OPERATION AND SERVICE INSTRUCTIONS

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OVERHAUL INSTRUCTIONS

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ILLUSTRATED PARTS BREAKDOWN

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PROPELLERS

215

FAA-DER APPROVED

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INTRODUCTION

This propeller handbook contains complete maintenance, servicing, inspection and overhaul instructions for the BEECHCRAFT ~~R200, B200, and~~ 215 series controllable-pitch propellers. It contains also an illustrated parts breakdown and numerical parts list for each propeller series.

The handbook contains a major section for each propeller series. Each section, in turn, is divided into sub-sections as follows: Operation and Service Instructions, Overhaul Instructions and Illustrated Parts Breakdown.

So that the handbook may be used conveniently by both large and small shops, each section is complete within itself, with individually-numbered pages, so that they become a series of small pamphlets. Their uniformity in style and organization make it possible to use the entire volume intact, or it may be broken up and the sections rearranged to suit the user's purpose: for example, all three parts sections kept in the stockroom, the overhaul sections in the propeller shop proper and the service and maintenance sections in a place convenient to flight line personnel. For convenience in making revisions and keeping each section current, each has its own title page and list of effective pages.

In carrying out the procedures in this handbook, bear in mind that it supplements, but does not supersede, the general methods, requirements and qualifications for propeller maintenance and repair set forth in Civil Air Regulations and Civil Aeronautics Manuals.

SECTION I

OPERATION AND SERVICE INSTRUCTIONS

215 Series Propeller

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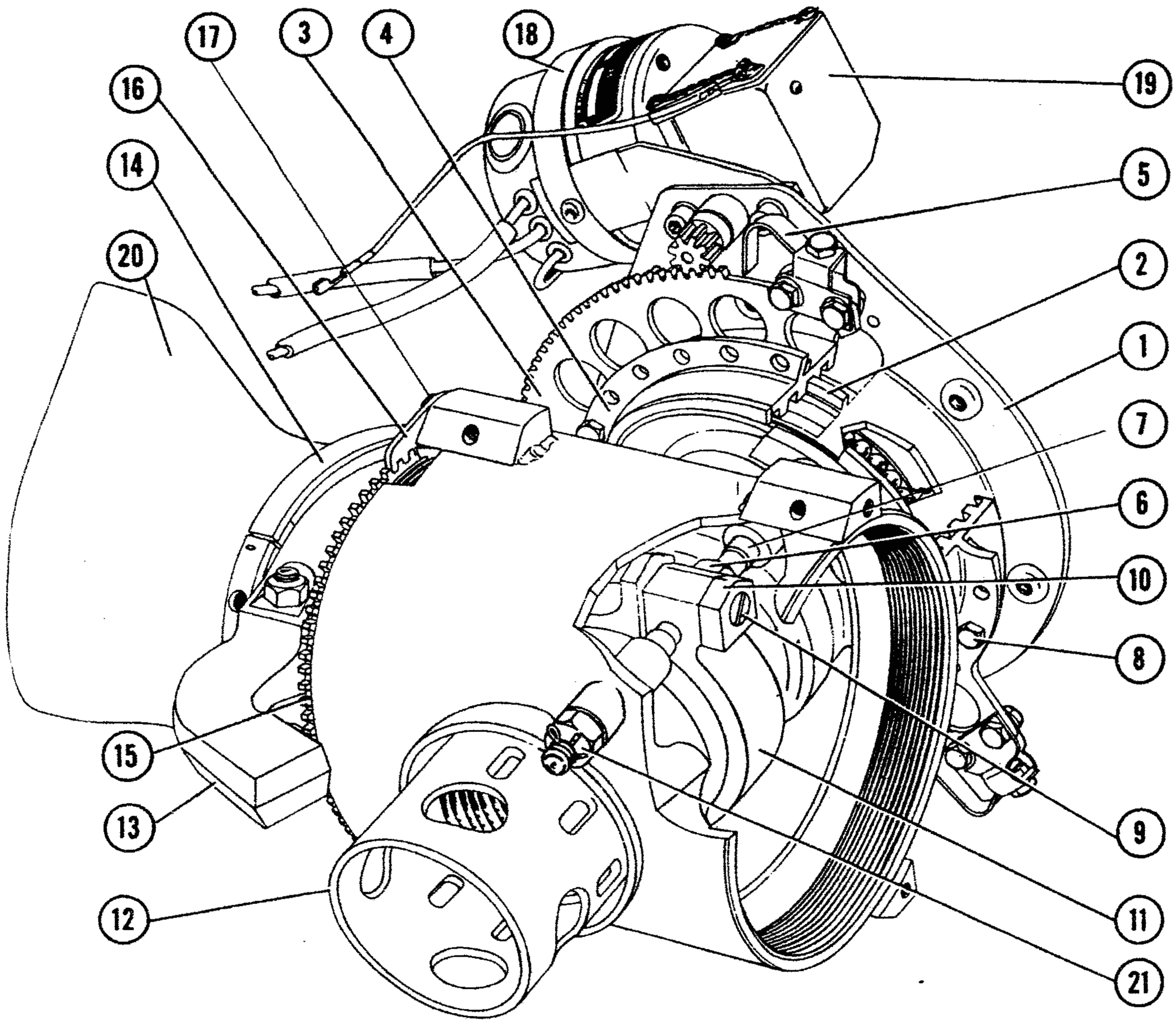
DESCRIPTION

The Series 215 Propeller is a controllable pitch propeller. The pitch of the propeller blades is changed by means of an electric motor mounted on the fixed sleeve (1, figure 1-1). A pinion gear actuated by the motor through a gear box drives the ring gear (3) which controls the position of the pitch control bearing (2). The pitch control bearing is mechanically linked to the yoke (11) by means of the control bolt (7). The bronze bushing (10) attached to the yoke (11) fits into slots in the base of the propeller blade. When the ring gear is actuated by the motor, the position of the pitch control bearing is changed; this motion is transmitted to the yoke by the control bolt and thereby to the propeller blades, changing the pitch of the propeller.



