SECTION 3. INSPECTION

1-27. GENERAL. Inspection of wooden structure includes some methods, equipment, and awareness of failure modes which are unique to wooden aircraft.

1-28. TYPES OF DETERIORATION AND DAMAGE.

a. Wood Decay. Wood is an organic product which is subject to attack by fungi. Fungi are plants that grow on and in wood. The moisture content of the wood nominally will have to be 20 percent or greater to sustain fungus growth. The result of this growth is called decay. Decayed wood exhibits softness, swelling if still wet, excessive shrinkage when dry, cracking, and discoloration. Repair or replace wood if any amount or form of decay is found.

b. Splitting. Splits or cracks in wooden members occur along grain lines. When the moisture content of wood is lowered, its dimensions decrease. The dimensional change is greatest in a tangential direction (across the fibers and parallel to the growth rings), somewhat less in a radial direction (across the fibers and perpendicular to the growth rings), and is negligible in a longitudinal direction (parallel to the fibers). These dimensional changes can have detrimental effects upon a wood structure, particularly when two parts are bonded together with grains in different directions. This effect can often be seen where a plywood doubler is bonded to a spruce member. As the spruce member dries, it attempts to shrink, but is restrained by the plywood, which shrinks less. The resulting stress in the spruce member exceeds its cross-grain strength, and a split occurs.

c. Bond Failure. Bond joint failure is generally due to improper fabrication technique or prolonged exposure to moisture in service. Although none of the older adhesives have been specifically found to fail by simple aging, the mechanic is advised to inspect all accessible joints carefully.

d. Finish Failure. The finish coat on wood structure (usually varnish) is the last line of defense to prevent water entry into wood and the resulting decay. Finish failure can be the result of prolonged water exposure, wood splitting, ultraviolet light exposure, or surface abrasion.

e. Damage. Stress, impact, or mechanical damage to a wood structure is caused by excessive aerodynamic loads or impact loads occurring while the aircraft is on the ground. Overtightening of fittings can also cause crushing of the underlying wood member and possible bending of the metal fitting.

1-29. INSPECTION METHODS. Whenever possible, the aircraft should be kept in a dry, well-ventilated hangar, with all inspection covers, access panels, etc., removed for as long as possible before final inspection. The aircraft should be given a preliminary inspection when first removing the inspection covers and access panels and inspected with a moisture meter at this time. If the moisture content is high, the aircraft should be thoroughly dried. If the aircraft is dry, this will facilitate later inspection, especially when determining the condition of bonded joints.

a. Likely locations for wood structure deterioration should be given special attention. Most damage is caused by external influence such as moisture, temperature extremes, or sunlight. Care should be taken to note all possible entry points for moisture, (i.e., cracks or breaks in the finish, fastener holes, inspection/access openings, control system openings, drain holes, and the interfaces of metal fittings and the wood structure). The mechanic should also look for evidence of swelling or warpage of the aircraft's wood structure, which would indicate underlying damage or decay. Particular attention should be paid to the wood structure immediately beneath the upper surfaces, especially under areas that are finished in dark colors, for signs of deteriorating adhesives. Cracks in wood spars are often hidden under metal fittings or metal rib flanges and leading edge skins. Any time a reinforcement plate exists that is not feathered out on its ends, a stress riser exists at the ends of the plate. A failure of the primary structure can be expected to occur at this point.

b. Tapping the wood structure with a light plastic hammer or screwdriver handle should produce a sharp solid report. If the suspect area sounds hollow and soft, further inspection is warranted by the following methods.

c. Probe the area in question, if accessible, with a sharp metal tool. The wood structure should be solid and firm. If the suspect area feels soft and mushy the mechanic should assume that the area is rotted. Disassembly of the structure is warranted at this point.

d. Prying the area of a bond joint will reveal any mechanical separation of the joint. If the mechanic detects any relative movement between two adjacent wood members, a failure of the bond is evident. Any loose fittings should arouse the mechanic's suspicion, and the fittings should be removed to check for elongated bolt holes. Disassembly is warranted for further inspection.

e. Odor is an important indicator of possible deterioration. During the initial inspection, as the access panels are being removed from the structure, the mechanic should be aware of any areas that smell musty or moldy. These odors are indicative of the presence of moisture and associated fungal growth and decay.

f. Visual inspection requires looking at the wood structure both externally and internally for visual signs of decay or physical damage. Any accumulations of dirt, bird nests, or rodent nests are likely places to hold moisture and promote decay.

(1) The mechanic should remove any such accumulations that are found and inspect the area for signs of decay. Decay will appear as a dark discoloration or gray stains running along the grain and often a swelling of the wood member if still wet. Fittings will be imbedded in the wood instead of flush.

(2) Highly suspected structurally damaged areas are shown in figure 1-3. A list of most likely areas to incur structural damage include the following:

(a) Check front and rear spars for compression cracks adjacent to the plywood reinforcing plates, where the lift struts attach, and at the rib attach points on either side of the strut attach points. Triple-check these areas and the spar to fuselage attach points for cracks if the wingtip has contacted the ground, a hangar wall, etc.

