Fatal	**Latitude, Longitude:**	37.095833, -119.299167

Administrative Information

Investigator In Charge (IIC):	Eliott Simpson	**Report Date:**	06/23/2014
Additional Participating Persons:	Nick Cabiness; Federal Aviation Adminstration FSDO; Fresno, CA Jan Smith; Cessna Aircraft Company; Wichita, KS Mike Council; Continental Motors, Inc.; Mobile, AL Rick Roper; RAM Aircraft LP; Waco, TX		
Publish Date:	06/23/2014		
Investigation Docket:	http://dms.ntsb.gov/pubdms/search/dockList.cfm?mKey=85553		