1 Fixed sleeve
2 Pitch control bearing
3 Ring gear
4 Ring gear hub
5 Spring stop
6 Yoke lock nut
7 Control bolt
8 Ring gear attaching bolt
9 Actuator bolt
10 Bronze bushing
11 Yoke
12 Propeller retention nut
13 Counterweight arm
14 Balance ring
15 Blade retention nut
16 Blade retaining nut lock
17 Blade retaining nut lock bolt
18 Propeller motor mounting bracket
19 Propeller motor assembly
20 Propeller blade
21 Safety low pitch stop nut

Figure 1-1. 215 Series Propeller

TABLE I. 215 SERIES PROPELLER

Propeller Assembly	Hub Assembly	Blade
215-110	215-109	215-207-88
215-108	215-107	215-207-88
*215-116	215-107	215-213-84
*215-117	215-109	215-213-84

*Used only with the E-225-8 engines having Serial No. 30087 and above and E185-1, -8 or -11 engines Serial No. 22183 and above.

DETAILED DESCRIPTION.

The Series 215 Propeller consists of three major assemblies: the blade assembly, the hub assembly, and the pitch control mechanism.

PROPELLER BLADES. Each propeller blade assembly consists of an aluminum alloy blade, steel sleeve, blade bearings, and blade retention nut. Thirty-one 7/16 inch diameter steel ball bearings ride in the bearing races of each blade and, the blade retention nut, which remains as a permanent assembly on each blade, holds the blade ball bearings in their races and threads into the propeller hub to secure the entire blade assembly. A single slot on each blade butt is provided for the bronze actuator bushings.

HUB ASSEMBLY. The hub assembly consists of a pitch control mechanism and a hub body. The hub body is threaded to receive the blade retention nut and its center bore is splined to fit a 20-spline crankshaft. The hub body may be considered the foundation of the entire propeller. When the propeller retention nut is loosened, the outer surface of the ridge on the aft end of the nut comes into contact with a snap ring in the hub body and operates as a propeller pulling device. The hub body receives the centrifugal load of the rotating propeller through the threads for the blade retention nut on the shank of the propeller blade.

PITCH CONTROL MECHANISM. The pitch control mechanism consists of three main assemblies; the actuator bearing and control bolts, the pinion and pitch control gear assembly, and the drive mechanism.

ACTUATOR BEARING AND CONTROL BOLTS.

The inner race of the actuator bearing rotates with the propeller and contains control bolts which are attached to a yoke. A bronze bushing is inserted on the round head of the yoke bolts, fits into the slots milled in the blades and transfers the movement of the yoke to the blades. The outer race is provided with special lugs designed to engage the internal threads on the pitch control gear. The lugs on the outer race fit into slots in the stationary sleeve assembly which prevents the race from rotating with the propeller. These lugs engage the internal threads in the pitch control gear assembly and the rotation of the latter assembly by the actuating motor causes the actuating bearing assembly to move either fore or aft thereby changing the pitch of the propeller. The actuator bearing is packed with grease at the factory and requires repacking at 250-hour intervals.

PINION AND PITCH CONTROL GEAR ASSEMBLY. The pinion and pitch control gear assembly consists of the internally threaded ring gear hub, ring gear, stationary sleeve assembly and a split lock ring. The pinion is an integral part of the motor which is mounted on the fixed sleeve. The ring gear is attached to the ring gear hub which fits over the stationary sleeve assembly and is held in place by means of the gear retainer ring. The sleeve contains slots so that the lugs on the outer race of the actuator bearing project through the sleeve and engage the internal threads of the ring gear hub. The entire assembly is secured to the engine by bolting the stationary sleeve assembly to the mounting plate on the nose case of the engine.

DRIVE MECHANISM.

The drive mechanism consists of an electric motor, necessary gearing and pinion gear. The electric motor is mounted on the fixed sleeve and provides the power for operating the blade pitch actuating mechanism.

PRINCIPLES OF OPERATION

The BEECHCRAFT Series 215 Controllable Pitch Propeller is basically mechanical in operation and provides a positive means of controlling the blade angle with few moving parts. (See figure 1-1.) The pinion gear is directly coupled to the motor assembly (19), and meshes with the ring gear (3). The ring gear is attached to the ring gear hub (4), which contains internal threads that engage a set of lugs on the bearing assembly (2). These lugs also engage slots in the sleeve, which is rigidly mounted, and prevent the external race of the bearing assembly from rotating with the propeller. The control bolts (7) attached to the inner race of the bearing assembly extend forward into the propeller hub and are attached to the yoke (11). The bushing (10) attached to the yoke (11) engages a slot in the propeller blade. As the ring gear is rotated in either direction, the bearing assembly (2), is moved either fore or aft within the ring gear hub. This fore or aft movement is transmitted to the yoke by means of the control bolts. As the yoke is moved, the movement is transmitted to the propeller blades by the bushing attached to the yoke, thereby changing the pitch of the propeller blades. The pitch range is limited by the mechanical spring stops (5) located on the ring gear (3).

tronically controls the propeller pitch change motor to change the blade angle with variations in load or engine output, maintaining a constant engine rpm. The governor-controlled propeller is independently manually-controllable in event of governor failure. The propeller is operated by a four-position toggle switch and a governor control knob on the control panel. Moving the toggle switch into "AUTO" position energizes the governor and the propeller then is controlled by the governor control knob. Turning the control knob to "TAKE-OFF", "CLIMB", or "CRUISE" position directs the electric governor to control the engine rpm at a constant speed for the selected setting, through the propeller pitch change motor.

