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National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: August 3, 1987
In reply refer to: A-87-103

Honorable T. Allan McArtor
Administrator
Federal Aviation Administration
Washington, D.C. 20591

The National Transportation Safety Board has completed the investigation of an accident that occurred in Conway, South Carolina, on November 9, 1986, involving a Cessna 152, N6537P. 1/ The investigation disclosed that while climbing at 2,500 feet the airplane vibrated violently and lost engine power. A forced landing was made in an open field, and during rollout the aircraft nosed over and came to rest inverted. The certificated flight instructor and student pilot on board were not injured. Examination of the wreckage revealed that one blade of the propeller, design number 1A103, serial number 773241, had separated and was missing. The propeller is a fixed pitch, solid propeller of the "gull wing" design with each blade extending somewhat forward from the hub. The propeller was manufactured by McCauley Accessories Division of Cessna Aircraft Company (McCauley) and had 3,425.1 total hours at the time of the accident.

The recovered portion of the propeller was examined at the Safety Board's Materials Laboratory. One blade of the propeller was separated about 3 inches from the centerline of the hub. An examination of the fracture surface on the blade revealed characteristics typical of fatigue cracking over more than one-half of the blade's cross section at the fracture location. The fatigue cracking initiated in the leading edge portion of the radius between the forward face of the propeller hub and the forward face of the broken blade. An examination of this area revealed that the radius was slightly undercut and contained chordwise sanding scratches. These scratches were much more readily visible after the paint was removed from the radius area. Examination of the fatigue origin area with a scanning electron microscope disclosed that fatigue initiation was from a small area along one of the sanding scratches. Similar chordwise sanding scratches were also found throughout the radius between the front face of the hub and the front face of the intact blade.

The Safety Board is aware of one additional McCauley design number 1A103 propeller that failed in a manner very similar to the propeller involved in the Conway accident. The other propeller, serial number 770439, was also installed on a Cessna 152 and had 1,930 hours of total time when it failed in 1980. The examination of this propeller was conducted by an independent laboratory and the report was reviewed by a Safety Board metallurgist. Fatigue cracking characteristics were found over much of this blade, and crack initiation was from the same radius as the propeller involved in the Conway accident. Chordwise sanding scratches were also found in this radius.

1/ NTSB Field Accident Report: ATL-87-LA-019. Accident Brief: File No 2171.
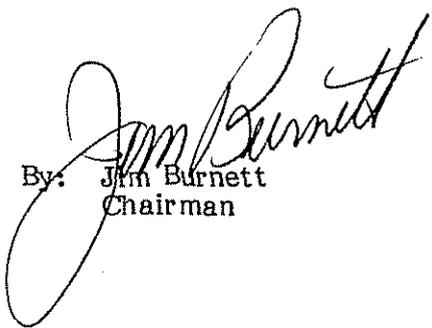
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The design number 1A103 propeller was first manufactured in 1977. A representative of McCauley indicated that the serial number 770439 propeller was made in 1977 and the serial number 773241 propeller was made in 1978. The representative also indicated that the radii between the front face of the hub and the front face of the blades on some of the design number 1A103 propellers produced during the early years of manufacture may have been sanded by hand after the area was machined. However, McCauley has no documentation on when the sanding may have occurred. In December 1984 the engineering drawing for the design number 1A103 propeller was revised by adding a surface finish requirement of 125 root mean square micro-inch. However, at the time that the two failed blades were manufactured, there was no surface finish requirement. The surface in the sanded areas on the propeller from the Conway accident visually appeared slightly rougher than the current requirement as a result of the presence of the sanding scratches.

The Safety Board is concerned that there may be additional McCauley design number 1A103 propellers with sanding scratches in the radii between the front face of the hub and the front face of the blades, that this condition may lead to fatigue crack initiation and to failure of the propeller, and that failure of the propeller can cause a serious accident.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

> Issue an Airworthiness Directive to require that all McCauley design number 1A103 propellers with a specified minimum number of hours be inspected for evidence of sanding scratches and cracks in the radii between the front face of the hub and the front face of the blades; this inspection should be conducted with the paint removed from the radii. In the event that sanding scratches or cracks are evident in the radii between the front face of the propeller hub and the front face of the propeller blades, specify appropriate criteria and procedures for repair or removal from service. (Class II, Priority Action) (A-87-103)

BURNETT, Chairman, GOLDMAN, Vice Chairman, and LAUBER, NALL, and KOLSTAD, Members, concurred in this recommendation.

