Aviation Investigation Final Report

Location:	LAGRANGE, Wisconsin	**Accident Number:**	CHI98FA153
Date & Time:	May 15, 1998, 09:10 Local	**Registration:**	N6059C
Aircraft:	Commander 114-B	**Aircraft Damage:**	Destroyed
Defining Event:		**Injuries:**	4 Fatal
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The accident airplane's pilot obtained a weather briefing for the accident flight the night before the flight. He filed an instrument flight rules (IFR) flight plan with the intention of flying the airplane at 154 knots. The airplane departed on the IFR flight plan and climbed to 6,900 feet above mean sea level (MSL) and maintained that altitude for about four minutes while on a southwesterly heading. Weather information showed cloud bases and tops to be about 6,000 and 10,000 feet MSL respectively in the airplane's immediate vicinity. The altitude began to vary about 200 to 300 feet above and below 6,900 feet MSL. The airplane's ground track changed a number of times during the flight. The aircraft heading changed as much as 90 degrees while altitude changes were occurring. The last FAA air traffic control radar contact with the airplane showed the altitude to be 4,500 feet MSL and the heading to be opposite of its original heading. Ground witnesses reported hearing the airplane's engine accelerating and decelerating followed by a "... ka-boom..." sound. One said he saw the airplane coming out of the clouds nose first and pointing at the ground. Another said he saw the airplane come out of the clouds tumbling without its empennage. The on-scene examination revealed no pre-existing anomalies with the airframe. Before flying the accident airplane as pilot-in-command, the pilot received 11.6 hours of flight training in the aircraft. His total time in the airplane was 23.2 hours according to his logbook. The pilot's logbook showed he had 18.5 hours of actual instrument flight time and 41.4 hours of simulated instrument time. His logbook showed he had flown .6 hours of simulated instruments in the accident airplane before the accident flight.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: the pilot not maintaining aircraft control during cruise flight and exceeding the airplane's design stress limits. Factors in this accident was the pilot's lack of total experience in the

airplane and the clouds.

Findings

Occurrence #1: LOSS OF CONTROL - IN FLIGHT
Phase of Operation: CRUISE

Findings
1. WEATHER CONDITION - CLOUDS
2. (C) AIRCRAFT CONTROL - NOT MAINTAINED - PILOT IN COMMAND
3. (F) LACK OF TOTAL EXPERIENCE IN TYPE OF AIRCRAFT - PILOT IN COMMAND

Occurrence #2: AIRFRAME/COMPONENT/SYSTEM FAILURE/MALFUNCTION
Phase of Operation: DESCENT - UNCONTROLLED

Findings
4. DESIGN STRESS LIMITS OF AIRCRAFT - EXCEEDED - PILOT IN COMMAND

Occurrence #3: IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation: DESCENT - UNCONTROLLED

Findings
5. TERRAIN CONDITION - GROUND

Factual Information

HISTORY OF FLIGHT

On May 15, 1998, at 0910 central daylight time (cdt), a Commander 114-B, N6059C, operated by an instrument rated private pilot, was destroyed during an in-flight break-up and collision with the ground. Visual meteorological conditions prevailed at the time of the accident. The 14 CFR Part 91 personal flight was operating on an instrument flight plan. The pilot and three passengers were fatally injured. The flight departed Waukesha, Wisconsin, at 0850 cdt.

Federal Aviation Administration (FAA) records showed N6059C's pilot filed two IFR flight plans at 2120 cdt on May 14, 1998, with the FAA's Greenbay, Wisconsin, Automated Flight Service Station (AFSS). The first IFR flight plan was from Madison, Wisconsin, to Waukesha, Wisconsin. The second IFR flight plan was from Waukesha, Wisconsin, to Columbus, Ohio.

While filing the first flight plan the pilot said N6059C's airspeed was planned at 154 knots at 5,000 feet above mean sea level (msl). The pilot said, "...we're going to get there in a hurry." The AFSS specialist said, "...that's red line on any airplane." N6059C's pilot replied, "ya that's true... ."