GROUND OPERATION. The engine is started in the normal manner with the cockpit propeller control switch in the "HI RPM" position. On a governor-equipped airplane, the switch should be in "AUTO" and the governor control at "TAKE-OFF". After the engine has been warmed up in accordance with the manufacturers recommendations, the throttle should be advanced according to preflight instructions for a ground operational check on the propeller. To check propeller operation, the propeller switch can be moved several times through the full range from "HI RPM" to "LO RPM". Governor operation can be checked by advancing the throttle to obtain manufacturers recommended static rpm; if the control knob then is turned to the "LO RPM" position, the tachometer should drop to the minimum governing speed. The customary check of engine manifold pressure against engine rpm should be made with the propeller switch in the "HI RPM" position.

IN-FLIGHT OPERATION.

TAKE-OFF. The manually operated propeller control switch is held in the "HI RPM" position until the rpm will increase no more. On a governor-equipped airplane, the switch should be in "AUTO" and the governor control at "TAKE-OFF".

CRUISING. The desired cruising rpm is attained by moving the manually operated propeller control switch to the "LO RPM" position and releasing the switch when the desired rpm is indicated. The desired cruising rpm on the governor-controlled propeller is attained by moving the governor control knob on the instrument panel to the desired rpm in cruise position. After the desired cruising rpm has been set with the propeller control, the governor will hold a constant engine speed. Changes in airplane attitude or in engine manifold pressure can be made without affecting the engine rpm as long as the propeller blades do not contact the pitch limit stops.

APPROACH AND LANDING. For approach and landing, the propeller control switch should be held in the "HI RPM" position until the rpm will increase no more. With this setting, the power output of the engine is controlled by the throttle during the approach and glide, and emergency power requirements can be met by the throttle alone. The governor control knob on the governor controlled propeller is placed in the "TAKE-OFF" position. On the ground the propeller control switch should not be changed from the previous "HI RPM" setting, or the control knob should be kept in the "TAKE-OFF" position; this leaves the blade in the full low pitch position, and affords better ground control and more satisfactory engine operation.

SPECIAL TOOLS

No special tools are required for the servicing of the B200 Series Propeller.

PERIODIC INSPECTION

Component	Nature of Inspection	Inspection Time
Propeller Hub.	Security of mounting.	Postflight.
Propeller Blades.	Minor nicks, scratches, and cracks.	Postflight.
Propeller Blades.	Metal tipping for looseness or slippage, separation of soldered joints, distortion, loose screws, loose rivets, breaks, cracks and corrosion.	Postflight nearest 50 hours.
Propeller Hub and Blades.	Blade retention and propeller track.	Postflight nearest 100 hours.

LUBRICATION

The 215 Series Propeller has no provisions for external lubrication; the propeller must be disassembled to permit the lubrication of the actuator bearing and the blades must be removed to permit lubrication of the blade bearings. The actuator bearing must be relubricated every 250 hours. Refer to Section II for lubrication procedure.

ADJUSTMENTS AND MAINTENANCE

With proper care, the Series 215 Propeller can give many hours of efficient operation. Inspect the blades and hub at the intervals noted in PERIODIC INSPECTION and perform only the maintenance described in the following paragraphs; maintenance and repairs which require more involved procedures or disassembly of the propeller must be performed by a licensed propeller repair station. If an out-of-balance condition is suspected, remove the propeller and send it to a licensed propeller repair station. Line maintenance personnel should not attempt to balance the propeller since balance procedures are intricate and require special tools and equipment.

MINOR BLADE REPAIR. Dents and abrasions may be removed from metal propeller blades by use of suitable sandpaper or round fine cut files. In no case should dents, nicks, abrasions be repaired by methods which attempt to relocate metal by cold-working to cover or conceal the defect.

NOTE

The leading edges of the 215-207-88 blades, between stations 35 and 42 and back 1-1/2 inches, must be well maintained with the Continental E225-8 engine. Keep this area free of nicks, scratches or gouges. On the 215-213-84 propeller blades, the critical area is between stations 31 and 37.

The defect should be corrected by removing material with round files or sandpaper in such a manner that the finished repair will be rounded off and all sharp corners removed. See figure 1-2. With the exception of cracks, it will not be necessary to completely remove deep dents or nicks provided the edges are saucered out and the bottom of the dent is comparatively smooth. It is important that no material be removed unnecessarily.

CHECKING PROPELLER TRACK ON THE AIRPLANE. The following procedure should not be attempted unless it is known that the engine shaft is not out of line. When checking the track, the airplane must be in a hangar where air currents will not rock it. Use the following procedure.

a. Place a stationary object at the tip of one of the blades and make a mark on the object where the center of the blade touches it.

b. Rotate the propeller 180 degrees and repeat the above operation with this blade.

c. Measure the distance between the centerline of the two marks. The allowable difference is 1/8-inch.

