



National Transportation Safety Board Aviation Accident Factual Report

Location:	DELANO, CA	Accident Number:	LAX99LA065
Date & Time:	01/02/1999, 1640 PST	Registration:	N1079G
Aircraft:	Mooney M20K	Aircraft Damage:	Substantial
Defining Event:		Injuries:	2 Minor
Flight Conducted Under:	Part 91: General Aviation - Personal		

On January 2, 1999, at 1640 hours Pacific standard time, a Mooney M20K, N1079G, collided with trees and terrain following a complete loss of engine power near Delano, California. The airplane, operated by the owner, sustained substantial damage after it collided with trees in an orchard during the emergency descent in fog. The private pilot and his passenger received minor injuries. The flight was being conducted under 14 CFR Part 91 when the accident occurred. The airplane departed Elko, Nevada at 1430, and was destined for Meadows Field Airport, Bakersfield, California. Instrument meteorological conditions prevailed at the time of the accident and the pilot was on an IFR flight plan.

Following an uneventful en route flight to the Bakersfield area, the pilot made an initial radio call to Bakersfield approach control on frequency 118.9 at 1621. Bakersfield issued an altimeter and told the pilot that he should expect the ILS approach to runway 30R. At 1630, Bakersfield approach control issued a heading of 140 degrees, vectors for the ILS, and told the pilot to descend to 3,000 feet.

The pilot reported an engine failure at 1632, and Bakersfield approach reported the distance and direction to the Delano airport and asked if the airplane wanted to land there. The pilot in the accident aircraft replied "affirmative." At 1636, Bakersfield approach issued a low altitude alert and reported that the Delano ceiling was 100-foot overcast and visibility was less than 1 1/4 miles, and asked the pilot if any landing areas were visible. The pilot of the accident airplane reported that he was entering instrument meteorological conditions (IMC).

At 1637, radar contact was lost with the flight and Bakersfield approach provided the last observed position relative to Delano to the pilot. The pilot acknowledged the radio transmission.

At 1639, the pilot transmitted on 118.9 and said he was on the ground in a field, exact location unknown. Bakersfield approach control acknowledged and advised the pilot that emergency personnel were en route. The pilot reported that he remained in IMC conditions until just above the almond orchard trees, and the airplane came to rest upright between the rows of trees.

In his written statement, the pilot said that the low voltage annunciator light illuminated followed quickly by a propeller governor run-away (referring to the engine overspeed condition). On further inspection, the pilot said the oil pressure indicated zero. He said the engine continued to idle and upon reapplication of the throttle, the engine made low power for about 30 seconds before seizing.

Following recovery of the aircraft an initial examination of the engine was performed. The oil pump drive gear was found separated and loose in the crankcase accessory section. One tooth on the oil pump drive gear was found. In addition, other gears in the accessory case exhibited unusual wear patterns. A detailed disassembly of the engine was conducted at the Teledyne Continental Motors (TCM) factory on a subsequent date and a complete discussion of the internal findings is presented in the TESTS AND RESEARCH SECTION of this narrative.

AIRCRAFT INFORMATION

A review of the engine maintenance records was conducted.

In March 1997, during maintenance, it was found that there was a tooth chipped off the camshaft gear, P/N 623477. The tach time on the airplane at the time of discovery was 2,430.0 hours. The following month, the pilot had Mattituck Airbase, Mattituck, New York replace all accessory case gears and reassemble them per the TCM overhaul manual.

The Federal Aviation Administration (FAA) issued Airworthiness Directive (AD) 98-19-02 for TCM engines with Superior Air Parts, Inc. PMA piston pins. If an engine had a piston pin installed after August 1, 1994, but it was installed by TCM, then no action was required. The engine logbook notes on December 5, 1998, that AD 98-19-02 was not applicable due to new TCM cylinder assemblies that were installed.

In April 1998, the airplane underwent an annual inspection with a recorded tach time of 2,555.4 hours. At the time of inspection, all AD's through 98-07 were checked for applicability.

TESTS AND RESEARCH

Metallurgical Examinations

The crankshaft cluster gear, camshaft accessory drive gear, and separated oil pump drive gear from the engine were sent to the Safety Board's Materials Laboratory for analysis. Visual examination of the gears revealed the shaft portion of the oil pump drive gear, P/N 634010, separated from the web of the gear. According to the Materials Laboratory report, most of the teeth for this gear were mashed, and one gear tooth fragment was missing. According to the lab, the "mashing" occurred as a result of comprehensive mechanical damage that results when a gear(s) run out of alignment and gear teeth run into each other. Scanning electron microscope examination of the longitudinal fractured portion of the shaft revealed crack arrest marks typical of fatigue cracking, and ratchet marks indicative of a fatigue initiation from

multiple origins all around the shaft at the fillet radius.

