AC 20-37C

DATE 7/15/80

ADVISORY CIRCULAR

DEPARTMENT OF TRANSPORTATION
Federal Aviation Administration
Washington, D.C.

Subject: AIRCRAFT METAL PROPELLER BLADE FAILURE

1. PURPOSE. This advisory circular (AC) provides information and suggested procedures to increase service life and to minimize failures of metal propeller blades.

2. CANCELLATION. AC 20-37B, Aircraft Metal Propeller Blade Failure, dated 9/12/74 is cancelled.

3. DISCUSSION. A high margin of safety is incorporated in the design of modern metal propeller blades. Even so, failures do occur. Reports of propeller blade failures do not show that the failures can be attributed to any particular aircraft/engine/propeller combination.

4. WHY BLADES FAIL.

a. An investigation of a representative number of propeller blade failures disclosed that the failures occurred because of fatigue cracks which started at mechanically formed dents, cuts, scars, scratches, nicks, or leading edge pits. Blade material samples, in most cases, did not reveal evidence of failure caused by material defects or surface discontinuities existing before the blades were placed in service.

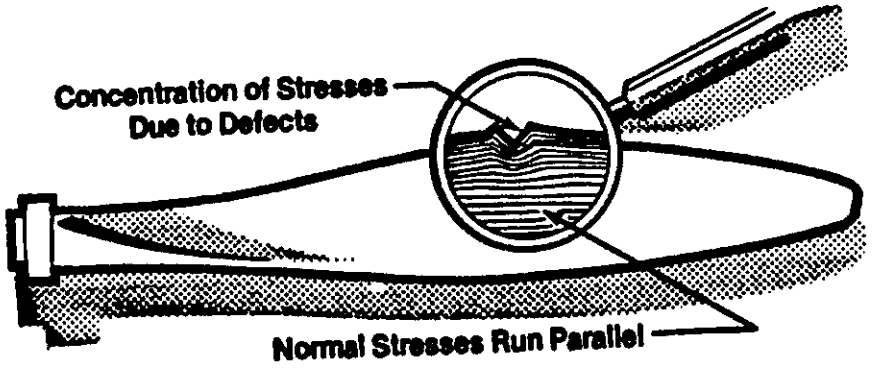
b. Often fatigue failure occurs at a place where previous damage has been repaired. This may be due to the failure actually having started prior to the repair or improperly performed repairs. Too many blade straightening or blade repitching operations can overstress the metal, causing it to fail. FAA AC 43.13-1A, Acceptable Methods, Techniques and Practices -- Aircraft Inspection and Repair, Chapter 12, and the propeller manufacturer's instructions or recommendations contain information concerning the limitations for repair or straightening of damaged blades. Exceeding these limitations may result in blade failure during operation. See figure 1 for acceptable repair methods. AC 43.13-1A may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Initiated by: AWS-300

c. Metal propeller blade failure may also occur in the least suspected areas (under leading edge deicer boots, under leading edge abrasion boots, and under propeller blade decals). During propeller blade overhaul, all leading edge boots and blade decals should be removed and those areas checked for corrosion, pitting, and evidence of fatigue cracks.

d. Metal propeller blade failure may also occur due to flutter. This vibration causes the ends of the blade to twist back and forth at a high frequency around an axis perpendicular to the crankshaft. At certain engine speeds this vibration becomes critical and, if the propeller is allowed to operate in this range, propeller blade failure may occur. For this reason tachometer accuracy is most important. Periodic tachometer accuracy checks should be accomplished using reliable testing instruments.

5. HOW BLADES FAIL. The stresses that normally occur in a propeller blade may be envisioned as parallel lines of force that run within the blade approximately parallel to the surface. When a defect occurs, it tends to squeeze together the lines of force in the defect area, thereby concentrating the stress. This increase in stress may be sufficient to cause a crack to start. Even a small defect, such as a nick or dent, may develop into a crack. The crack, in turn, results in a greater stress concentration. The resulting growth of the crack will almost inevitably result in blade failure. This condition is so common, and the results are so serious, that great emphasis should be placed on the daily and preflight inspection of propeller blades for defects. There are many stresses on a propeller. The propeller is at the end of the energy chain and it is responsible for efficiently converting the brake horsepower of the engine into thrust. During normal operation there are at least four separate stresses imposed on it: thrust, torque, centrifugal force, and aerodynamic force. Additional stresses may be imposed by vibration caused by fluttering or uneven tracking of the blades.



