Aviation Investigation Final Report

Location:	EDEN PRAIRIE, Minnesota	**Accident Number:**	CHI01FA220
Date & Time:	July 19, 2001, 17:30 Local	**Registration:**	N2HW
Aircraft:	Mooney M-20R	**Aircraft Damage:**	Destroyed
Defining Event:		**Injuries:**	1 Fatal
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The airplane was observed proceeding westbound from the airport at a low altitude. A witness said, "I watched and listened thinking he would soon apply power and climb. The engine noise was smooth sounding but low. The plane was not gaining altitude and slowly losing altitude." The witness said the airplane flew parallel to, and north of the road in front of her house. "As it crossed the point of my driveway, the plane banked slightly, hit the tree tops and crashed and exploded." Control tower communications revealed that shortly after being instructed to contact departure control, the pilot responded, "two hotel whiskey - engine failure". An examination of airframe records showed that a new engine was installed at the annual inspection on February 5, 2001. The airplane logged approximately 75.7 hours from the time of the annual inspection to the time of the accident. An examination of the airplane's engine revealed that three teeth from the camshaft gear were fractured. An additional eight teeth were crushed, in total rendering the camshaft unable to be driven. A Materials Laboratory examination of the camshaft gear and fractured gear teeth showed two of the three teeth indicating signs of fatigue. The third tooth showed evidence of overstress. Rockwell hardness measurements made on the gear portion of the camshaft gear showed an average hardness of Rockwell 64HR30-N. Specification drawings for the camshaft gear indicated that the gear teeth should be hardened by gas-nitride process to a hardness of Rockwell 69HR30-N, minimum.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The fractured camshaft gear and the pilot not maintaining aircraft control. Factors relating to this accident were metal fatigue in the camshaft gear teeth, the inadvertent stall, the low airspeed, and the trees.

Findings

Occurrence #1: LOSS OF ENGINE POWER(TOTAL) - MECH FAILURE/MALF
Phase of Operation: CLIMB

Findings
1. (C) ENGINE ASSEMBLY,GEAR - FRACTURED
2. MATERIAL INADEQUATE - MANUFACTURER
3. (F) ENGINE ASSEMBLY,GEAR - FATIGUE
4. ENGINE ASSEMBLY,GEAR - OVERLOAD

Occurrence #2: LOSS OF CONTROL - IN FLIGHT
Phase of Operation: CLIMB

Findings
5. (C) AIRCRAFT CONTROL - NOT MAINTAINED - PILOT IN COMMAND
6. (F) STALL - INADVERTENT - PILOT IN COMMAND
7. (F) AIRSPEED - LOW
8. ALTITUDE - LOW

Occurrence #3: IN FLIGHT COLLISION WITH OBJECT
Phase of Operation: DESCENT - UNCONTROLLED

Findings
9. (F) OBJECT - TREE(S)

Occurrence #4: IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation: DESCENT - UNCONTROLLED

Factual Information

HISTORY OF FLIGHT

On July 19, 2001, at 1730 central daylight time, a Mooney M-20R, N2HW, owned and operated by a private pilot, was destroyed when it impacted trees and a road in a residential area 1 1/2 miles west of the Flying Cloud Airport (FCM), Eden Prairie, Minnesota. A post-crash fire ensued. Visual meteorological conditions prevailed at the time of the accident. The personal flight was operating on an instrument flight rules flight plan from Eden Prairie, Minnesota, to Aberdeen, South Dakota, under the provisions of 14 CFR Part 91. The pilot was fatally injured. The cross-country flight was originating at the time of the accident.

According to the Federal Aviation Administration (FAA) review of FCM Air Traffic Control Tower communications, just after takeoff the tower controller instructed the pilot to contact departure control. Immediately after the instructions were transmitted, the pilot responded, "two hotel whiskey". A "click" was heard. Then the pilot transmitted, "engine failure".

A witness to the accident said that she was working in the front yard and driveway of her home when she saw the airplane proceeding westbound from FCM at a low altitude. She said that the airplane was approximately 1,200 feet away. She said, "I watched and listened thinking he would soon apply power and climb. The engine noise was smooth sounding but low. The plane was not gaining altitude and slowly losing altitude." The witness said the airplane flew parallel to, and north of the road in front of her house. "As it crossed the point of my driveway, the plane banked slightly, hit the tree tops and crashed and exploded."

Another witness who saw the airplane said it was flying the normal path but it was much lower than normal. The witness said, "The plane went down then pulled up and went left over the trees behind our house. The plane did not right itself." The witness said he saw the airplane go out of sight into the trees. A few seconds later, the witness said he saw smoke and flames.

