Dry Rot: It Can Kill You

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A Mooney's wooden wings are excellent structures, but are susceptible to rot if allowed to be damp for long periods.

(The spring months are a good time for the homebuilder to make a thorough aircraft inspection, particularly if it contains components made of wood. No matter how much care went into the construction, operation and storage of such craft, the likelihood of dry rot occurring is an ever present problem.

(Many fine homebuilts today employ considerable woodwork, the Fly Baby, VP-1 and VP-2 among them. Restorers of antique and classic craft, such as the UC78 Bobcat, Culver Cadet, Fairchild PT-19, Johnson Rocket and wooden-winged BT-13s are familiar with requirements for careful inspection.

(There are two sides to the coin, however: Wood is easy to work with, inexpensive, strong and lightweight, but it also is subject to deterioration when exposed to moisture. In World War I, the Aeronautical Engineering Division of the Army Signal Corps enlisted the services of the Forest Products Laboratory at Madison, Wis., to develop standards for kiln-dried woods.

(Today wood standards for aircraft use are virtually the same, with Sitka spruce at the top of the fist for all uses. Quarter-sawn and carefully selected, Sitka spruce has a tensile strength of 6000psi, weighs only 45 lbs/sq. ft., and has a strength-to-weight ratio of 153 higher than steel.

(But dry rot can spoil your whole day. so take time now and thorough~ inspect your wooden wonder for spring flying. The following FAA report on dry rot dramatically explains why! — Ed.)

WHEN YOU MENTION wood constructed aircraft many people immediately think of the pioneer days of aviation and antiques like the old Curtiss "Jenny," but actually there are still hundreds of antique and contemporary wooden aircraft being flown today. Contemporary designs utilizing wooden structural parts are built by several manufacturers and an increasing number of homebuilt aircraft employ wood to some degree.

Those who fly aircraft with wood components are convinced of its ad vantages over the use of metal in construction. Amateur workers say it is easier and more economical to work with and repair than metal. They note that wood is more pliable and can be more easily molded They also point out that wood never fatigues, whereas metal can suffer fatigue and fatigue cracks.

However, despite these advantages, there is one unique problem which weakens the case for wood — wood can rot. If this happens and it goes undetected, then during flight, particularly in turbulence, some critical structure of the airplane may snap. If that happens you may receive an impromptu lesson in the art of landing an aircraft with portions of the wing or tail missing.

Such was the case of a Mooney "Mark 20A,' vintage 1957, recently purchased in western Massachusetts and later given a new paint job at a shop nearby. The new owner and his son arranged to fly the aircraft back to their home field at Westfield, Mass, as soon as the paint was dry. The Mark 20A is of plywood construction covered with fabric with wooden spars and structures in the wing and empennage.

The new owner was also a new pilot, with only 60 hours of flying time, but he was a mechanic by trade and when he found his airplane sitting in a leaky, rain-soaked hangar he knew he had cause for concern. But after cleaning and drying the aircraft and inspecting it as well as he could, he found no sign of trouble. So he and his son concluded the preflight check and took off at 2:35 p.m. for the short, 20-mile flight home to Westfield. He did not file a flight plan or obtain a weather report.

(A "weatherscope" on the airport he departed from was indicating wind gusts from 30 to 50 mph between 2:00 and 3:00 p.m. that afternoon, according to the airport management. The position of several aircraft tied down on the field had to be changed during this period as a precaution against possible wind damage.)

After takeoff the pilot climbed to 3500 feet, hoping to find smoother air than the turbulence he had encountered near the surface. Within a few minutes he sighted Barnes Municipal Field at Westfield and he called the tower for landing instructions He was cleared to land on RWY 20, and was preparing to start his descent when he and his son heard a loud "bang!" behind them, as if something had struck the tail.

At the same time the pilot discovered he had no tension on the right rudder pedal and no elevator control. He immediately called the tower and told them his predicament. The tower responded, telling him to try to keep the aircraft level; he was not yet close enough for a visual inspection. He was then over Northampton, five miles from the airport, but he was lined up with RWY 20 and he thought for a few moments he might be able to make the field.

But then the Mooney suddenly swung abruptly to the left and started down in a spiraling dive. The pilot lost control of the airplane and he shouted into the microphone that they were going down.

He pulled the throttle back and continued to work at the controls as the airplane continued down. Finally, at about 200 feet the plane came out of the dive, and the pilot was able to get it into a wide spiral.

The UC-78 Cessna "Bamboo Bomber" has wooden wings and a center section that must be inspected regularly for dry rot.

He saw a wooded area ahead and headed for it, hoping that the trees could absorb some of the force of the inevitable crash. When they got down to about five feet he cut the power and turned off the switches. The airplane struck the trees in a left wing-and-nose down attitude, flipped over, and came to rest in an inverted position. The Mooney was nearly demolished, but did not burn. The pilot received only minor injuries, while his son suffered a broken leg.