While speaking with the AFSS specialist the pilot asked for the next day's winds aloft forecast. The AFSS specialist replied, "...starting out... it's not as bad... as I thought it'd be, it's two one zero in the... eighteen knot range at seven thousand feet... ." The AFSS specialist advised the pilot that he would be "...flying basically into a high pressure ridge aloft... ." He told the pilot there would be "...significant thunderstorm activity..." in Wisconsin after 1200 cdt. There is no record of the pilot obtaining a weather briefing before his flight from Madison, Wisconsin, to Waukesha, Wisconsin, or before the accident flight.

At 0859:27 cdt, the pilot of N6059C contacted FAA Approach Control at the Greater Rockford Airport, Rockford, Illinois. The pilot said, "Rockford approach, Commander six zero five nine charlie six thousand three hundred up to seven." The approach controller acknowledged the radio call and issued the pilot an altimeter setting of 29.95 inches of mercury. The pilot acknowledged the altimeter setting at 0859:40 cdt. That was the last radio transmission from N6059C. The approach controller called N6059C two additional times without a response from the airplane's pilot. At 0910:46 cdt the controller said he did not see N6059C on his radar screen.

The FAA's Chicago, Illinois, TRACON radar track data showed N6059C's altitude was 6,200 feet above mean sea level (msl) at 0859:25. The radar data showed N6059C had continued to climb and leveled off at 6,900 feet msl at 0901:03 cdt. The airplane maintained that altitude until 0903:26 cdt. Four seconds later the radar data showed N6059C's altitude was 6,800 feet

msl. N6059C's altitude varied between 6,800 and 7,000 feet msl until 0906:26 cdt. Thirteen seconds later its altitude was 6,600 feet msl. The airplane maintained this altitude for eleven seconds. At 0907:08 cdt the radar data showed N6059C's altitude was 4,500 feet msl. The 4,500 feet msl altitude report was the last radar identification of N6059C.

The radar data showed N6059C's ground track heading (heading) was 223 degrees magnetic at 0859:25 cdt. At 0901:03 cdt the radar data showed its heading was 209 degrees magnetic. According to the radar data, N6059C's heading changed eleven times while it was flying at 6,900 feet msl. The headings changed from 209 to 193 degrees magnetic and then to a maximum of 274 degrees magnetic at 0906:26 cdt. N6059C's heading and altitude's had continued to change until its last radar identification at 0907:08 cdt. At that time the reported heading was 045 degrees magnetic. According to the TRACON radar data, the airplane's ground speed varied between 274 and 182 knots during the 0859:25 and 0906:26 cdt period. Excerpts of the FAA's Rockford Air Traffic Control Tower Aircraft Accident Package and the Chicago, Illinois, TRACON radar data are appended to this report.

Witnesses reported hearing between one and three loud bangs coming from the clouds above them after they heard an airplane engine increasing its RPM. The Walworth County Sheriff's Department, Walworth County, Wisconsin, report showed one witness said he "...heard the roaring of an airplane engine, and then he heard, what sounded like a 'ka-boom'... ." The report showed that another witness said "...he [heard] loud revs of an engine up and down, similar to a stunt plane. The witness said that he looked southwest and saw a plane come out of the fog nose first. He said that it was nose first toward the ground, with the wings rotating slowly. He heard three loud bangs before the plane came out of the clouds... ." The report presented another witness who said, "...at approximately 9:05 A.M., he heard an engine rev very, very fast, as if it were racing. He observed pieces of an airplane falling from the sky from very high up. He heard and saw this before he saw the plane crash."

The Walworth County Sheriff's report said that one witness "...heard the noise of an engine revving. He stated he saw one plane, and no debris, coming from the sky, going straight down in the area of the crash site. He said that the airplane had wings when it was going down, and again emphasized that it was going straight down, however he did say that it was tumbling nose over tail, stopped its rotation and then fell straight down from the sky... ." The report showed that another witness, located about 3/4 mile west-northwest of the accident site said "...the plane suddenly did a forward barrel roll, the right wing ripped off the plane and then she observed it crash."