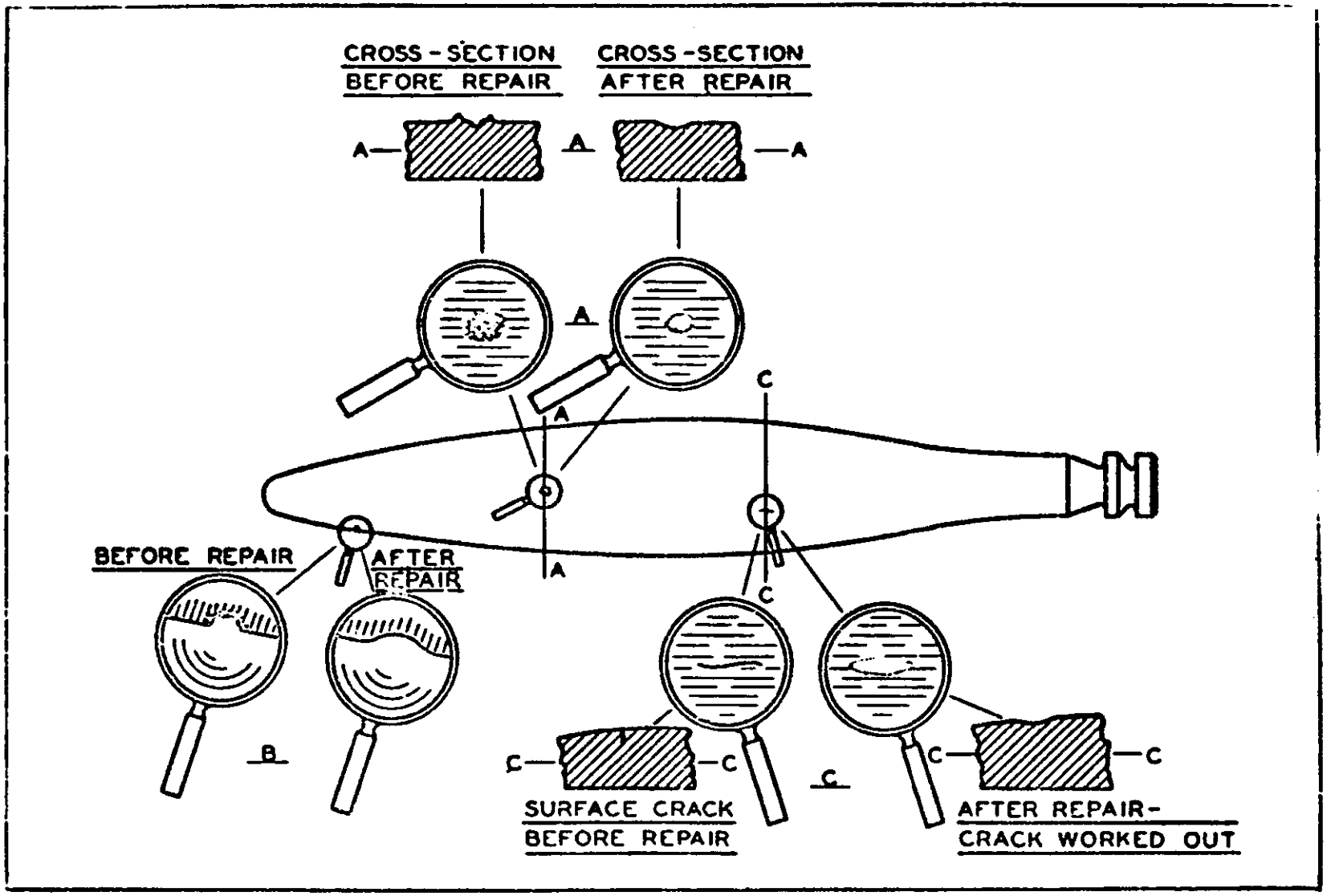


Figure 1 Method of repairing surface cracks, nicks, etc., on aluminum alloy propellers.

6. WHERE BLADES FAIL. Experience indicates that fatigue failures normally occur within a few inches of the blade tip; however, failures also occur in other portions of the blade when dents, cuts, scratches, or nicks are ignored. Since failures also occur in blades, near the shank and at the propeller hub well out of the critical areas, no damage should be overlooked or allowed to go without repair.

7. BLADE INSPECTION.

a. When performing propeller inspections and preflight inspection in particular, inspect not only the leading edge but the entire blade for erosion, scratches, nicks, and cracks. Regardless of how small any surface irregularities may appear, consider them as stress risers subject to fatigue failure.

b. Propeller manufacturers' manuals, service letters, and bulletins specify methods and limits for blade maintenance, inspection, service, and repair. In certain cases, suspected cracks or defects should be local etched repeatedly until their nature is determined. Remove from service damaged blades that are on the manufacturer's list of blades that cannot be repaired. When repairs are possible, the manufacturer's instructions should be followed using accepted industry techniques and practices. All propeller repairs should be performed by qualified repair agencies and competent personnel.

c. The owner/operator should be aware of airworthiness directives that apply to the propeller installed on his aircraft. Particular attention should be paid to repetitive requirements of applicable ADs.

8. "BLADE TIPS."

a. Keep blades clean - cracks and other defects cannot be seen if covered with dirt, oil or other foreign matter.

b. Avoid engine runup areas containing loose sand, stones, gravel, etc.

c. Do not move the aircraft by pushing or pulling on the propeller blades - they were not designed to be used as handles. There is always the potential of injury should the engine start because someone left the ignition switch on.

d. During the normal 100 hour inspection the engine tachometer should be checked for accuracy to preclude operation in any restricted R.P.M. range.

e. Your conscientious application of these helpful tips will greatly reduce propeller blade failures.