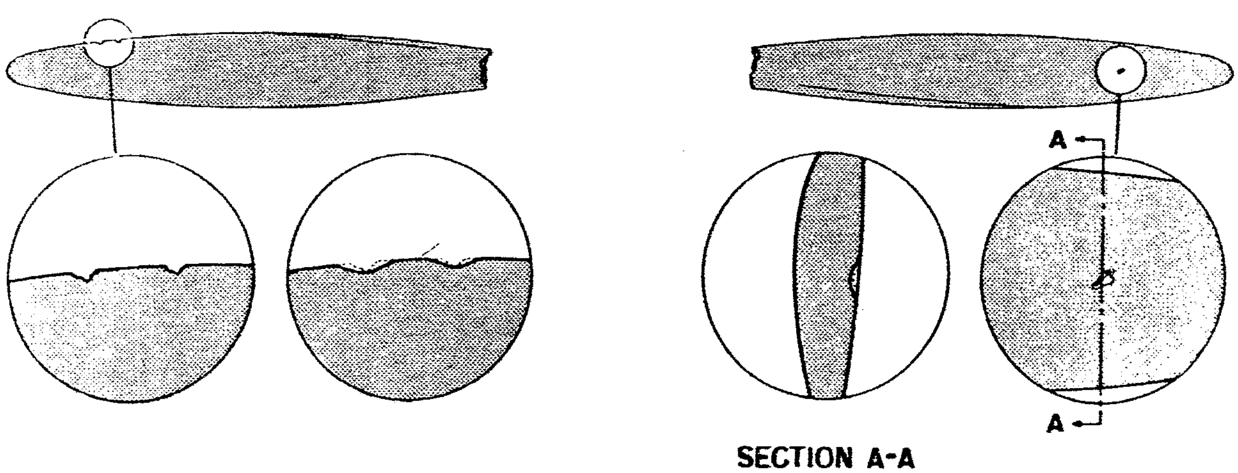


Figure 1-2. Removal of Dents and Nicks

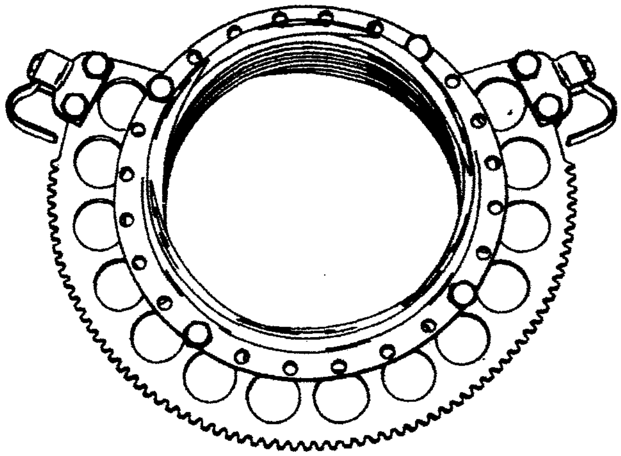


Figure 1-3. Spring Stop Pitch Adjustment

d. If the distance is greater than 1/8-inch, the propeller should be sent to a licensed propeller repair station for further inspection and repair.

CHECKING PROPELLER TRACK IN THE SHOP.

a. With the propeller in low pitch, mount it on a bench mandrel.

b. Place a stationary object at the tip of one of the blades and make a mark on the object where the center of the blade touches it.

c. Rotate the propeller 180 degrees and repeat the above operation with this blade.

d. Measure the distance between the centerline of the two marks. The allowable difference is 1/8-inch.

e. If the distance is greater than 1/8-inch, the propeller should be sent to a licensed propeller repair station for further inspection and repair.

ADJUSTMENT OF PROPELLER STOP. The Series 215 Propeller is equipped with mechanical spring stops located at each end of the propeller drive gear. Adjustment of the propeller stop may be made by removing the four ring gear attaching bolts and moving the gear approximately one-eighth inch to the right or left until the next set of holes line up. (See figure 1-3.) The stops should be located to permit the specified static rpm at full throttle with the propeller in full low pitch. When making the stop adjustment, place the propeller in full low pitch. Move the gear clockwise (looking aft) to decrease the rpm, and move the gear counterclockwise to increase the rpm.

PROPELLER BLADE PITCH ADJUSTMENT.

There is no propeller blade pitch adjustment necessary on the 215 propeller. It is automatically adjusted when the yokes are set during the assembly of the propeller.

REMOVAL AND INSTALLATION

PROPELLER REMOVAL. Remove the propeller in the following manner:

a. Remove the propeller spinner.

b. Disconnect the motor leads at the motor.

c. Remove the six bolts that connect the propeller sleeve to the nose case bracket.

d. Remove the clevis pin from the propeller retaining nut and engine crankshaft.

e. Turn the propeller retaining nut counterclockwise. When loosening the nut, care must be taken to prevent damage to control bolts and counterweights.

NOTE

A snap ring permits the propeller retaining nut to pull the propeller from the engine crankshaft as the retaining nut is being removed.

INSTALLATION OF PROPELLER ASSEMBLY. Install the Series 215 Propeller using the following procedures:

a. Install the rear cone spacers, the rear cone, and the propeller mounting bracket.

b. Install the propeller mounting bracket with the four special hexagonal head screws and stake in place. The flat side of the mounting bracket should be located about 45 degrees to the right of the perpendicular centerline of the airplane (looking aft).

c. Place the face of the mounting plate perpendicular to the crankshaft centerline with 0.010-inch total indicator reading.

d. Install the rubber grommets and spacers in the fixed sleeve (see figure 1-4).

e. Install the propeller and tighten the retaining nut. Check to see that 3/16 ± 1/32-inch distance is maintained between the sleeve and the hub at the closest point through a complete 360-degree rotation of the propeller, when the rubber grommets are flush with the mounting bracket. This distance may be varied by adding or subtracting spacers behind the rear cone. Apply 400 to 440 foot-pounds torque to retaining nut when propeller is properly installed. Safety the retaining nut in place.

f. Attach the pitch control sleeve to the mounting bracket using the six bolts and nuts provided. These and the propeller mounting bracket.

b. Install the propeller mounting bracket with the four special hexagonal head screws and stake in place. The flat side of the mounting bracket should be located about 45 degrees to the right of the perpendicular centerline of the airplane (looking aft).

c. Place the face of the mounting plate perpendicular to the crankshaft centerline with 0.010-inch total indicator reading.

d. Install the rubber grommets and spacers in the fixed sleeve (see figure 1-3).

e. Install the propeller and tighten the retaining nut. Check to see that 3/16 ± 1/32-inch distance is maintained between the sleeve and the hub at the closest point through a complete 360-degree rotation of the propeller, when the rubber grommets are flush with the mounting bracket. This distance may be varied by adding or subtracting spacers behind the rear cone. Apply 400 to 440 foot-pounds torque to retaining nut when propeller is properly installed. Safety the retaining nut in place.