PERSONNEL INFORMATION

The pilot held a private pilot certificate with single-engine land and instrument airplane ratings issued on November 18, 1995.

The pilot held a third class medical certificate dated May 5, 2000. The certificate indicated no limitations.

According to his logbook and supplemental records provided by the airplane's co-owner, the pilot had 631.9 total flying hours, 619.3 hours were in single-engine land airplanes, and 382.3 hours were in the make and model of the accident airplane. His logbook showed that the pilot

completed a flight review on September 4, 2000.

AIRCRAFT INFORMATION

The airplane was a 1996 Mooney M-20R, serial number 29-0099. The airplane was privately co-owned and operated by the pilot and his brother-in-law, and was used for business and pleasure. The airplane was certified in the normal category.

The airframe records showed the airplane underwent an annual inspection on February 5, 2001. At the annual inspection, a factory new IO-550-G6B engine (serial number 684937) was installed. The airframe time recorded at the annual inspection was 263.8 hours. The last recorded maintenance performed on the airplane was done on June 20, 2001. The recorded airframe time was 335.6 hours. According to information provided by the airplane's co-owner, the airplane was flown approximately 3.9 additional hours between June 20, 2001, and the accident date.

WRECKAGE AND IMPACT INFORMATION

The NTSB on scene investigation began on July 20, 2001, at 0915. The accident site was located along the south edge of Beverly Drive, an east- west running paved road, and in the front yard of a residence in Eden Prairie.

The accident site began with a 6-foot long, 6-inch wide, and 2-inch deep ground scar that ran along a 170-degree heading, and ended at the north edge of the road. At the beginning of the ground scar were several small pieces of clear Plexiglas. Preceding the ground scar and located 40 feet north of the road was a 16-foot long, 10-inch diameter trunk of an elm tree. The tree trunk was pushed over and broken at the roots and fell along the south edge of a ditch along a 150-degree magnetic heading. The top part of the trunk was broken laterally from north to south. The remaining portion of the trunk, including the top branches and leave, rested in the middle of the road. The top of the tree was oriented so the trunk ran north to south along a 180-degree magnetic heading. Also preceding the road, approximately 15 feet west of the ground scar and 12 feet north of the road edge was another damaged elm tree. Several of the top branches were broken along a 45-degree angle running southwest to northeast. Broken branches and leaves from the elm tree were found on the road and in the yard on the south edge of the road.

Beginning at the north edge of the road and proceeding across the road from north to south were a series of parallel-running scrapes and gouges in the asphalt. The scrapes beginning at the north side of the road curved slightly toward a 1602-degree magnetic heading. Passing the center of the road, the scrapes became deeper and curved toward a 135-degree magnetic heading until reaching the south edge of the road. The series of scrapes were 51 inches at its widest point near the south edge of the road. Scrapes within 5 feet of the road's south edge showed gouges that were 1 to 1.5 inches deep. Also running parallel among the scraps were several white-colored smears on the road surface. The smear color was similar to the white

color-scheme used on the accident airplane.

The airplane's right wing tip rested on the road approximately 21 feet from the beginning of the ground scar. The wing tip was broken longitudinally along the rivet line. The clear Plexiglas cover over the strobe and position lights was broken out.

The airplane's right aileron rested along the south edge of the road approximately 32 feet from the beginning of the ground scar on a 156-degree magnetic heading. A burned area of grass, approximately 7 feet long east-to-west and 6 feet long south-to-north surrounded the right aileron. The aileron was broken out at the hinges and actuator arm. The aileron surface was bent upward and twisted aft at its outboard edge and running approximately 12 inches inboard. The surface showed smoke damage and soot.

The airplane's main wreckage was approximately 49 feet from the beginning of the ground scar, on a 156-degree magnetic heading. The main wreckage included the engine, propeller, top cowling, cabin floor, tube structure outlining the cabin, the wings, aft fuselage, and the empennage. The engine, propeller, and remaining cabin were oriented on a 090-degree magnetic heading.

Preceding the main wreckage was a small 6-inch diameter birch tree that was broken and pushed over at the roots. The birch tree was broken laterally 4-feet up the trunk from the roots. Large areas of bark were scraped away from the trunk on one side. The trunk was oriented on a southerly heading and ended at the main wreckage. Portions of the trunk were charred.