They felt extremely fortunate to be alive, after practically falling out of the sky from 3500 feet. The FAA maintenance inspector from the Westfield CADO, on examining the wreckage, discovered that the rudder and the vertical stabilizer were missing. The vertical stabilizer was found that same day on a sidewalk about a mile from the accident site. An appeal was made in the local newspaper for the missing rudder, and a few days later a man who was walking his dog in a field about a mile and a half from the accident site found it.

Both the rudder and the stabilizer were sent to the Department of Transportation's laboratory in Oklahoma City for examination, and the final report was quite revealing. The wooden vertical stabilizer spar showed signs of previous partial deterioration, as indicated by the discoloration of the wood. The discolored area on the right side of the spar was about one-half inch deep at both the forward edge and the trailing edge, and somewhat more extensive on the left side.

This evidence of wood decay prior to the accident, plus the occurrence of strong, gusty winds on the day of the flight, present an almost classic case of what can happen to a wood constructed aircraft that is not properly maintained.

Homebuilts such as the Bowers Fly Baby are easy to build, but be careful that wooden parts are protected from moisture.

The Mooney's records showed that it had undergone its annual inspection the previous August, some five months before the crash. But since that time it had been parked outside, and it had only been flown for a total of 16 hours. In addition, the pilot stated that he had flown it to the paint shop on December 13th, leaving it there for six weeks. Apparently it was stored in an old World War II hangar with gaping holes in the roof, where he had found it dripping wet, but with no visible indication of damage. However, dampness is the implacable enemy of wood, and it wreaks havoc frequently under sleek and shining surfaces.

An examination of the aircraft's logs and a comparison with a list of applicable Airworthiness Directives for the Mooney M-20A revealed another surprising fact: The record of the annual inspection five months earlier contained no mention of compliance with a 1969 Airworthiness Directive about inspecting for wood and glue deterioration in the wooden wing and empennage structures.

That 1969 AD made compliance with an M-20A Mooney Service Bulletin mandatory at each annual inspection. The Bulletin warned about "an alarming number of wood repair malpractices, inadequate inspections, and unauthorized maintenance by apparently novice repairmen The Bulletin required the removal of all the fabric from the horizontal and vertical stabilizers and a careful examination of the wood skin and glue joints for possible deterioration.

Asked by the CADO inspector about his failure to record compliance with the AD at the time of the annual, the mechanic responded that, unfortunately, he had been unaware of the AD. He stated that he had made a careful inspection of the Mooney, and there were no signs of deterioration he could spot. The decay under the skin had gone unnoticed. FAA’s regional office issued a violation for his failure to comply with the AD. Of course, in flying an aircraft not in compliance with the AD (still in effect today) the owner/operator, who was also the pilot, was also subject to being cited.

Wood decay, or rot, is caused by a fungus, a form of plant life which feeds on and destroys the cellulose content and structure of the wood fibers. The seed of a fungus plant is a microscopic, airborne spore, present in almost all common environments. These spores will endure in a dormant stage for years, and spring into growth when the wood becomes damp.

A germinating spore sends out minute hair like strands, much like veins, which seek out the cellulose of the wood and absorb it. These filaments break down the cell walls of the wood with a resultant loss of strength. As the fungus develops, the wood darkens because the microscopic hairs then become so numerous as to form visible masses, In an advanced stage, this fungus can even produce bore holes, caused by highly localized areas of fungus which penetrate the walls of adjoining wood cells.

Incidentally, the term "dry rot" which is often used is actually a misnomer. There is no such thing as dry rot. There must be moisture for rot to develop in wood. The term "dry

rot" seems to have originated far back in nautical history when sailors discovered powder in pieces of wood which were then dry because the whole rotting process had been completed; so they called it "dry" rot.

In the earlier days of aviation, mechanics inspected the structural wood by poking a narrow pick of some kind through the fabric and testing for the firmness of the wood beneath. This does not appear to be completely satisfactory today, however, and modern aircraft maintenance manuals usually require some type of closer inspection.

The Mooney Service Bulletin and AD mentioned above, for instance, require a removal of the fabric over critical structural areas for inspection of the wood, as well as cutting additional holes in the wood skin for structure inspection. And the Bulletin also notes that "discoloration penetrating into the wood grain is considered evidence of wood deterioration."

The Bulletin instructs the mechanic to sand all discolored areas to determine the depth of the penetration. He is also instructed to inspect all the glued joints which are also susceptible to deterioration, by gently flexing the parts or by tapping the joints with a small plastic mallet to listen to variations in the sounds. Some mechanics believe that visual inspection of the wooden parts is the only safe means of checking for decay or deterioration.

In the case of very minor surface deteriorations of the wood, the discolored parts can be sanded out. But any discoloration that goes into the wood for more than a fraction of an inch should be viewed with suspicion. A wood component which shows signs of serious deterioration should be replaced immediately by a competent airframe mechanic who knows how to work with wood. FAA's Advisory Circular, "Aircraft Inspection and Repair," devotes its first chapter to aircraft wood structures and gives helpful advice for the mechanic who works on wood aircraft. (AC 43-13-1A is available for S3.70 from the Government Printing Office, Washington, D.C. 20402.)