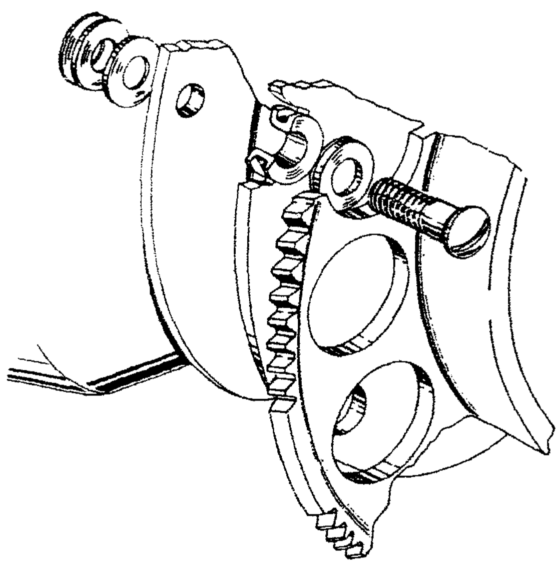


Figure 1-3. Mounting Bracket Alignment

f. Attach the pitch control sleeve to the mounting bracket using the six bolts and nuts provided. These are to be tightened using a large thick washer under the head of the bolt and large thin washers behind the rubber grommet and the washer under the nut to prevent the nut from riding up on the non-threaded portion of the bolt.

CAUTION

Do not tighten the mounting bolts more than necessary to compress the grommets 0.005 inch. When properly installed, the bolt will turn when twisted by hand (without the use of tools). Beginning with airplane Serial D-2199, a new type grommet employing a grip bushing has been used to eliminate the possibility of overtightening the mounting bolts.

g. Check between the propeller blades and stationary portions of the airplane to make certain that a minimum clearance of 0.50 inch is maintained.

h. Connect the two motor leads directly to the switch through the circuit breaker and connect the ground lead to engine case.

i. Start the engine and run up until the desired static rpm is obtained, then tighten the safety low pitch stop nuts so they will rest on the sleeve.

j. Install the spinner making certain that 3/16-inch minimum clearance is maintained between the spinner and the stationary parts of the airplane.

SECTION II

OVERHAUL INSTRUCTIONS

215 Series Propeller

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LIST OF EFFECTIVE PAGES

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IDENTIFICATION

This section provides the basic technical information for the overhauling of the Series 215 Controllable Pitch Propeller. The equipment involved is manufactured by the Beech Aircraft Corporation, Wichita, Kansas.

SPECIAL TOOLS

The following tools are used in overhauling the 215 Series Propellers.

PART NUMBER	NOMENCLATURE
No number	Table - Propeller Assembly
278-349	Bar - Propeller Balancing
278-348	Mandrel - Propeller Balance
TK1016	Mandrel - Propeller
50-590015	Wrench - Blade Retention
B200-100-806	Fixture - Yoke Dimension

DISASSEMBLY

See figure 2-1 for index numbers referenced in the following steps:

a. Place the propeller on a mandrel for support.

b. Check the propeller blade angle in extreme low pitch and note the degree.

c. Remove the propeller blade locks (29).

d. Remove the propeller blades (1) from the hub body (18) by turning out retaining nut with a special wrench.

e. Remove the low pitch safety stop cotter pin and nut.

f. Remove the pitch change motor assembly (9).

g. Rotate the ring gear (25) to place the bearing assembly (28) at the top of the sleeve (26).

h. Remove the ring gear (25) and the bearing assembly (28) by removing the nuts that secure the bearing assembly to the bolts (14).

i. Loosen the yoke lock nut.

j. Remove the actuator bolts (14) from the yoke (22).

k. Turn out the control bolts and remove the yoke lock nut. Remove the yoke from the hub assembly.

Legend for Figure 2-1

1 Blade assembly
2 Counterweight
3 Counterweight
4 Blade bearing race (2)
5 Ball bearing
6 Blade bearing race (4)
7 Balance ring assembly
8 Hex socket set screw
9 Motor assembly
10 Internal hexagonal head screw
11 Propeller retention nut
12 Snap ring
13 Safety low pitch stop nut
14 Pitch control bolt
15 Yoke lock nut
16 Pitch control bolt sleeve
17 Actuator bearing attaching nut
18 Hub
19 Ring gear clip tooth
20 Spring stop
21 Spring stop bracket
22 Yoke
23 Blade bushing
24 Gear retainer ring
25 Ring gear
26 Stationary sleeve
27 Gear hub
28 Actuator bearing assembly
29 Blade retention nut lock
30 Constant speed switch assembly
31 Constant speed switch actuator cam

( ) Indicates quantities other than one.