PERSONNEL INFORMATION

The pilot obtained his airplane, single-engine land, private pilot certificate on April 14, 1997. According to the FAA's Airman Certificate and/or Rating Application, he had received 142.9 hours of dual flight instruction and had 28.8 hours of solo flight time before obtaining his pilot's certificate. The pilot's logbook confirms these hours. According to his logbook, the pilot had 5.1 hours and 2.7 hours of actual instrument and simulated instrument time

respectively as of April 14, 1997.

According to FAA records, the pilot obtained his airplane instrument rating on November 5, 1997, after receiving 77.2 hours of dual. His logbook showed he had 34.9 hours of simulated instrument and 9.6 hours of actual instrument flight time respectively as of November 5, 1997. Between August 12, 1997, and August 22, 1997, the pilot obtained 18.1 hours of synthetic trainer experience, according to his logbook.

The pilot's logbook showed he had 340.6 hours total time and 196.7 hours pilot-in-command flight time as of May 9, 1998. The logbook showed he had received 241.5 hours of dual flight instruction as of this date. Of the total time shown for this date, 18.5 and 41.4 hours were shown as actual instrument and simulated flight time respectively. His total time in the Commander 114-B was 23.2 hours. Of this time 11.9 hours were shown as pilot-in-command.

The logbook showed the pilot had .3 hour instrument time in N6059C between the time he received his pilot-in-command endorsement and the accident flight. Before receiving flight training in N6059C the most recent instrument flight time was logged on February 16, 1998. On that date the logbook showed he had 3.0 hours simulated instrument flight time and .5 hour of actual instrument flight time.

The instructor who transitioned the pilot to the airplane had used an FAA Form entitled, "Sample Training Plan for Transition to High Performance Airplanes." This form is part of an FAA Advisory Circular AC 61.98A entitled, "Currency and Additional Qualifications Requirements for Certificated Pilots." The form showed the instructor had given the pilot 10.5 hours of ground instruction related to the accident airplane, and 11.6 hours of flight instruction in the airplane. The form showed the pilot had demonstrated unusual attitude recovery by reference to instruments during his transition training to N6059C. The form is appended to this report.

The pilot's logbook showed he had flown a Cessna 172 and Piper PA-28-181 during his instrument flight training. The logbook showed he had flown the Commander 114-B 6.3 hours before receiving an endorsement authorizing him to fly the airplane as pilot-in-command. The logbook showed the pilot had .8 hour of simulated instrument flight time while receiving the checkout in N6059C.

AIRCRAFT INFORMATION

N6059C was a Commander 114-B, serial number 14649. According to the airframe maintenance records N6059C, had "...been inspected and found to conform to the Type Certificate therefore, to be in condition for safe operation..." on February 24, 1997. At that time N6059C had a total of 4.2 hours of flight time on its airframe. A Standard Airworthiness Certificate was issued for the airplane on this date. The maintenance records showed its next annual inspection was due on February 28, 1998.

The maintenance records showed N6059C had 58.7 hours time in service when it received an annual inspection on March 11, 1998. This entry showed that a "...[3 1/2 inch] crack in [the] inboard wing skin..." had been repaired. The crack was located on the right wing's lower wing skin near the wheel well. Copies of the airframe logbook entry, repair station work order, and company's repair description are appended to this report.

According to the Commander 114-B Pilot's Operating Handbook (POH), the airplane's maximum structural cruise speed is 148 knots calibrated and indicated airspeed. The POH states that the significance of this speed is: "Do not exceed this speed except in smooth air, and then only with caution." This airspeed is shown on the airspeed indicator by the end of the green arc at the high airspeed range. The POH said that the green arc represents the airspeeds within the airplane's Normal Operating Range. The Normal Operating Range for this airplane goes from 60 to 148 knots calibrated airspeed. The never exceed airspeed, Vne, is 186 knots calibrated and 187 knots indicated airspeeds respectively.

