Aviation Investigation Final Report

Location:	PRATTSBURG, New York	**Accident Number:**	NYC99LA202
Date & Time:	August 15, 1999, 14:00 Local	**Registration:**	N3243F
Aircraft:	Mooney M20E	**Aircraft Damage:**	Destroyed
Defining Event:		**Injuries:**	2 Serious
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

About 20 minutes into the flight, the pilot heard a loud bang, then saw an object go by the windshield. The airplane started to shake so badly that the door popped open, and oil appeared on the windshield. The pilot shut down the engine, the shaking ceased, and the pilot performed a forced landing to a hilly field. Post-flight examination revealed that approximately 27 inches of one propeller blade was missing. Examination of the remaining fracture surface revealed features typical of fatigue cracking, and metallographic examination of the origin area revealed the grain structure and the presence of intergranular corrosion cracks. Review of maintenance logbooks failed to reveal any indication of 'prop strike,' overspeed, or any other catastrophic event to the propeller. On August 20, 1989, the propeller was removed for overhaul, and for compliance with AD 77-12-06. Since then, it had logged about 530 hours of operation. There were no requirements for mandatory propeller corrosion inspections.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: Propeller blade separation, resulting from fatigue cracking initiated by intergranular corrosion. A factor was the lack of propeller blade corrosion inspection requirements.

Findings

Occurrence #1: PROPELLER FAILURE/MALFUNCTION
Phase of Operation: CRUISE

Findings
1. PROPELLER SYSTEM/ACCESSORIES,BLADE - SEPARATION
2. PROPELLER SYSTEM/ACCESSORIES,BLADE - FATIGUE
3. (C) PROPELLER SYSTEM/ACCESSORIES,BLADE - CORRODED
4. (F) INSUFFICIENT STANDARDS/REQUIREMENTS - FAA(ORGANIZATION)

Occurrence #2: FORCED LANDING
Phase of Operation: EMERGENCY DESCENT/LANDING

Factual Information

On August 15, 1999, about 1400 Eastern Daylight Time, a Mooney M20E, N3243F, was destroyed during a forced landing near Prattsburg, New York. The certificated private pilot and the passenger were seriously injured. Visual meteorological conditions prevailed at the time of the accident, and no flight plan was filed for the flight, between Elmira/Corning Regional Airport (ELM), Elmira, New York, and Ledgedale Airpark (7G0), Brockport, New York. The personal flight was conducted under 14 CFR Part 91.

According to a Federal Aviation Administration (FAA) Inspector, the pilot reported that about 20 minutes into the flight, he heard a loud bang, then saw an object go by the windshield. The airplane started to shake so badly that the door popped open, and oil appeared on the windshield. The pilot had difficulty reaching the mixture to shut the engine down; however, after engine shutdown, the shaking ceased, and the pilot performed the forced landing to a hilly field.

The Inspector examined the wreckage and noted that engine oil was deposited on the windshield and throughout the engine compartment. Engine cylinder compression was verified; the oil dip stick tube and cap were loose, and there were no visible holes in the engine crankcase. Inspection of the propeller and the surrounding vicinity revealed that approximately 27 inches of one propeller blade was missing.

Later inspection with an engine manufacturer's representative confirmed crankshaft movement, and rear accessory gear and engine driven fuel pump pin movement. The starter housing was removed, and revealed deep rotational gouge marks. The spark plugs were also examined, and "indicated signs of colorization associated with normal combustion." Both magnetos produced spark. The oil spin-on filter and oil sump screen were removed. The filter was cut open and sump screen "indicated no anomalies."

The remaining piece of the broken propeller blade was forwarded to the Safety Board Materials Laboratory for examination. According to the Laboratory's factual report, the fracture surface revealed a "flat, chord-wise fracture area that contained crack arrest positions,...features typical of fatigue cracking." The fatigue crack features were present in approximately 80 percent of the fracture cross section; "the remaining portion of the surface showed an incline plane, typical of an overstress fracture stemming from the fatigue region."

"Only one fatigue origin was found, on the forward (camber) face of the blade...about 1.6 inches from the leading edge...." It was examined in a scanning electron microscope (SEM), which "confirmed fatigue cracking by the presence of striations."

"The inclined area was covered with mud-cracked oxide deposits.... X-ray energy dispersive

spectroscopy (EDS) of the...deposits revealed the presence of aluminum, titanium, oxygen and, to a lesser extent, sulfur."

EDS of the bulk material of the propeller blade generated results "consistent with the specified forged 2025-T6-alluminum alloy. Also, results from hardness testing on the bulk material were consistent with the material specification."

Examination of the camber side of the blade revealed several corrosion pits near the fracture origin area; however, none were found at the fracture edge itself and, "in general, the number of pits was small, and they were only visible by SEM."

Metallographic examination of the origin area "revealed the grain structure and the presence of intergranular corrosion cracks." There was also a nearby "corrosion pit" on the camber face, and "multiple intergranular corrosion cracks extended from the corrosion pit into the blade material."

The pilot-owner provided the airplane's airframe and engine logbooks for review. There was no propeller logbook. Review of the logbooks failed to reveal any indication of "prop strike," overspeed, or any other catastrophic event to the propeller.

