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NATIONAL TRANSPORTATION SAFETY BOARD  
WASHINGTON, D.C.

ISSUED: August 15, 1984

Forwarded to:

Honorable Donald D. Engen  
Administrator  
Federal Aviation Administration  
Washington, D. C. 20591

SAFETY RECOMMENDATION(S)

A-84-87 through -92

On January 29, 1983, a Mooney Model M-20A airplane, N8146E, crashed after the left wooden wing failed and separated during VFR flight in good weather conditions at Prattville, Alabama. All four persons aboard the airplane were killed. The Safety Board's investigation of the accident disclosed that the left wing main spar had deteriorated due to wood decay <sup>1/</sup> and that a previous structural repair of the spar had been improperly accomplished.

Between 1955 and 1960, Mooney Aircraft, Inc., manufactured models M-20 and M-20A airplanes with wooden wings and empennages. Since 1960, the M-20 series airplanes (M-20B, M-20C, M-20E, etc.) have been manufactured with metal wings and empennages. The transition to an all-metal airframe has increased the safety and reliability of these airplanes as evidenced by the difference in the fatal accident records between those airplanes constructed of wood and those constructed of metal. For example, between 1964 and 1983, the wooden M-20 series airplanes, with relatively little accumulated flight time as a whole, were involved in 12 fatal airframe failure in-flight accidents; however, during the same period, the all-metal M-20 series airplanes, with much more accumulated flight time, were involved in only 4 fatal accidents of this type. The difference in the accident records is largely due to the fact that the wooden M-20 series airplanes are often subject to significant deterioration due to wood decay and/or separation of wood glue joints.

According to Mooney maintenance experts, annual or 100-hour inspections of the wooden M-20 and M-20A airplanes should be conducted only by mechanics and airworthiness inspectors who have experience in the inspection and maintenance of these and/or other wooden airplanes. More importantly, accidents involving these airplanes are replete with related instances of undetected deterioration of the wooden wing and tail which evidence the need for such specialized skills. Such deterioration would have been detected if the the airplanes had been inspected properly by maintenance personnel with the appropriate skills. As a result, the Safety Board believes that the Federal Aviation Administration (FAA) should conduct a Directed Safety Investigation (DSI) of M-20 and M-20A airplanes to ascertain their structural status. If the DSI discloses

<sup>1/</sup> On January 6, 1984, the Safety Board issued Safety Recommendations A-84-1 through -3 because of a similar accident involving a Bellanca Model 17-31 ATC Turbo Super Viking.

significant structural deterioration, the FAA should issue an Emergency Airworthiness Directive requiring an immediate inspection of all M-20 and M-20A airplanes and/or replacement of the wood empennage with an all-metal empennage as provided for in Mooney Service Bulletin M-20-170A. These inspections should be conducted at a Mooney Service Center or at other approved facilities with the requisite skills in wooden airplane maintenance, as designated by the FAA. Additionally, the Safety Board believes that the airplanes should be periodically reinspected at these wooden airplane service centers to assure their continued airworthiness.

Substantial deterioration of wooden components on M-20 and M-20A airplanes often occurs after they have been parked outside for an extended time with loose, cracked, or broken fabric, cracked plywood skins, or defective seals. The latter conditions allow moisture to enter the interior of the airplane resulting not only in wood decay but also in the separation of the wood glue joints under freezing conditions. The likelihood of loose fabric, cracked plywood skins, and other defects which precipitate wood decay and/or glue joint separation increases with the age of the airplane. Consequently, it is imperative to further protect these airplanes from the environment either by hangaring them or through the use of protective covers when they are parked outdoors.