METEOROLOGICAL INFORMATION

The FAA's surface weather reports for General Mitchell International Airport, Milwaukee, Wisconsin, showed an overcast sky with bases at 20,000 feet msl and an altimeter setting of 29.97 inches of mercury at 0856 cdt. The weather at Waukesha County Airport, Waukesha, Wisconsin, was a clear sky with an altimeter setting of 29.98 inches of mercury at 0855 cdt. Dane County Regional Airport, Madison, Wisconsin, showed a broken layer of clouds at 5,500 feet above ground level (agl) and an altimeter setting of 29.94 at 0853 cdt. Weather at the Greater Rockford Airport, Rockford, Illinois, was reported as scattered clouds at 25,000 feet agl and an altimeter setting of 29.96 at 0854 cdt.

The FAA's winds aloft forecast for Greenbay, Wisconsin, showed the winds at 3,000 feet msl were forecast to be 220 degrees magnetic at 20 knots and 220 degrees magnetic at 22 knots for 3,0000 and 6,000 feet msl respectively. The Joliet, Illinois, forecast winds aloft showed the winds forecast were for wind to be at 230 degrees at 23 knots and 220 degrees at 21 knots for 3,000 and 6,000 feet respectively. The accident flight occurred during the valid time for these forecast winds.

The NTSB's Senior Meteorologists Factual Report showed visual meteorological conditions reported in the area of the flight and accident site. The report showed "Selected PIREPS, [pilot reports], relevant to Wisconsin... showed scattered to broken cirrus clouds and haze tops at 6,000 feet msl about 10 miles east of Madison, Wisconsin." The report states, "...haze tops 6,000 feet [msl]; turbulence smooth [about 12 miles east of Janesville, Wisconsin." The accident site is about 25 nautical miles northeast of the Rock County Airport, Janesville, Wisconsin.

The report shows there was an AIRMET issued for the Milwaukee, Wisconsin, and Chicago, Illinois, that advised the pilot there could be "...occasional visibility below 3 miles [due to] haze." The report stated there were "No SIGMETS or Convective SIGMETS [that] were valid for

the accident area. No Center Weather Advisories... were valid for the accident area." According to report information, the cloud bases were about 6,000 feet msl. The Doppler radar data showed the cloud tops were about 10,000 feet msl. The Doppler data did not show measurable turbulence during the time period of the accident flight. The wind speed at N6059C's altitude was about 35 knots from a south-southwest direction. A copy of the Meteorological Factual Report is appended to this document.

WRECKAGE AND IMPACT INFORMATION

N6059C's wreckage was located about 1/2 statute mile south of U.S. Route 12 and about 1/4 mile east of Walworth County Road "H." The wreckage trail was about 1-1/2 statute miles in length. A wreckage diagram is appended to this report.

N6059C's main wreckage was laying on its right side on a magnetic heading of about 330 degrees. The main wreckage consisted of the airplane's fuselage and left wing. The inboard section of the right wing was located about 900 feet northwest of N6059C's location. The upper half of the airplane's vertical stabilizer was located about 2,000 feet north-northwest of the main wreckage site. The horizontal stabilizer and elevator were located about 1/2 statute mile north-northwest of N6059C's location. Both elevator balance tabs had separated from the elevator. One was found about 1,500 feet northwest of the wreckage. The second elevator balance tab was found about 1/2 statute mile north-northwest of N6059C. The outboard third of the right wing was located about 100 feet north of the horizontal stabilizer/elevator assembly. Smaller pieces of N6059C's wreckage were scattered north of the right wing section.

N6059C's fuselage was crushed inward on its right side, along its longitudinal axis. The top aft section of the fuselage was ruptured open from the leading edge of the vertical stabilizer forward to about the dorsal fin's midspan location. The left wing was angled about 90 degrees forward from its normal position and had pressed into the forward fuselage.

The left main landing gear was in the extended position. The bottom of N6059C's fuselage was ruptured open and crushed in toward the fuselage center. The tail cone was bent about 20 degrees toward the left. The nose landing gear was in the extended position.