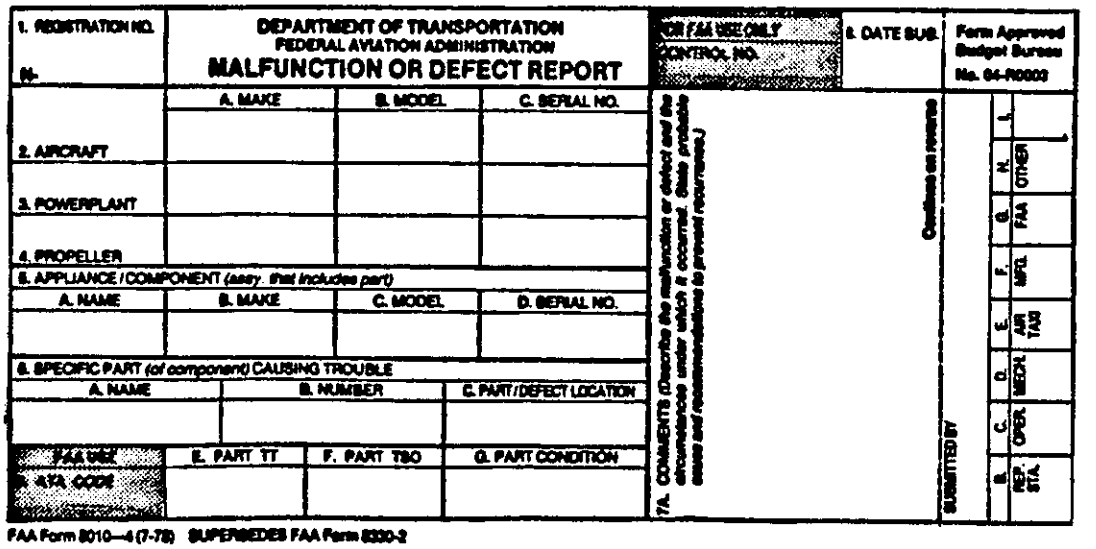
9. HELP WANTED. In order to continuously develop improved design data, operational procedures, and maintenance techniques, we need information relative to all propeller blade failures. It is requested that all owners, pilots, repair stations, and maintenance personnel cooperate by voluntarily reporting all propeller blade failures. FAA Form 8010-4, Malfunction or Defect Report (formerly FAA Form 8330-2), is a convenient means of supplying the FAA with the desired information. Forms are available from any General Aviation or Flight Standards District Office (GADO/FSDO) and are preaddressed for free mailing to the FAA. FAA AC 20-109, Service Difficulty Program (General Aviation), provides further information about the use of FAA Form 8010-4. Copies of AC 20-109 can be obtained from the U.S. Department of Transportation, Publications Section, M 443.1, Washington, D.C. 20590. Information that will be of great value to FAA includes:

a. A brief maintenance and operation history of the airframe and engine, including any incident of sudden engine stoppage due to the propeller contacting the ground or other objects.

b. A service history of the propeller, including any previous damage, all repairs and alterations, operating time in service since any repairs or alterations have been performed, total operating time, and whether or not the propeller has been used on other aircraft.

c. A description of any instance of rough engine operation at any time during the life of the installation.

d. A description of the amount of wear present in the engine crankshaft dynamic damper and attaching parts.



1. REGISTRATION NO. (N-)

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
MALFUNCTION OR DEFECT REPORT

FOR FAA USE ONLY
CONTROL NO.

8. DATE SUB.

Form Approved
Budget Bureau
No. 04-R0003

	A. MAKE	B. MODEL	C. SERIAL NO.
2. AIRCRAFT			
3. POWERPLANT			
4. PROPELLER			

5. APPLIANCE / COMPONENT (assy. that includes part)

A. NAME	B. MAKE	C. MODEL	D. SERIAL NO.

6. SPECIFIC PART (of component) CAUSING TROUBLE

A. NAME	B. NUMBER	C. PART/DEFECT LOCATION

FAA USE	E. PART TT	F. PART TSO	G. PART CONDITION
7. ATA CODE			

7A. COMMENTS (Describe the malfunction or defect and the circumstances under which it occurred. State probable cause and recommendations to prevent recurrence.)

Continue on reverse

SUBMITTED BY

a. REP. STA.
b. OPER.
c. MECH.
d. AIR TAXI
e. MFR.
f. FAA
g. OTHER
h.

FAA Form 8010-4 (7-78) SUPERSEDES FAA Form 8330-2

Fortunately, most propeller blade failures allow for a safe landing with little or no other damage. With the cooperation of the aviation community in investigating propeller fatigue failures, our combined efforts and contributions in this regard can materially enhance flying safety.

M. C. BEARD
Director of Airworthiness

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