

REPAIR INSTRUCTIONS

1. CLEANING: Before a damaged propeller can be properly examined to determine whether it is repairable, it should be cleaned and the paint removed. Cleaning may be accomplished with soap and water, or with a suitable mineral solvent and a soft bristle brush. The paint must be soaked free with a suitable commercial paint remover and removed with a soft bristle brush or a rag. It should not be scraped off with a steel tool nor brushed off with a wire brush.

2. PRE-REPAIR INSPECTION: The purpose of a pre-repair inspection is to avoid investment of labor, only to later discover unrepairable damage had been sustained by the propeller.

When a blade is bent, the bend must be measured by the method shown in Figure 1 of this manual, and compared to the appropriate graph of maximum allowable bend vs. blade radius. **Beware of repairing bends which, by the shape of the bend, indicate that the blade may have been pre-straightened to bring it within allowable limits. See A.C. 20-7J (August, 1972).**

The depth of a cut or gouge should be measured to determine whether repair is possible within the limits of the appropriate minimum blade dimensions.

A pre-repair examination must include a visual inspection with a magnifying glass of at least three-power for the presence of fatigue cracks. An indispensable aid to visual inspection is either an etching or dye-penetrant process.

3. STRAIGHTENING A BENT BLADE: If the bend is within allowable limits, this should be the first repair operation. Using a suitable bending tool or repair bench, the blade should be straightened in small increments proceeding from the portion of the bend nearest the hub, where the blade is thicker, outward along the blade until the fairing and appearance of the blade are reasonably good. At this point, the results can be judged by sighting along the blade. Blade contours should flow smoothly from the tip inward, without apparent waves or curvature reversal. The propeller should then be placed on a propeller checking stand, and its face alignment checked by comparing corresponding stations of the repaired blade with those of the undamaged blade.

It is not feasible, in this manual, to include complete face alignment data for each propeller. However, if both blades of a propeller have been bent, and if an undamaged propeller of the same model and pitch is not available for comparison, the correct elevation of the blade tip from the rear hub face is given with the repair specifications

for each propeller model.

4. BLADE ANGLES CORRECTION: After the blades have been brought into face alignment, blade angles should be checked. Blade Angle Templates (available from the Sensenich factory) should be used as shown by Figure 4 as indicated by the appropriate repair specifications, which list the proper blade angles and tolerance for each specified pitch. The blades should be twisted to agree with these specifications. Note that bending a blade into face alignment and twisting to obtain the proper blade angles are not independent operations. After blade angles have been corrected, face alignment must be checked, and vice-versa until both are within tolerance.

5. EDGE ALIGNMENT: Inspection of edge alignment should not be attempted before face alignment and blade angles are correct. Edge alignment can then be measured on a propeller checking stand by setting height gauges to touch the leading edge of each blade at corresponding stations, then removing the propeller from the stand and rotating it 180 degrees before replacing it on the stand. It is never permissible to straighten a blade which has been bent out of edge alignment. If it is not possible to achieve proper 180 degree index of the blades by removal of metal from the leading edge of one blade and from the trailing edge of the opposite blade within allowable blade dimensions, the propeller must be removed from service.

6. REPAIR OF BLADE DAMAGE: Approved techniques for repair of damage to metal propeller blades are shown by Figures 2 and 3 of this manual.

Nicks or cuts into the leading or trailing edge of a blade may be individually repaired as shown by Figure 2, Illustration B. The repair should be accomplished by rounding out and fairing with a file to slightly deeper than the apparent depth of the damage, to ensure that the bottom of the injury is removed, and polishing with a fine abrasive cloth. The chordwise depth of the finished repair must not be greater than 3/16 inch (0.48 cm.) and the final chord must equal or exceed the minimum specified by this manual. The radius of curvature in the area of the repair must be 3/8 inch (0.95 cm.) minimum. The faired length of the repair should not exceed 1½ inches (3.8 cm.). More than one of these repairs is permissible only if the repair areas do not overlap.