The cockpit annunciator panel located on N6059C's instrument panel had light bulbs whose filaments were distorted. Two of the four "Lamp Test" bulbs were distorted. The two "Day" bulbs had distorted filaments. The remaining light bulb filaments were not distorted. The autopilot annunciator panel had two indicator light bulbs with distorted filaments. The bulbs that had distorted filaments were: Flight Director and Autopilot.

The right wing was fragmented into various-sized pieces from its root outboard to its wingtip. The inboard, forward section of the wing, from the root to about six feet outboard of the main landing gear strut mount was the largest piece of the right wing. The main landing gear was retracted. This section of the wing was separated from the main spar. This wing section had

an inverted bow in it that began at the main landing gear attach point. The forward wing root attach fitting had separated from its fuselage mounting. The rivet holes in the flanges of the fitting were torn, distorted and lipped toward its fuselage attach point. The top and bottom surface of this wing section were oil-canned.

The second largest piece of the right wing began about eight feet from the wing root to the wingtip. This section had part of the main spar attached to it. The inboard fracture shape of this section matched the shape of the previously described wing section's outboard fracture. Examination of the fractures on the spar end and separated metal showed shear lips and a grainy surface appearance that are consistent with an overload fracture.

The section of the right wing aft of the main spar consisted of various sized pieces of the wing. The right aileron had separated from the wing structure. The outboard section of the aileron was bent down about 90 degrees. The bend line was about 12 inches inboard of the aileron's outboard edge. The landing flap was torsionally twisted and had spanwise bending . The flap had separated into two pieces at its midspan location. The right wing's main spar had separated from the wing structure.

This started at the airplane's center section to about midspan of the right wing. Its fractured end matched that of the outboard wing section with the main spar attached to it. The fracture ends were grainy in surface texture and had shear lips along the fractured edge. The center section end of the main spar was bent downward from the inboard side of the wing walk to where it had separated from its attach point. The bottom of the main spar directly below this section was bent upward. The spar webbing was crushed between the top and bottom spar sections. The spar was bowed upward from the wing walk's outboard edge to about the main landing gear attach point. It was then bowed downward from about midspan to the wingtip. This section of main spar was twisted along its vertical axis and bent aft about 20 degrees. The bend began near the wing walks outboard edge. The fracture ends on this section of wing spar had a grainy surface texture with shear lips around the fractures.

Various components of the right wing had part numbers that were hand written. The handwritten numbers were black and not able to be removed by rubbing with a dry or water-dampened cloth. Exposed components on the left wing had stamped numbers on them.

The left wing's leading edge was crushed aft to the main spar from the wing root to the wingtip. The landing flap was separated from the wing. The aileron was attached to the aft spar. The top and bottom wing skins aft of the main spar were oil-canned and had compression bends in them. The wing was angled down about ten degrees from its root outboard. The main spar was twisted about 25 degrees along its vertical axis from the fuselage center to the wing root. The spar was curved forward about five degrees along its longitudinal axis from the center section to its midspan location. The spar bent aft about five degrees from the wing's midpoint to the wingtip.

The left wing's spar center section webbing had compression bending from the wing root

inboard to the fuselage centerline. The main spar's center section upper and lower doubler plates were attached to the spar ends. The distance between the top and bottom ends of the wing spar had increased about 25 percent over its original size. Fractures on the ends of the upper and lower main spar caps had a grainy appearance with shear lips along their edges. The center section truss assembly had separated from its attach points on the main spar and its rear attach point. The rear mount had its attachment bolts mounted in the truss assembly's flange. The forward mount had its mounting bolts and portions of the main spar attached to it. The fracture surfaces of the brace's forward mount and wing spar section it was attached to had grainy surface texture and shear lips along their edges.

The main wingspar's center section upper and lower spar doubler plate bolts and nuts were in their respective positions. The break away torque for each bolt was checked. The break away torque readings for the upper spar doubler plate varied from 20 to 130 inch pounds. The break away torque readings for the lower spar doubler plate varied between 20 to 110 inch pounds. There were two smaller bolts at each end of the doublers. According to N6059C's manufacturer, the torque range should be between 50 to 70 inch pounds. The remaining bolts have a torque range requirement between 95 and 110 inch pounds. One upper doubler plate bolt and nut that were also part of the truss assembly were found loose. Specific bolt locations and their respective break away torque settings are appended to this report.