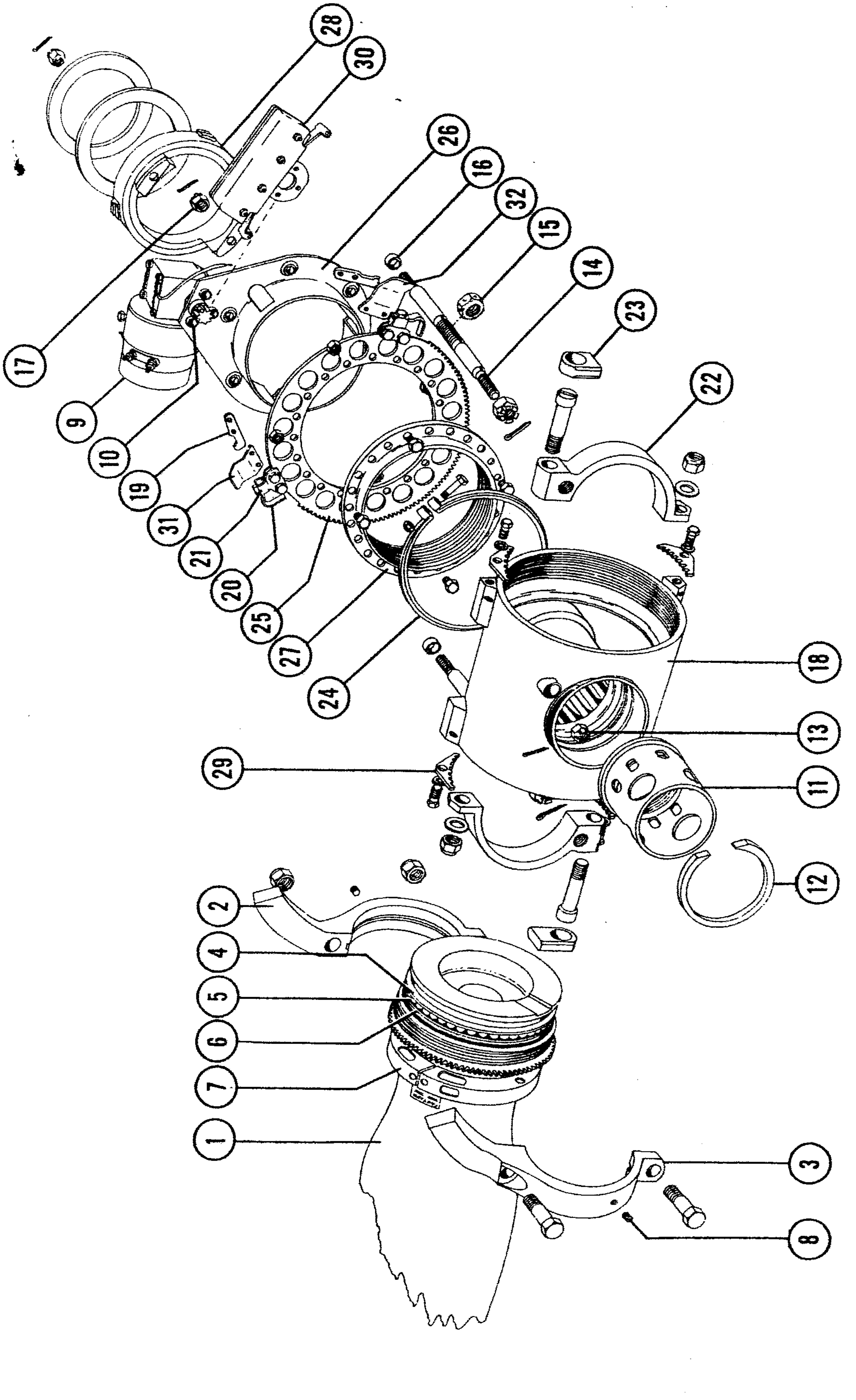


Figure 2-1. 215 Series Propeller

CLEANING

After disassembly of the propeller, all parts shall be thoroughly cleaned by spraying, immersion or wiping in cleaning solvent, Federal Specification P-S-661a. Except as authorized herein for operations of etching and repair, scrapers, power buffers, steel wool, steel brushes or abrasive compounds that will scratch or otherwise mar the surface will not be used on blades. Internal passages shall be blown out with compressed air to insure that they are cleaned and free of foreign particles. The cleaning fluid shall be kept free from all foreign matter by suitable strainers, and shall be periodically renewed. All parts shall be completely free of oil and wiped dry of cleaning fluid before inspection. If the parts are to remain idle for some time after inspection and before reassembly, coat with anti-corrosion compound, Specification MIL-C-5545.

INSPECTION

DAILY INSPECTION.

a. Visually inspect the condition of the blades.

b. Check operation of propeller pitch change through the entire range.

c. Check propeller operation for roughness.

100-HOUR INSPECTION.

a. Remove and replace rubber mounting grommets.

b. Check tightness of blades. (Should have slight play.)

c. Visually check condition of hub and blades.

d. Blades that have been straightened must be inspected for cracks after each 100 hours of operation.

e. Visually inspect the spinner bulkheads for cracks.

250-HOUR INSPECTION (Includes 100-hour Inspection.)

a. Remove blades, clean and relubricate bearings.

b. Remove actuator bearing. Clean and relubricate.

c. Inspect propeller mounting plate for cracks.

500-HOUR INSPECTION (Includes 100-Hour Inspection.)

a. Check track of propeller.

b. Remove, disassemble, and magnaflux all steel hub components.

c. Check all parts for wear.

d. Clean the blade thrust bearing and repack with grease using MIL-L-7711 (AN-G-15).

e. Check the ring gear and pinion drive gear for wear.

f. Remove the paint from the blades and inspect for cracks using caustic etch, anodic, or fluorescent oil inspection procedure.

g. Clean and relubricate actuator bearing using MIL-G-3278 (AN-G-25) grease.

VISUAL INSPECTION. Carefully inspect all parts for wear, galling, metal pickup, cracks, nicks, burrs, and other damage. Examine all gaskets for deformation and deterioration. Check blade races for chipping at break points. This will cause a severe "brinelling" action to the bearings. Races showing chipping effect at break points will be replaced. Check all threads for rough edges and irregularities. Inspect hub and blade retention nut threads for metal pickup, galling and/or out of tolerance pitch diameters. Thoroughly examine all plated and painted parts for damage exposing bare metal. It should be noted at this point that the Beech 215 Series Propeller blades are anodized giving them a dull gray finish. Inspect moving parts for freedom of movement. Check shrink fits such as the blade retainer for tightness. Examine internal passages for cleanliness and freedom from loose particles of metal or other substances. Examine the control bolts thoroughly for severe scoring on the bearing surfaces.