By: Jim Burnett
Chairman

File No. - 2171   11/09/86   CONWAY,SC   A/C Reg. No. N4537P   Time (Lcl) - 1640 EST

----Basic Information----
Type Operating Certificate-NONE (GENERAL AVIATION)

		Injuries			
		Fatal	Serious	Minor	None
Aircraft Damage					
SUBSTANTIAL	Crew	0	0	0	2
Fire	Pass	0	0	0	0
NONE					

Type of Operation   -INSTRUCTIONAL
Flight Conducted Under   -14 CFR 91
Accident Occurred During -LANDING

----Aircraft Information----
Make/Model   - CESSNA 152   Eng Make/Model - LYCOMING O-235-L2C   ELT Installed/Activated - YES/YES
Landing Gear - TRICYCLE-FIXED   Number Engines - 1   Stall Warning System - YES
Max Gross Wt - 1670   Engine Type   - RECIPROCATING-CARBURETOR
No. of Seats - 2   Rated Power   - 108 HP

----Environment/Operations Information----
Weather Data
Wx Briefing   - NO RECORD OF BRIEFING   Itinerary
  Method   - N/A   Last Departure Point   Airport Proximity
  Completeness   - N/A   CONWAY,SC   OFF AIRPORT/STRIP
Basic Weather   - VMC   Destination   Airport Data
Wind Dir/Speed- UNK/NR   LOCAL   Runway Ident   - N/A
Visibility   - 10.0   SM   ATC/Airspace   Runway Lth/Wid - N/A
Lowest Sky/Clouds   - 4000 FT   Type of Flight Plan - NONE Runway Surface - N/A
Lowest Ceiling   - 4000 FT BROKEN   Type of Clearance   - NONE Runway Status - N/A
Obstructions to Vision- NONE   Type Arch/Lnds   - FORCED LANDING
Precipitation   - NONE
Condition of Light   - DAYLIGHT

----Personnel Information----
Pilot-In-Command   Age -   26   Medical Certificate - VALID MEDICAL-NO WAIVERS/LIMIT
Certificate(s)/Ratings(s)   **   Biennial Flight Review   Flight Time (Hours)
  COMMERCIAL,CFI   Current   - YES   Total   - 712   Last 24 Hrs -   4
  SE LAND,ME LAND   Months Since - 5   Make/Model- 239   Last 30 Days- UNK/NR
                                                     Aircraft Type - C-152   Instrument-   79   Last 90 Days- 310
                                                                              Multi-Eng -   22

  Instrument Rating(s)   - AIRPLANE

----Narrative----
ONE BLADE OF THE FIXED PITCH PROPELLER SEPARATED 3" FROM THE HUB DURING A ROUTINE INSTRUCTIONAL FLIGHT. THE IMBALANCE
RESULTED IN A BROKEN ENGINE MOUNT AND A TOTAL LOSS OF POWER WAS EXPERIENCED. A FORCED LANDING WAS MADE IN A SOFT FIELD
DURING WHICH, THE AIRCRAFT NOSED OVER. A METALLURGICAL EXAMINATION OF THE FAILED BLADE, DESIGN NUMBER 1A103, DISCLOSED
A FATIGUE CRACK THAT ORIGINATED FROM CHORDWISE SURFACE SCRATCHES UNDERNEATH THE PAINTED FINISH. THE PROPELLER TOTAL
TIME IN SERVICE SINCE NEW WAS 3425 HOURS AND IT HAD NOT BEEN REFINISHED DURING THAT TIME.

File No. - 2171   11/09/86   CONWAY,SC   A/C Reg. No. N6537P   Time (LCL) - 1640 EST

Occurrence #1   AIRFRAME/COMPONENT/SYSTEM FAILURE/MALFUNCTION
Phase of Operation   CLIMB

Finding(s)
  1. PROPELLER SYSTEM/ACCESSORIES,BLADE - FATIGUE
  2. PROPELLER SYSTEM/ACCESSORIES,BLADE - FAILURE,TOTAL

Occurrence #2   LOSS OF POWER(TOTAL) - MECH FAILURE/MALFUNCTION
Phase of Operation   DESCENT - EMERGENCY

Finding(s)
  3. MIXTURE CONTROL - LOSS,TOTAL

Occurrence #3   FORCED LANDING
Phase of Operation   DESCENT - EMERGENCY

Occurrence #4   NOSE OVER
Phase of Operation   LANDING - ROLL

Finding(s)
  4. TERRAIN CONDITION - SOFT

----Probable Cause----

The National Transportation Safety Board determines that the Probable Cause(s) of this accident
is/are finding(s) 1,2.