The radial portion of the fracture from the oil pump drive gear progressed between the longitudinal fracture and the chamfer for the hole. The transition area between the longitudinal and radial fracture was a corner approximately 90 degrees. The fracture intersected the fillet radius located in the transition region between the shaft portion and the web of the gear portion. The fracture in the gear was on two distinct planes, one that extended longitudinally and one that extended radially. The gear contains a machined counterweight hole that progresses from the aft side of the gear along the centerline of the shaft portion. This machined hole has a countersink chamfer on the aft side of the gear, and the radial fracture intersected this countersink chamfer.

Scanning electron microscope examination of the longitudinal fractured portion of the shaft revealed crack arrest marks typical of fatigue cracking, and ratchet marks indicative of a fatigue initiation from multiple origins all around the shaft at the fillet radius, in the areas indicated by brackets "O" in figure 4 of the Materials Laboratory factual report. The fillet radius contained circumferential machining marks that intersected the fatigue origin areas. The longitudinal portion of the fracture extended approximately 0.090 inch in the aft direction from the fillet radius. The longitudinal fracture surface contained clearly defined fatigue striation features between the fillet radius and a position approximately 0.015 inch toward the radial fracture. The remaining portion of the longitudinal fracture contained mechanical damage that resulted from relative movement between mating fractures.

The radial portion of the fracture from the oil pump drive gear contained fatigue striations that emanated from the longitudinal fracture. The fatigue cracking on the radial plane propagated radially inward, and intersected the chamfer for the hole. The laboratory examined metallurgical sections of the oil pump drive gear and conducted hardness testing of these parts. Examination of the polished and etched section revealed a microstructure of tempered martensite, typical for quenched and tempered steel. No weld or braze material was found at the fracture locations of the gear assembly. The section contained a uniform microstructure, as if the gear was machined from one piece of metal. The outside diameter of the shaft and outer surface of the gear contained a white layer, typical of nitriding that measured approximately 0.0005 inch. The laboratory stated that the thickness of this layer was within typically expected range (0.0002 - 0.0005 inch) reported by a representative of TCM.

The machine engineering drawing, P/N 632550, for the oil pump drive gear indicated a flat bottom groove is machined on the shaft next to the web portion of the gear to create a clearance for other gears. Figure 5 shows that the surface finish of the flat bottom groove is rougher compared with the surface finish of the shaft portion.

The crankshaft gear was examined using visual and scanning electron microscope examinations. The excised gear tooth fracture revealed crack arrest marks typical of fatigue cracking that emanated from multiple origins at the face of the gear tooth adjacent to the root radius. According to the laboratory report, the fatigue crack originated from several corrosion pits on the surface of the root radius at the base of the tooth. The fatigue crack propagated

through the wall of the tooth and intersected the face on the opposite side of the tooth. The EDS spectrum of the fracture contained major peaks of iron and minor peaks of chromium, manganese, nickel, and silicon consistent with the specified AMS 6322 steel alloy (equivalent to the SAE 8740 steel).

According to the report, the microstructure consisted of tempered martensite mixed with what appeared to be islands of ferrite, which a representative of TCM indicated is normal for this gear. The representative indicated that the surface of the gear is carburized. The outside edges of the teeth contained a darker etching layer typical of a carburized surface. This layer measured approximately 0.031 inch, within the specified thickness (0.020-0.045 inch). Rockwell "C" hardness testing on the surface of the section in the core area produced an average hardness of HRC 77, within specified limits (HRC 25-45).

Engine Examination

The crankcase, crankshaft, camshaft, main bearings, and counterweights were sent to the TCM factory for examination. They were opened from their respective boxes and examined under the supervision of both the Safety Board and FAA on March 23, 1999. The crankcase exhibited two work order numbers on the rear top of the case halves. These work order numbers were "405" and "0863303". According to the TCM written report, the number one main bearing appeared normal. The number two main bearing was black and scored from oil distress. The number three main bearing was black, scored, and cracked from lubrication distress. The front main bearing appeared normal.

Further examination revealed that the crankshaft connecting rod journals exhibited oil starvation. The number one journal was black and partially melted, the number two and three journal was discolored, and the number four journal was slightly discolored. The number five journal was black and partially melted, and the number six journal was slightly discolored.

The number two and three camshaft journals exhibited aluminum pickup on the journal surface. The camshaft was impact damaged between the number one and two exhaust lobes. The crankcase was taken to the TCM layout inspection area to measure the crankshaft and camshaft bores for possible misalignment. The distance between the bores measured within TCM specifications. The crankshaft and camshaft gears were measured for gear pitch diameter and were found to be within TCM specifications.