(b) Check all metal fittings which attach to wooden structure for looseness, corrosion, cracks, or warps. Areas of particular interest are strut attach fittings, spar butt fittings, aileron and flap hinges, jury strut fittings, compression struts, pulley brackets, and any landing gear fittings.

(c) Check front and rear spars for longitudinal cracks at the ends of the plywood reinforcement plates where the lift struts attach. Triple-check this area if the wing has encountered any kind of ground strike.

(d) Check ribs on either side of strut attach points for missing or loose rib-to-spar attach nails.

(e) Check ribs on either side of strut attach points for cracks where the cap strips pass over and under the spars.

(f) Check for cracked leading edge skin and/or failed nose ribs in the area directly in front of the jury strut.

(g) Check the brackets which attach the struts to the spars for cracks.

(h) Check the aileron, flap hinge, and hinge brackets for cracks and loose or missing rivets.

(i) Check all exposed end grain wood, particularly the spar butts, for cracking or checking. Checking, or splitting, of wood spar butts is common on aircraft based in arid areas.

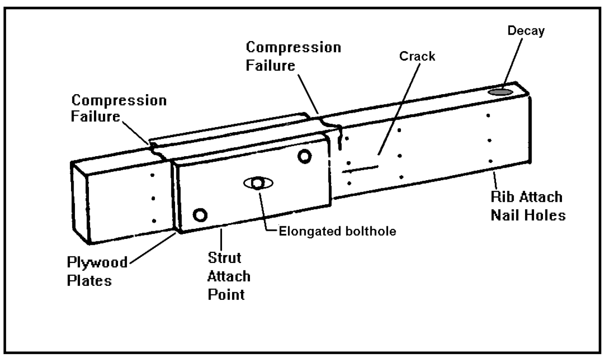

FIGURE 1-3. Likely areas to incur structural damage.

(j) Also check for any cracks that indicate a bond line failure or structural failure of the wood member. Any evidence of movement of fittings, bushings, or fasteners should be cause for concern, and further inspection is warranted. Splits in fabric covering the plywood, especially on upper surfaces exposed to ultraviolet light and water, dictate that the mechanic remove the fabric around the split so the underlying plywood may be inspected for physical damage or decay. When removing metal fasteners from wood, check for evidence of corrosion. Any corrosion present indicates the presence of moisture and the strong probability of decay in the adjoining wood structure.

(k) Any wooden member that has been overstressed is subject to compression failure (e.g., ground loop). Compression cracking and failure of the wood spars in certain aircraft are a continuing problem. Compression failures are defined as failure of wood fibers on a plane perpendicular to the wood fiber's longitudinal axis. If undetected, compression failures may result in structural failure of the wing during flight. Compression cracks have been found emanating from the upper surfaces of the wing spars and progressing downward.

(l) The usual locations for cracks have been the front spar at both ends of the reinforcement plate for the lift strut and the front spar rib attach points, both inboard and outboard of the spar reinforcement plate; and the rear spar lift strut and rib attach points. An inspection of both the front and rear spars for compression cracks is recommended.

(m) The two areas where it is possible to identify a compression crack are on the face and top surface of the spar. Using a borescope through existing inspection holes is one method of inspection. An alternate method is to cut inspection holes in the skin. If inspection holes are cut, they should be made on the aft side of the front spar and the forward side of the rear spar. This will allow the fabric to be peeled away from the spar. Longitudinal cracks may also be detected during this inspection. Loose or missing rib nails may indicate further damage and should be thoroughly investigated. The mechanic may shine a light, at a low angle and parallel with the grain, in the area of the member subjected to the compression load. An area of grain waviness would indicate a potential compression failure. In all cases the manufacturer's inspection data should be followed.

g. Moisture Meters are effective tools for detection of excessive moisture content in wood members. An instrument such as this allows the mechanic to insert a probe into the wood member and read its moisture content directly off the meter. A correction chart usually accompanies the instrument to correct for temperature and species of wood. Any reading over 20 percent indicates the probability of fungus growth in the member. Moisture content of the wood should be 8-16 percent, preferably in the 10-12 percent range (this range is during inspection). Where plywood skin covers the spar and the spar would be inaccessible without removing the skin, the moisture meter probe can be inserted through the plywood skin and into the spar to check the moisture content of the spar. The small holes made by the probe are easily sealed.

h. Destructive testing of sample bonded joints whenever a new bond joint is made, a sample joint should be made with the adhesive from the same batch used on the repair and scraps of wood left over from the repair. After curing, the sample joint should be destructively tested to ensure proper bonding of the two wood pieces. Any failure in the bond line indicates a cohesive failure of the adhesive. Any failure along the bond line indicates an adhesive failure, which is indicative of poor bonding. The ideal situation is when wood fibers are observed on both sides of the fracture surface. This indicates a failure in the wood, and indicates the bond joint is actually stronger than the wood.

1-30.—1-35. [RESERVED.]