In all but the driest of climates it is impossible to protect wood structures in aircraft from being attacked by fungus to some degree. But there are a number of preventive actions which can be taken to inhibit the decay process

1. Store wooden aircraft in a hangar if possible, preferably a heated hangar, especially in winter. Admittedly this is becoming increasingly difficult today, as hangar space becomes more precious and many owners of wooden airplanes are being forced to settle for an outdoor tie-down area.

2. There are a number of good wood preservatives available today, such as copper napthenate and pentachlorophenol. Properly impregnated into the wood, these will prevent or retard deterioration. Incidentally, regular paint and varnish do not necessarily ward off wood rot. When you paint or varnish you can actually seal many spores to the surface of the wood, and moisture Is capable of penetrating the painted surface under humid conditions.

3. Most wood-constructed airplanes have some drain holes at the bottom of each wood component, so that any water which has accumulated there can drain out. It is imperative that drains be kept open and unclogged so that they can perform their invaluable function of allowing water to flow out, Make certain you know the location of all the drain ports on your aircraft, and inspect them at every preflight check.

Problems arising from structural decay in wooden aircraft appear to be on the rise. For the five year period 1971 to 1976 there were 26 cases of structural failure due to wood rot, glue separation, or cracks reported to FAA's Service Difficulties Program on one model of wooden aircraft alone! This may represent only a portion of the total number of such problems which have cropped up. Failures of this kind can be a very serious potential hazard regardless of the number of cases reported, because of the fact that they usually occur in flight, without warning, and result in loss of control of the aircraft.

Recently an FAA maintenance inspector in Lancaster, Calif., was checking the flap bay area of a Mooney Mark-20 by flexing the flap hinge brackets, when the bracket dropped off virtually into his hands. An inspection revealed well-developed wood rot which apparently had begun after moisture seeped in through several screw holes at the trailing edge of the wing. Careful inspection of components during the preflight check is a good precaution against in flight separation. The owner of this aircraft was lucky — a takeoff run over rough ground might easily have resulted in a disastrous structural failure in the air, Note that Lancaster is located at the edge of the Mojave Desert, not exactly an environment where you would expect problems with rot.

Less fortunate were the two occupants of another aircraft with wood components, flying out of Sussex, N.), The aircraft was a Bellanca 17-30, the pilot a 37-year-old contractor with a commercial certificate and some 600 hours of flight time. He and his passenger set out on a Sunday morning local pleasure flight and were flying level at about 3000 feet when they heard a sharp cracking sound and to their horror saw the entire right wing break off. The aircraft nosed over immediately and fell off into a tight spiral dive, out of control and culminating in a violent crash. Both occupants were killed on impact.

Once again, turbulence apparently played a role in triggering the wing failure. Another pilot flying a light plane in the area at about the same time reported experiencing light to moderate turbulence, which may have placed more of a load on the wing than it was capable of carrying in its current condition.

However, the report of the National Transportation Safety Board investigators established "inadequate inspection of the aircraft" as the probable cause of the accident.

Fairchild PT-19 primary trainers must be carefully inspected for dry rot in the center section areas that can trap water.

Structural examination of this airplane's all-wood wing disclosed significant decay of the right front spar. It was obvious from the rusty fasteners, drying checks, and surface stains that water had leaked inside the wing. Sections of the failed right wing were sent to the United States Forest Products Laboratory at Madison, Wis., for further examination, The laboratory's technical staff substantiated the fact that the front spar was moderately to heavily decayed as a result of fungus infection, they believed, after considering the conditions associated with the accident airplane, that this decay would have required two years or longer to develop . . ."

The deterioration, according to the Forest Products Laboratory, would have required standing water in the wing spar area. The Board concluded that . . . "Since the design of the wing would normally prevent entrapment of water, even under adverse environmental storage conditions, water probably leaked into the wing's interior as a result of a maintenance-related mechanical impairment — e.g., cracked paint, fabric or plywood wing covers." Cracked fabric, the Board noted, is particularly suspect, since such fabric cracks are often caused by cracks or other faults in the wing cover itself. Water may also leak into the wing through deteriorated or improperly installed seats around the neck of the fuel filler pipe, which is recessed enough to hold considerable standing water.

Wooden aircraft, no doubt, have their special virtues and deserve the loyal and persistent following they enjoy among purchasers of type certified planes as well as amateur builders. They can be flown safely as long as they are maintained safely. Maintenance of wooden aircraft requires some special precautions, including the following:

• Keep the aircraft as clean and dry as possible (dirt and moisture promote fungus growth).

• Keep an effective waterproof coat of paint on the skin and do not allow breaks or cracks to go un-remedied. If you buy a wooden aircraft with cracked paint, have the fabric or panels removed for a thorough inspection of the spars before flying it or repainting.

• A similar inspection is in order for any wooden aircraft that has been standing outside over the winter, or kept in a damp, unheated hangar. Given enough time, moisture will penetrate virtually any surface. Interior inspection costs more than eyeballing the surface, but it lets you fly with a sense of assurance and peace.

It is not the heat, or cold, but the humidity that can cripple your little wooden bird.

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