Standard category or amateur-built airplanes with wooden wings, wooden empennage, or other wooden components will continue to be licensed and flown for many years. Moreover, the potential for increased deterioration of older wooden airplanes, the manufacture of new wooden airplanes, such as the Bellanca Model 17-31, and an expanding interest in amateur-built airplanes, make it essential for pilots and maintenance personnel to understand the nature and characteristics of airplanes constructed of wood and related environmental problems. Therefore, the Safety Board believes that the FAA should continue to publish Malfunction and Defect Reports regarding deterioration of wooden airplanes in Advisory Circular No. 43-16, General Aviation Airworthiness Alerts. In Safety Recommendation A-84-3, the Safety Board recommended that inspection methods, techniques, and information to assist in detecting deterioration of wooden components in aircraft be included in this publication. However, as a result of the accident involving N8146E, it has become increasingly apparent that the FAA also should publish a new Advisory Circular addressing the maintenance, inspection, and repair of wooden airplanes exclusively.

Because the condition of certain major portions of wooden airplanes cannot be directly assessed by visual examination, nondestructive sonics testing techniques, such as tapping with a plastic mallet or other blunt object, are often employed in attempting to locate wood decay through a change or variation in the sound emitted. The results of the test depend largely upon the individual's technique, experience, and knowledge of the aircraft being inspected. A similar technique involves the application of a constant vibratory source of sound as the structure is surveyed with a stethoscope. The use of sonics is often supplemented by direct probing for wood decay with a sharp awl. Resistance-type moisture meters, although seldom used, can measure existing structural moisture levels and, therefore, the potential for decay; moisture probes implanted at the time of manufacture or major inspection/repair could provide for a continuous recording of moisture levels. The full potential of these and other more sophisticated nondestructive testing techniques involving radiography, ultrasonics, microwave, and acoustic emission is unknown. As a result, the Safety Board believes that the FAA's Technical Center should conduct a research and development program to determine the feasibility and effectiveness of nondestructive testing in applications involving the inspection of wooden airplanes.

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

Conduct a Directed Safety Investigation (DSI) of Mooney Model M-20 and M-20A airplanes to ascertain the degree of undetected structural deterioration of these airplanes. If the results indicate a significant level of deterioration, an Emergency Airworthiness Directive should be issued requiring an immediate inspection of all M-20 and M-20A airplanes and/or replacement of the wood empennage with an all-metal empennage as provided for in Mooney Service Bulletin M-20-170A. The inspections should be performed at a Mooney Service Center or at other approved facilities skilled in the maintenance of wooden airplanes. (Class II, Priority Action) (A-84-87)

Issue an Airworthiness Directive requiring that the next 100-hour or annual inspection of Mooney Model M-20 and M-20A airplanes be performed at a Mooney Service Center or at other designated facilities skilled in the maintenance of wooden airplanes. Similar inspections conducted at these designated facilities should be required at appropriate, periodic intervals, e.g., once every 3 years. (Class II, Priority Action) (A-84-88)

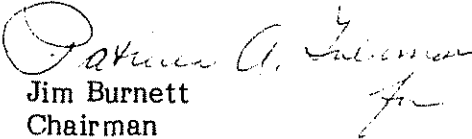
Issue an Airworthiness Directive requiring that owners/operators of Mooney M-20 and M-20A airplanes shelter the airplanes from the environment when parked, either by hangaring or through the use of wing and empennage covers. (Class II, Priority Action) (A-84-89)

Issue an Advisory Circular relating to the maintenance, inspection, and repair of wooden airplanes exclusively. (Class II, Priority Action) (A-84-90)

Continue to publish Malfunction and Defect Reports regarding the deterioration of wooden airplanes in Advisory Circular No. 43-16, General Aviation Airworthiness Alerts. (Class II, Priority Action) (A-84-91)

Conduct a research and development program at the Federal Aviation Administrations' Technical Center to determine the potential of various nondestructive testing techniques in applications involving the inspection of wooden airplanes. (Class II, Priority Action) (A-84-92)

BURNETT, Chairman, GOLDMAN, Vice Chairman, BURSLEY and GROSE, Members, concurred in these recommendations

By:   
Jim Burnett  
Chairman