The top cowling was broken off and rested in front of the propeller. The propeller spinner was crushed inward on two sides. Longitudinal-running scraps were observed in the crushed in areas. The three-bladed propeller remained attached to the engine at the flange. One propeller blade was bent aft, twisted and curled. The front face of the blade showed deep parallel-running scratches beginning near hub and running outward toward the blade tip. The second blade was bent aft slightly. The third blade was bent forward slightly at mid-span. The blade tip showed deep scratches in the edge. The airplane's bottom cowling was charred, melted and consumed by fire. The airplane's engine was broken at the mounts and canted 75 degrees to the right. The bottom and left side of the engine were charred and melted. The forward fuselage and nose wheel well were crushed upward, charred and melted. The nose gear was broken aft, charred, and melted. The nose gear doors were broken aft, charred, melted and consumed by fire.

The cockpit area of the cabin, including the windscreen, glare shield, instrument panel, flight and engine controls, pilot's seat and right front seat were charred, melted, and consumed by fire. The side cabin walls, passenger seats, ceiling, and cabin windows were consumed by fire. The aft baggage compartment was crushed inward, charred and melted.

The aft portion of the airplane's right wing was broken free of the fuselage at the root. The inboard 3 feet of the right wing was charred and melted. The wing flap was broken and bent

underneath the wing. The right main landing gear was broken inward and aft. The inner gear door was crushed upward. Tree branches and leaves were embedded in the outer door and right main landing gear tire. The outboard 5 feet of the right wing was bent upward 28 degrees. The outer 10 inches of the wing prior to the tip was torn upward and aft. The right wing tip was separated at the rivet seam. The right aileron was bent upward and buckled. Flight control continuity to the right aileron was confirmed.

The left wing remained attached at the wing root. The inboard 6 feet of the airplane's left wing was charred, melted, and consumed by fire. The top of the inboard forward wing skin covering the fuel tank was charred, melted, and consumed by fire. Fuel was observed in the remains of the fuel tank. The bottom of the wing was bent, buckled and charred. The left main landing gear and outboard gear door was bent outward. The inboard gear door was broken aft, charred, and melted. The outboard 9 feet of the left wing was broken and twisted aft near mid-span, and came to rest invested along the left bottom side of the fuselage. The top wing skin at the fracture showed deep lateral-running scrapes and exposed bare metal. The top of the outboard wing section was charred and melted. The left flap remained attached and was bent over at mid-span. The top of the left flap was charred. The left aileron was broken out at the hinges and actuator linkage. The wing skin around the left aileron hinges was charred and melted. The outer 14 inches of the wing, inboard of the wing tip rivet seam, was charred and melted. Flight control continuity to the left aileron was confirmed.

The fuselage aft of the cabin and baggage compartment was bent around a 10-inch diameter poplar tree, approximately 60 degrees to the right of the longitudinal axis defined by the orientation of the engine and the remaining cabin. The aft fuselage was bent inward, crushed upward, buckled, charred, and melted. The tree's trunk was charred and its branches and leaves were consumed by fire.

The airplane's empennage was intact and showed minor damage. The vertical stabilizer and rudder showed small inward dents and skin wrinkles. The outboard 8 inches of the right horizontal stabilizer was bent upward. The tip of the stabilizer was bent inward and broken longitudinally. The outboard 8 inches of the right elevator was bent upward. The left horizontal stabilizer and elevator showed minor buckling and skin wrinkles. Flight control continuity to elevators and rudder was confirmed.

The airplane's right wing tip was located approximately 23 feet south of the main wreckage. It was broken longitudinally at the rivet seam. The position light, strobe light and clear Plexiglas cover were broken out. Fanning out southward from the main wreckage were tree branches, wing inspection panels, leaves and wood shards. The right aileron counterweight was located approximately 55 feet southeast of the main wreckage.

The on-scene examination of the airplane's systems revealed no anomalies. The airplane's engine was retained for further examination.

MEDICAL AND PATHOLOGICAL INFORMATION

An autopsy of the pilot was conducted by the Hennepin County, Minnesota, Medical Examiner, on July 20, 2001. Final diagnosis was reported as blunt force and thermal injuries due to airplane crash.

Federal Aviation Administration toxicology testing of samples taken from the pilot revealed the following volatile concentrations:

16 percent CARBON MONOXIDE detected in blood.

1.44 micrograms per milliliter (ug/ml) CYANIDE detected in blood.

FIRE

The Eden Prairie Police Department received notification of the accident at 1731. They immediately responded the residence where the crash had occurred. On arrival at the scene, officers described finding the airplane's passenger compartment "fully involved in flames" and observed thick black smoke rising from the plane's fuselage.

The Eden Prairie Fire Department arrived immediately after the police and extinguished the fire.

An area of the front lawn of the residence, encompassing burned grass, several small charred bushes, tree saplings, and the trunks and lower branches of a few large trees, extended south and east from the airplane main wreckage. The burned area was 27 feet long, north to south, and 31 feet wide, west to east. The burned area was bordered on the east by the driveway to the residence, and to the north by the road.