According to logbook entries, the airplane was constructed in April 1967. On October 17, 1974, a different engine was installed on the airplane, with a "zero since overhaul" propeller. The tachometer reading at that time was 1 hour. On December 31, 1975, after rework, the engine was reinstalled on the airplane. On March 1, 1978, the propeller was "dressed." On August 20, 1989, the propeller was removed for overhaul, and for compliance with AD 77-12-06. The tachometer reading at that time was 432 hours. On June 16, 1996, the engine was reinstalled after a major overhaul. At that time, the tachometer indicated 800 hours. On December 21, 1998, at 945 hours, the latest annual inspection was completed. At the accident site, the tachometer indicated 963.67 hours.

According to a representative from Hartzell Propeller, Inc.,

"AD 77-12-06 essentially called for repetitive inspection and compression rolling of blades per Hartzell Service Bulletin 118. This was initiated as a result of failures in the retention lip of the blade of Hartzell "Y" shank propellers, which are widely used on small aircraft. The task was so complex that it logically should be performed in conjunction with a propeller overhaul. Therefore, at the time, the repetitive inspection requirement was for the blades to be re-inspected/re-rolled at intervals specified in Hartzell Service Letter 61 (which provides time between overhaul specifications). Generally, this was 2000 hours of service or 5 years whichever comes first.

This went on for many years. The public generally had the perception that it was a mandatory 5 year propeller overhaul (which isn't quite correct).

After over 15 years of success, i.e. no more blade failures, all agreed that the AD could be relaxed. The FAA, instead of revising the AD, elected a simpler route - for Hartzell to revise our TBO specification to say that, for purposes of compliance with AD 77-12-06, the calendar limit no longer applies and the hourly limit was raised to 12,000 hours. This was done with Service Letter 61R dated February 28, 1992. This essentially killed the AD without the FAA having to re-write it. We are still waiting for the FAA to simplify matters by revising the AD (it's "in process")."

The representative further stated that, according to Hartzell Service Letter 61U,

"The '5 year overhaul requirement' forced propellers into shops for blade rolling, but a side benefit was that the propellers were being internally inspected on a regular basis. Since at least a general 'search' inspection is required during this work, propellers typically had corrosion problems corrected prior to return to service.

There is no FAA requirement for a corrosion inspection. Some will say that the aircraft annual inspection provides that check, however, the reality is that external corrosion is often ignored. Also, during an annual inspection, the propeller cannot be inspected for internal corrosion because it is not disassembled. The notion of a mandatory periodic corrosion inspection has two major obstacles: 1) the inspection would need to address restoration and protection of surfaces - which ultimately leads to doing a complete overhaul rather than merely an inspection and, 2) it's expensive, resistance by users...is significant."

Pilot Information

Certificate:	Private	**Age:**	41,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	None	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 2 Valid Medical--w/ waivers/lim	**Last FAA Medical Exam:**	October 28, 1998
Occupational Pilot:	UNK	**Last Flight Review or Equivalent:**	
Flight Time:	324 hours (Total, all aircraft), 195 hours (Total, this make and model), 167 hours (Pilot In Command, all aircraft), 3 hours (Last 90 days, all aircraft), 3 hours (Last 30 days, all aircraft), 2 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Mooney	**Registration:**	N3243F
Model/Series:	M20E M20E	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	670036
Landing Gear Type:	Retractable - Tricycle	**Seats:**	4
Date/Type of Last Inspection:	December 21, 1998 Annual	**Certified Max Gross Wt.:**	2575 lbs
Time Since Last Inspection:	18 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	1412 Hrs	**Engine Manufacturer:**	Lycoming
ELT:	Installed, activated, did not aid in locating accident	**Engine Model/Series:**	IO-360
Registered Owner:	MICHAEL A. ROBINSON	**Rated Power:**	200 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:	ELM ,955 ft msl	**Distance from Accident Site:**	28 Nautical Miles
Observation Time:	13:53 Local	**Direction from Accident Site:**	150°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	8 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	20°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30 inches Hg	**Temperature/Dew Point:**	21°C / 11°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	ELMIRA , NY (ELM)	**Type of Flight Plan Filed:**	None
Destination:	ROCHESTER , NY (ROC)	**Type of Clearance:**	None
Departure Time:	13:40 Local	**Type of Airspace:**	Class G

Airport Information

Airport:		**Runway Surface Type:**	
Airport Elevation:		**Runway Surface Condition:**	Vegetation
Runway Used:	0	**IFR Approach:**	None
Runway Length/Width:		**VFR Approach/Landing:**	Forced landing

Wreckage and Impact Information

Crew Injuries:	1 Serious	**Aircraft Damage:**	Destroyed
Passenger Injuries:	1 Serious	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	2 Serious	**Latitude, Longitude:**	42.519065,-77.290267(est)

Administrative Information

Investigator In Charge (IIC):	Cox, Paul
Additional Participating Persons:	SERGIO PEREZ; ROCHESTER, , NY DAVE MOORE; WILLIAMSPORT , PA TOM MCCREARY; PIQUA , OH
Original Publish Date:	August 13, 2001
Last Revision Date:	
Investigation Class:	Class
Note:	
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=47057