The section of vertical stabilizer that is positioned above the horizontal stabilizer had separated from N6059C. This section of the vertical stabilizer had separated from, and expanded outward, at its rear spar. The tip of this assembly was crushed downward and was angled about 20 degrees to the left. The bottom of the vertical stabilizer's rear spar was bent aft about five degrees. The vertical stabilizer section below the horizontal stabilizer was crushed down and to the left.

The rudder separated about one foot from its bottom end. The skin on both sides of the rudder was wrinkled. The rudder tip was crushed down about 2 inches from its normal position. The rudder balance weight had separated from the rudder assembly. The rudder horn had an "S" shaped bend in it on either side of the rudder torque tube. The rudder horn's right arm was bent down about 30 degrees. The left rudder horn arm was bent up about 20 degrees to where the rudder cable was attached. It then bent down about 10 degrees to the tip. The left rudder stop was bent in toward the fuselage centerline about 20 degrees. The rudder cable end bolt nut was found pressed against it. The right rudder control horn stop was bent about five degrees to the right.

The rudder hinge bushing contains a bracket, bolt and attachment nut, two washers, spacer and a bronze bushing. The top hinge of the rudder had portions of the bushing missing. There was play between the bushing and spacer. The wall of the bushing was reduced in thickness and stretched. The bushing fracture had a grainy surface and its edges had shear lips. The mating hole for the bushing contained fretting wear damage.

The horizontal stabilizer had separated from its vertical stabilizer and fuselage attachment

points. The forward mounting bolts that attached the horizontal stabilizer to the vertical stabilizer's forward spar had remained with the horizontal stabilizer. The holes on the vertical stabilizer spar were deformed aft. The top and bottom sides of the slot at the horizontal stabilizer's leading edge slot were deformed downward. The left horizontal stabilizer's leading edge had an indentation in it about two feet nine inches outboard of the assemblies centerline.

The area around the stabilizer's indentation was crushed aft about three inches either side of the indentation's center. A "Z" shaped bend extended aft from the indentation to the horizontal stabilizer's rear spar. The stabilizer's section outboard of the bend was elevated about three inches above the rest of the stabilizer's upper surface. The rear stabilizer attach arms remained with the unit. The rivets in both attachment arms were still in the arms. The fracture surfaces of the rivets were shinny.

The lower skin of the left horizontal stabilizer, in an area slightly outboard of the spanwise fold, exhibited a series of five linear paint transfer marks that were oriented parallel to each other. The color of the paint marks in this series were red, red, red, gray-silver, and blue, sequentially from inboard to outboard. The upper area of the vertical stabilizer that was above the horizontal stabilizer contain rivet heads that are spaced two inches apart. The heads of several rivets on the upper right side of the vertical stabilizer contained scrape marks and, in turn, these scrape marks coincided with the color of the parallel paint transfer marks found on the lower skin of the left horizontal stabilizer.

About 50 percent of the left elevator's trim tab was bent upward about 30 degrees from the midspan point to its outboard edge. The left side elevator balance tab assembly had separated from the elevator at the outboard elevator hinge.

The right elevator was attached to the horizontal stabilizer. Its balance tab had separated from the assembly. The elevator hinge bushings had damage that was similar to that found on the rudder hinge bushings. The left elevator's outboard hinge was attached to the horizontal stabilizer. The attachment fitting had pieces of the elevator's forward spar attached to it. The right elevator's outboard hinge separated from the horizontal stabilizer's mount. The up elevator control horn had a strike mark on the inside edge that matched a crush area on the horizontal stabilizer's rear spar.

Examination of the flight control system revealed several separated cables. Each separated end was broomed and the individual strands were necked. The flight control cables were attached to their respective control surface and cockpit control assembly.