CRACK DETECTION BY NEAR ULTRAVIOLET LIGHT. Propeller blades may be inspected for cracks by use of near ultraviolet light inspection in conjunction with a solution of fifty percent aircraft engine oil and fifty percent kerosene. The solution should be tested to make certain that it has fluorescent quality.

a. Clean the blade carefully with carbon tetrachloride and dry the blade thoroughly, using an air blast if necessary. The fluorescent oil solution should be placed in a suitable dipping tank and maintained at a temperature of 90° to 130° F.

b. Completely immerse the blade in the solution, including the blade retaining nut and allow it to remain for a minimum of thirty minutes. After this period, remove the blade from the bath and allow the excess fluid to drain. Spray the blade with carbon tetrachloride to completely remove the remaining solution. Allow the blade to stand for fifteen minutes so that the solution will bleed out of any cracks present.

c. Carefully inspect the entire blade under a near ultraviolet light source. The inspection must be conducted in a darkened booth or room. Solution bleeding from a surface crack will show up under the light as a bright fluorescent line.

d. Cracks may be repaired using the same procedure as outlined for repairing dents and abrasions, with the exception that the crack must be completely removed and still be within the repair limits.

DETECTION OF CRACKS BY ANODIC TREATMENT. Where facilities are available the blades may be inspected for cracks by anodizing the blade surface and careful inspection for evidence of cracks. When chromic acid anodizing is used, the blade shall be completely anodized only from the tip to a point which is 6-inches from the shank. This area will be inspected by the fluorescent inspection method. Do not allow the chromic acid bath to contact the blade retainer nut and bearings. Completely mask off these areas. The anodizing shall be performed in accordance with Specification AAF 200400. Immediately after anodizing, the blade shall be rinsed in cold, clear running water for three to five minutes, and then dried with an air blast. Allow the blade to stand for a minimum period of 15 minutes, then inspect it for cracks and other damage. A crack will usually show up as a brown line against the clear anodized background when this process is used. Blades having cracks or damage that cannot be worked out within the repair limits given in this section shall be scrapped. For sealing of the anodized surface, the blade may be immersed in hot water 82° -100° C. (180° -212° F.), for half an hour after inspection.

MAGNETIC INSPECTION. A careful magnetic check should be made to determine whether any fatigue cracks have developed on the following parts: hub, control bolts, yoke, blade races, retention nut and all steel nuts and bolts. Before magnetization, all parts shall be cleaned of dirt, grease, corrosion preventive compound, and discolorations by wiping with a suitable solvent. In order to provide good contact in the machine, it may be necessary to remove surface oxidation with fine emery and crocus cloth from the contact areas. Two methods of magnetization are used: one, direct magnetization, in which the current flows directly through the part; two, bar type induced magnetization, in which the part (usually circular in shape) is suspended from a bar carrying the current. In general, the hub shall be magnetized twice in such a manner that the magnetic field will show defects lying in all planes of the part.

a. Magnetize the hub inductively by contacting the ends of a brass rod through the center of the hub, thus checking for cracks around the outer circumference.

b. Turning hub 90°, magnetize directly by contacting each pair of opposite lugs successively between the electrode plates checking for cracks in the welded areas, and threads in blade sockets. Metal pickup, cracks, distortion or out of tolerance pitch diameters will be cause for rejections.

When checking the blade races, place a copper braided cable between the races and the blade. Then placing the bar between the electrode plates, fashion the cable between plate and bar thus inducing magnetic contact. Magnetize the races in five or more equally spaced positions to insure complete coverage. No insulation is necessary between cable and races.

INSPECTION AFTER OVERSPEED.

The following inspection procedures apply to the 215-110 propeller using the 215-109 hub and 215-207-88 blades; the 215-108 propeller using the 215-107 hub assembly and 215-207-88 blades; the 215-116 propeller using the 215-107 hub assembly and 215-213-84 blades; and the 215-117 propeller using the 215-109 hub assembly and 215-213-84 blades.

a. Up to 3000 rpm - visually inspect.

b. 3000 to 3500 rpm - Disassemble and completely inspect (magnetically inspect all steel parts; etch or anodize and inspect aluminum portion of blade for cracks by one of the standard approved methods; visually examine blade hardware and blade retention, but do not disassemble blade hardware). Keep anodize solution off steel parts on blade.

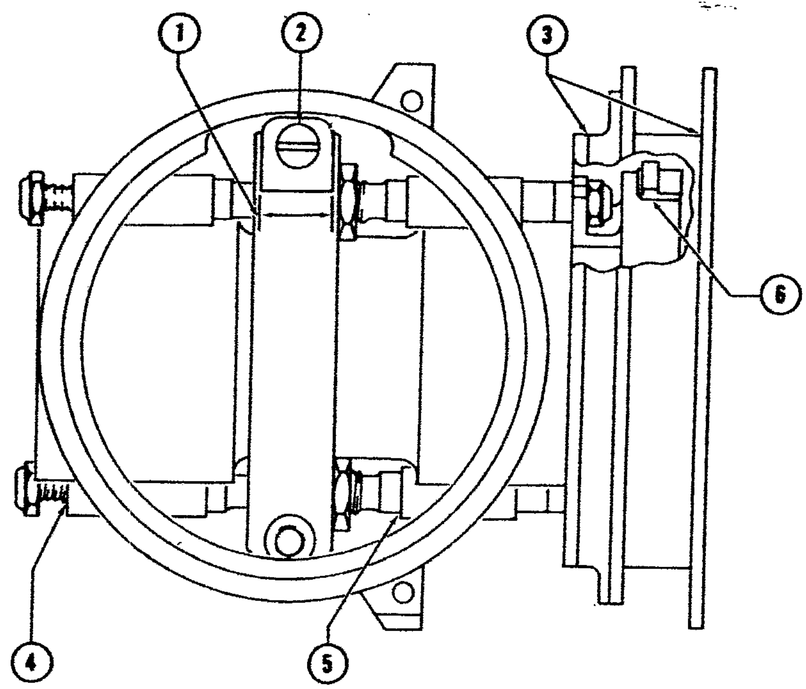
c. Over 3500 rpm - scrap blades and hub.