The TCM metallurgist examined the broken crankshaft gear tooth. He concluded that the tooth was broken in fatigue, originating from the rear thrust side of the tooth. The camshaft gear teeth exhibited distress on the antithrust side of the teeth.

Examination of the oil pump gear fracture indicated that it was broken in overload. The broken tooth from the crankshaft gear lodged inside the internal camshaft gear and caused the oil pump shaft to break.

The Safety Board investigator also requested that the magnetos, magneto drive gears and couplings be examined at the TCM factory. The examination took place on May 13, 1999, in Mobile, Alabama. The first magneto examined, Slick Aircraft Products MN 6324, S/N 96072513, revealed that this magneto has an irregular wear pattern on the drive face of the magneto keyed driver. One of the coupling bushings was damaged on the side adjacent to the magneto drive gear, and the center magneto-coupling sleeve is fractured. According to the TCM metallurgist, the fracture appeared to be fatigue related.

The second magneto, MN 6324, S/N 96072507, revealed no damage to it or to the magneto drive assembly. Both magnetos were operated on a test bench. Both magnetos sparked across a 7MM sparkgap and sparked normally at all test speeds, and operated without vibration or ignition anomalies. According to the TCM factory report, one magneto drive gear inner bushing was broken, position unknown. The rubber bushings were also broken up at one end of the retainer cup. The damage to the drive gear bushings and rubber bushings is consistent with torsional vibration problems.

Release of Wreckage

The wreckage was released to the insurance company representing the owner on May 25, 1999 following return of the engine components.

Pilot Information

Certificate:	Private	Age:	48, Male
Airplane Rating(s):	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:	No
Medical Certification:	Class 3 Valid Medical--no waivers/lim.	Last FAA Medical Exam:	07/17/1998
Occupational Pilot:	Last Flight Review or Equivalent:		
Flight Time:	1065 hours (Total, all aircraft), 979 hours (Total, this make and model), 995 hours (Pilot In Command, all aircraft), 14 hours (Last 90 days, all aircraft), 8 hours (Last 30 days, all aircraft), 7 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Mooney	Registration:	N1079G
Model/Series:	M20K M20K	Aircraft Category:	Airplane
Year of Manufacture:		Amateur Built:	No
Airworthiness Certificate:	Normal	Serial Number:	25-0578
Landing Gear Type:	Retractable - Tricycle	Seats:	4
Date/Type of Last Inspection:	04/19/1998, Annual	Certified Max Gross Wt.:	2900 lbs
Time Since Last Inspection:	108 Hours	Engines:	1 Reciprocating
Airframe Total Time:	2668 Hours	Engine Manufacturer:	Continental
ELT:	Installed, activated, aided in locating accident	Engine Model/Series:	TSIO-360-LB
Registered Owner:	FRACO INCORPORATED	Rated Power:	210 hp
Operator:	FRACO INCORPORATED	Operating Certificate(s) Held:	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Instrument Conditions	Condition of Light:	Day
Observation Facility, Elevation:	DLO, 314 ft msl	Distance from Accident Site:	2 Nautical Miles
Observation Time:	1556 PST	Direction from Accident Site:	360°
Lowest Cloud Condition:	Partial Obscuration / 0 ft agl	Visibility	1 Miles
Lowest Ceiling:	Obscured / 0 ft agl	Visibility (RVR):	0 ft
Wind Speed/Gusts:	3 knots /	Turbulence Type Forecast/Actual:	/
Wind Direction:	10°	Turbulence Severity Forecast/Actual:	/
Altimeter Setting:	30 inches Hg	Temperature/Dew Point:	5°C / 3°C
Precipitation and Obscuration:			
Departure Point:	ELKO, NV (EKO)	Type of Flight Plan Filed:	IFR
Destination:	BAKERSFIELD, CA (BFL)	Type of Clearance:	IFR
Departure Time:	1430 PST	Type of Airspace:	Class E

Wreckage and Impact Information

Crew Injuries:	1 Minor	Aircraft Damage:	Substantial
Passenger Injuries:	1 Minor	Aircraft Fire:	None
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	2 Minor	Latitude, Longitude:	

Administrative Information

Investigator In Charge (IIC): DEBORAH L CHILDRESS

Additional Participating Persons: LARRY DECOSTA; FRESNO, CA
MIKE GRIMES; LANCASTER, CA

Investigation Docket: NTSB accident and incident dockets serve as permanent archival information for the NTSB's investigations. Dockets released prior to June 1, 2009 are publicly available from the NTSB's Record Management Division at pubinq@ntsb.gov, or at 800-877-6799. Dockets released after this date are available at <http://dms.nts.gov/pubdms/>.