MEDICAL AND PATHOLOGICAL INFORMATION

The autopsies on the pilot-owner and pilot-rated passenger were conducted at the Lakeland Medical Center, Elkhorn, Wisconsin, on May 16, 1998. The toxicology examination on the pilots was conducted by the Federal Aviation Administration's Civil Aeromedical Institute located in Oklahoma City, Oklahoma. The results of both examinations were negative.

TESTS AND RESEARCH

The on-scene examination of N6059C's wreckage was conducted with the aide of an NTSB Metallurgist. His report stated that an "...examination of the fractures from the accident airplane revealed no evidence of a preexisting crack or corrosion. All fractures contained features typical of an overstress separation." The report continues, "The skin on the upper surface of the right wing toward the aft end in the area of wing separation was folded up, as if the wing had folded up and aft."

According to the factual report, "The bottom end of the aft spar for the vertical stabilizer, and the skin on the left side at the base of this stabilizer contained deformation consistent with the vertical stabilizer separating aft and to the left with respect to the fuselage."

The tip assembly (balance tabs) for the left and right elevators had separated about one foot in from the outboard ends. The report states, "The skin deformation in the area of this separation was consistent with the tips separating up and aft." The elevator and rudder hinge bushing assembly examination revealed, "The wall of the bushings for the left elevator and upper rudder stabilizers was reduced and stretched out as a result of mechanical deformation. This deformation caused a gap between the bushing and spacer. Several fragments separated from these bushings. Fractures of the bushing contained no fatigue features or corrosion damage. No wear damage was noted on the spacer or thread of the attachment bolts." A copy of the metallurgist's factual report is appended to this report.

N6059C's propeller was still attached to its engine. The propeller was buried in the ground to the hub. One propeller blade was above the ground. This blade did not have any damage. One blade buried beneath the ground had one indentation into its leading edge and some leading edge scoring that went aft about 25 to 30 percent of the chord. This blade was bent aft about 15 degrees at its junction with the propeller hub. The third blade was buried in the ground. It was bent aft about 45 degrees at its hub and was torsionally twisted about 60 degrees starting at its mid span location. The leading edge had indentations from the tip to about 1/3 span inboard from the tip. The trailing edge had a cut in it starting about 8 inches in from the tip and going forward about 3 inches. This blade had chord wise scoring along its entire span.

The vacuum pump inspection revealed it did not have any pre-impact anomalies that would have prevented its operation. The attitude and heading indicator's rotor cases had scoring on the inside. The scoring area matched marks found on the vanes of the instrument's rotors. The heading indicator's case side had rub marks that were also found on its rotor.

After N6059C's engine had been disassembled the crankshaft and crankcase were examined by the NSTB Material Laboratory Division in Washington, D.C. The metallurgists factual report stated, "Examination of the engine case revealed no signs of mechanical damage or electrical arcing. None of the journals showed the burning or scorching that is typical of oil starvation... ." The report continued, "With the exception of the forward end of the [crankshaft's] main

bearing journal, the journal surfaces had minimal amounts of discoloration and wear." The surface of the forward end of the crankshaft's main bearing journal contained a large amount of transferred material. The report stated, "[The] material transfer began approximately 0.25 inches aft of the oil slinger flange, and extended over approximately 1.7 inches. Energy-dispersive spectroscopy (EDS) of this material detected primarily aluminum, with small amounts of oxygen, silicon, and tin. According to the metallurgist's factual report, "Examination of the inside of the bearings from the main bearing journal revealed a loss of material in the areas corresponding to the location of the crankshaft material transfer... ." A copy of the metallurgist's factual report is appended to this document.

The autopilot and related components were examined at the manufacturer's facility. Among the items examined and tested were the left seat pilot's control wheel switches. The control wheel steering and autopilot disconnect switches functioned to the manufacturer's specifications. The autopilot's directional gyro was not able to be operated due to damage. Rotational scoring was found on the gyro rotor and inside the rotor housing interior.