Dents or gouges in blade faces may be individually repaired as shown by Figure 2, Illustration A. This repair should be accomplished by rounding out and fairing with suitable abrasive paper or cloth to

a depth sufficient to ensure complete removal of the damaged metal and polishing with a fine abrasive cloth. The finished repair must not exceed 1/16 inch (0.16 cm.) in depth and curvature of the surface in the area of the repair must be 3/8 inch (0.95 cm.) radius minimum. The finished repair should not exceed 3/8 inch (0.95 cm.) chordwise by 1 inch (2.54 cm.) long. More than one of these repairs per blade is permissible only if the repair areas do not overlap a common blade radius.

Longitudinal cuts, as shown by Illustration C of Figure 2, may be repaired in the same manner as repair of a dent or gouge in a blade face.

A transverse (chordwise) crack in a blade face, or at the leading or trailing edge cannot be repaired. The presence of a crack indicates that blade failure is imminent. The propeller must be immediately removed from service.

WARNING: Repair of nicks, cuts, or cracks by peening over the adjacent edges is not permissible. This procedure will induce a tensile pre-stress at the bottom of the damage and will almost certainly initiate the development of a fatigue crack. Such a crack will usually progress rapidly and lead to an early fatigue failure.

The use of weld material to fill damaged areas is never permissible. This will result in substitution of low-strength cast material for the original high-strength forged aluminum.

- 7. PROPELLER RECONDITIONING:** It is recommended that the blades of a metal propeller should be reconditioned periodically. Flight-time intervals between reconditioning are recommended in note 5 of the repair specifications. More frequent reconditioning is advisable when minor repairs, and accumulated scratches and nicks, are numerous.

The reconditioning operation includes removal of the anodize coating from the entire surface of the propeller by 20% caustic soda etch, followed by 20% nitric acid rinse and inspection for cracks, and repair of all damage to the blade surface.

Metal removal during blade reconditioning should be at least 0.004 inch (0.01 cm.) per surface over the entire blade. In any case, whether chemical or mechanical, all traces of damage must be removed. Total removal of damage can only be assured by etching or dye-penetrant inspection.

When a propeller has been reworked to minimum chord, thickness, and diameter but does not clean up in the last inch of leading edge adjacent to the tip, it is permissible to round the tip as shown by Figure 3.

8. POST REPAIR INSPECTION: Repaired blades must be visually inspected, using a magnifying glass of at least three-power, to ensure that the bottom of the notch has been removed. If an incipient crack is suspected at the root of the notch, a local etch or dye-penetrant method of inspection should be employed.

- 9. BALANCE:** The maximum allowable Moment of Unbalance for each propeller is shown by the repair specifications. This is the maximum static unbalance which is allowed when the propeller is placed on a leveled propeller balancing stand with hardened and ground cylindrical rails, using a hardened and ground steel mandrel of diameter equal to the diameter of a standard mounting flange pilot stub inserted through the propeller pilot bore. The room in which propeller balance is inspected should be free from air currents. With this type of equipment, a balanced propeller will remain in any position with no tendency to rotate.

Horizontal balance may be corrected by removal of small amounts of metal from the heavy blade at locations where chord and thickness exceed the dimensions of the light blade. Vertical balance may be corrected by removal of metal from the heavy side of the hub.

- 10. REFINISHING:** Repaired propellers should be prepared for painting by chromic-acid anodizing (MIL-A-8625B) or ALODINE chemical conversion coating (MIL-C-5541). U.S. PAINT CO. ALUMI-GRIP or equivalent products may be used in accordance with the manufacturer's instructions.

The following color pattern is recommended: The rear (Thrust) face of each propeller blade should be finished dull black to reduce glare into the cockpit, from about 5 inches (13 cm.) radius to the tip. The remainder of the propeller should be painted gray, except for two 2-inch wide tip-strips added on the camber (front) face of each blade.

A decal showing propeller model, Type Certificate Number, and attaching bolt wrench torque should be applied near the trailing edge on the front face with the inner edge at $6\frac{1}{4}$ inches (16 cm) blade radius.