TESTS AND RESEARCH

The airplane's engine was examined at Teledyne Continental Motors, Mobile, Alabama, on October 31, 2001. The examination revealed that three of the gear teeth were broken off from the camshaft gear. Eight additional gear teeth were crushed inward. Numerous metal shavings were found surrounding the alternator drive gear. Additional metal shavings were found in the accessory gears off of the crankshaft and in the oil pan. The three fractured gear teeth were retrieved from the oil pan. When the engine was turned, everything rotated with exception of the camshaft. The camshaft gear and the three fractured gear teeth were retained for NTSB Materials Laboratory examination.

The camshaft gear and three fractured gear teeth were examined at the NTSB Materials Laboratory, Washington, DC, on May 3, 2002. The examination of the camshaft gear revealed that the entire fracture face for two of the broken gear teeth was smooth and had crack arrest positions, features typical of fatigue cracking. The fatigue cracks emanated from the pressure side of the relief radius located at the base of the tooth. The fatigue crack propagated through the base of the tooth and intersected the relief radius on the non-pressure side.

The fracture face of the third broken gear tooth contained a fatigue crack that emanated from the pressure side and a fatigue crack that emanated from the non-pressure side of the relief radius located at the base of the tooth. Each fatigue crack extended through approximately 30 percent of the tooth base. The fractographic features of the fatigue crack on the non-pressure side were coarse compared to those of the fatigue crack on the pressure side. The portion of the fracture between the fatigue crack regions contained rough, irregular features typical of overstress. The flanks of the three broken gear teeth showed no evidence of severe wear.

An engineering drawing for the camshaft gear indicated that the gear teeth should be hardened by gas-nitride process to a hardness of Rockwell 69HR30-N, minimum. Rockwell hardness measurements made directly on the gear portion produced an average hardness of 64HR30-N.

The NTSB Materials Laboratory Factual Report, Number 02-36, is provided as an addendum to this report.

ADDITIONAL INFORMATION

Parties to the investigation were the FAA Flight Standards District Office, Minneapolis, Minnesota, and Teledyne Continental Motors.

All airplane wreckage and related components were released and returned to Phoenix Aviation Mangers, Incorporated, Richfield, Minnesota.

Pilot Information

Certificate:	Private	**Age:**	37,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	Yes
Medical Certification:	Class 3 None	**Last FAA Medical Exam:**	May 5, 2000
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	September 4, 2000
Flight Time:	632 hours (Total, all aircraft), 382 hours (Total, this make and model), 487 hours (Pilot In Command, all aircraft), 13 hours (Last 90 days, all aircraft), 5 hours (Last 30 days, all aircraft), 1 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Mooney	**Registration:**	N2HW
Model/Series:	M-20R	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	29-0099
Landing Gear Type:	Retractable - Tricycle	**Seats:**	4
Date/Type of Last Inspection:	February 5, 2001 Annual	**Certified Max Gross Wt.:**	3368 lbs
Time Since Last Inspection:	76 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	340 Hrs at time of accident	**Engine Manufacturer:**	Continental
ELT:	Installed, activated, did not aid in locating accident	**Engine Model/Series:**	IO-550-G(6)
Registered Owner:	JOEL W. HOIUM & MICHAEL J. HOLTE	**Rated Power:**	300 Horsepower
Operator:		**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	FCM,906 ft msl	**Distance from Accident Site:**	2 Nautical Miles
Observation Time:	17:44 Local	**Direction from Accident Site:**	90°
Lowest Cloud Condition:	Scattered / 4000 ft AGL	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	3 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:		**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.9 inches Hg	**Temperature/Dew Point:**	31°C / 23°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	EDEN PRAIRIE, MN (FCM)	**Type of Flight Plan Filed:**	IFR
Destination:	ABERDEEN, SD (ABR)	**Type of Clearance:**	IFR
Departure Time:	17:30 Local	**Type of Airspace:**	Class B

Airport Information

Airport:	Flying Cloud Airport FCM	**Runway Surface Type:**	Concrete
Airport Elevation:	906 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	27L	**IFR Approach:**	Unknown
Runway Length/Width:	3909 ft / 75 ft	**VFR Approach/Landing:**	Unknown

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Destroyed
Passenger Injuries:		**Aircraft Fire:**	On-ground
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Fatal	**Latitude, Longitude:**	44.823333,-93.491386

Administrative Information

Investigator In Charge (IIC):	Bowling, David
Additional Participating Persons:	Barry Johnson; Federal Aviation Administration; Minneapolis, MN Scott Boyle; Teledyne Continental Motors; Arvada, CO
Original Publish Date:	August 26, 2002
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=52768