The roll servo was damaged. However, its d.c. servo motor operated and responded to commands placed upon it. The servo's slip clutch torque was tested and found to slip at 19 inch pounds. The manufacturer's torque is 23 inch pounds, plus or minus two inch pounds. The pitch servo was impact damaged. Its motor would not operate.

The pitch trim sensing switches functioned according to the manufacturer's specifications. The servo's slip clutch torque was tested and found to slip at 30 inch pounds. The manufacturer's torque is 36 inch pounds, plus or minus four inch pounds. The pitch trim servo was damaged and could not be operationally tested. Its slip clutch torque was tested and found to slip at 32 inch pounds. The manufacturer's torque is 30 inch pounds, plus or minus three inch pounds.

The other autopilot components were not able to be operationally tested due to impact damage. The FAA Principal Avionics Inspector's report is appended to this report.

ADDITIONAL INFORMATION

According to Commander Aircraft Company's airplane construction Material Discrepancy Report for the accident airplane, there were thirteen items that were related to the N6059C's wing. These items were related to modifications and repairs made during the airplane's construction. These sheets are appended to this report.

According to Commander Aircraft Company's Process Specification, Section 3.3.3, MARKING TYPE 1 (DIRECT),CLASS 17-INDELIBLE INK PEN, "This method shall be applied freehand, printed in large enough print so as to not smear letters together, but be clearly readable." A copy of this specification is appended to this report.

Pilot Information

Certificate:	Private	**Age:**	43,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	Yes
Medical Certification:	Class 3 Valid Medical--w/ waivers/lim	**Last FAA Medical Exam:**	April 23, 1998
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	
Flight Time:	341 hours (Total, all aircraft), 23 hours (Total, this make and model), 99 hours (Pilot In Command, all aircraft), 28 hours (Last 90 days, all aircraft), 8 hours (Last 30 days, all aircraft), 1 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Commander	**Registration:**	N6059C
Model/Series:	114-B 114-B	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	14649
Landing Gear Type:	Retractable - Tricycle	**Seats:**	4
Date/Type of Last Inspection:	March 11, 1998 Annual	**Certified Max Gross Wt.:**	3260 lbs
Time Since Last Inspection:	20 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	80 Hrs	**Engine Manufacturer:**	Lycoming
ELT:	Installed, not activated	**Engine Model/Series:**	IO-540-T4B5
Registered Owner:	QAULITY MACHINING, INC.	**Rated Power:**	260 Horsepower
Operator:		**Operating Certificate(s) Held:**	None
Operator Does Business As:		**Operator Designator Code:**	

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	MKE ,720 ft msl	**Distance from Accident Site:**	37 Nautical Miles
Observation Time:	08:56 Local	**Direction from Accident Site:**	60°
Lowest Cloud Condition:	Unknown	**Visibility**	5 miles
Lowest Ceiling:	Overcast / 2000 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	7 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	140°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29 inches Hg	**Temperature/Dew Point:**	67°C / 61°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	WAUKESHA , WI (UES)	**Type of Flight Plan Filed:**	IFR
Destination:	(CMH)	**Type of Clearance:**	IFR
Departure Time:	08:50 Local	**Type of Airspace:**	Class E

Airport Information

Airport:		**Runway Surface Type:**	
Airport Elevation:		**Runway Surface Condition:**	
Runway Used:	0	**IFR Approach:**	
Runway Length/Width:		**VFR Approach/Landing:**	

Wreckage and Impact Information

Crew Injuries:	2 Fatal	**Aircraft Damage:**	Destroyed
Passenger Injuries:	2 Fatal	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	4 Fatal	**Latitude, Longitude:**	42.829116,-88.73085(est)

Administrative Information

Investigator In Charge (IIC):	Gattolin, Frank
Additional Participating Persons:	TIM ANDERSON; MILWAUKEE , WI BOBBY D THIESSEN; BETHANY , OK GREGORY ERIKSON; WAYNE , IL PHILLIP GOETTEL; OLATHE , KS
Original Publish Date:	September 7, 2000
Last Revision Date:	
Investigation Class:	Class
Note:	
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=10739