REPAIR AND REPLACEMENT

MINOR HUB REPAIR. Inspect the hub visually and by the magnaflux method. Minor galling and scoring of the front and rear flanges may be removed by polishing with emery paper. Galling and scoring in the control bolt holes may be polished out with emery paper. Scrap the hub if threads in hub for the blade retention nut are damaged beyond repair.

PLATED PARTS. All plated parts showing exposed base metal shall be replated. After cadmium plate, all parts must be embrittlement relieved.

BLADE REPAIR LIMITS. The removal of blade material and over-all repairs to the blade will be confined to within the limits shown in the repair limit chart, figure 2-2. If it is necessary to reduce the dimension beyond the limits established by the repair limit chart to repair a blade, the blade will be retired from service. The repair limit chart shows the maximum percentage of reduction of either the width or the thickness of the blade at all stations. To determine the maximum dimension reduction, first determine the station location of the defect. Locate the station on the repair limit chart. Follow the station line vertically to the curve intersection point. Read the maximum allowable percentage re-



1. Bushing width	.743	inch	minimum
2. Diametrical clearance between bolt head and bushing	.0035	inch	minimum
3. Total combined clearance at ends of gear hub	.017	inch	maximum
4. Inside diameter of front bushing	.447	inch	maximum
Outside diameter of small end of bolt	.433	inch	minimum
5. Inside diameter of rear bushing	.510	inch	maximum
Outside diameter of large end of bolt	.496	inch	minimum
6. Minimum thickness of bearing lug .060 inch from top	.175	inch	minimum

Figure 2-1A. Propeller Hub Wear Tolerances

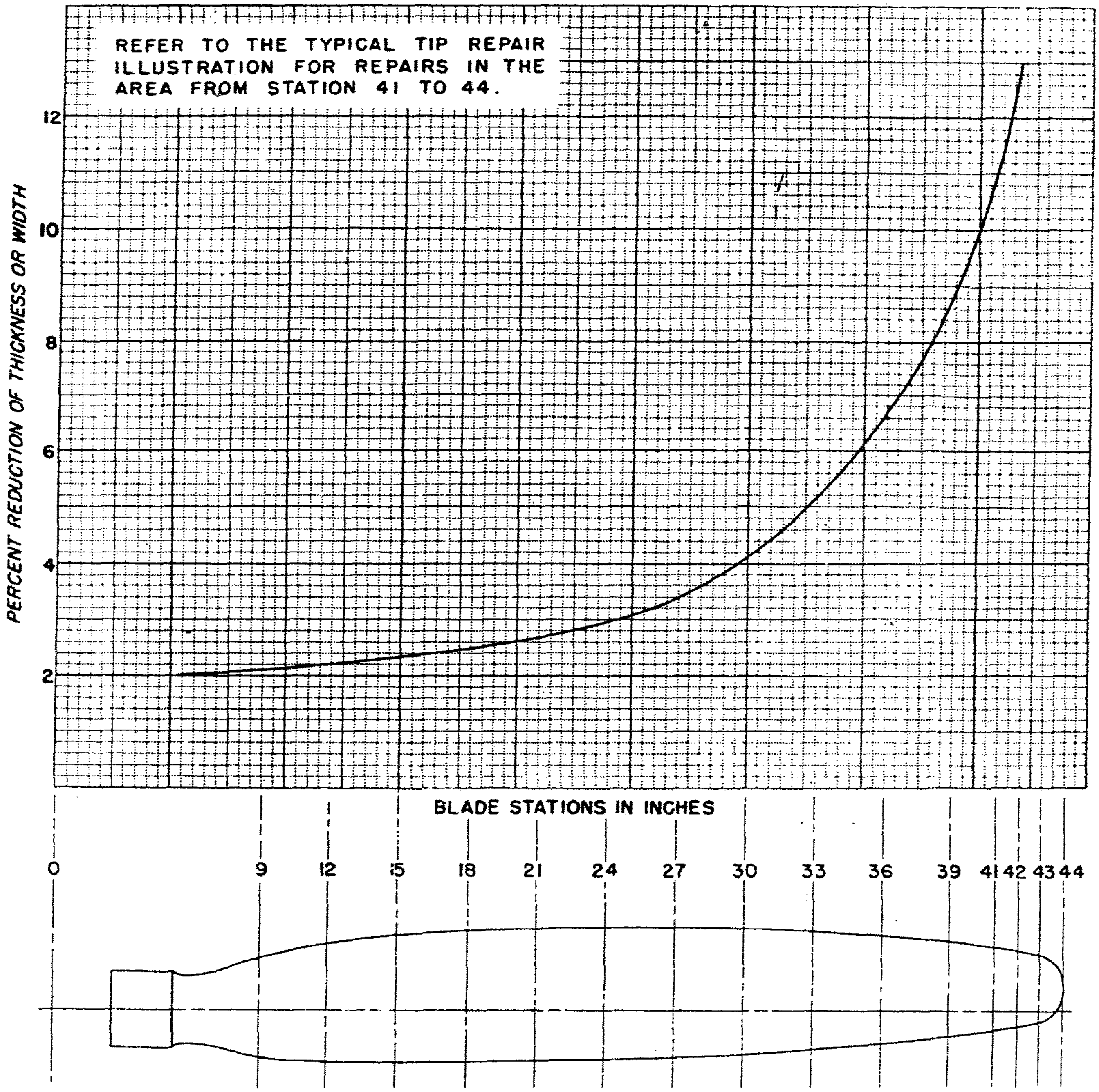


Figure 2-2. Repair Limit Chart

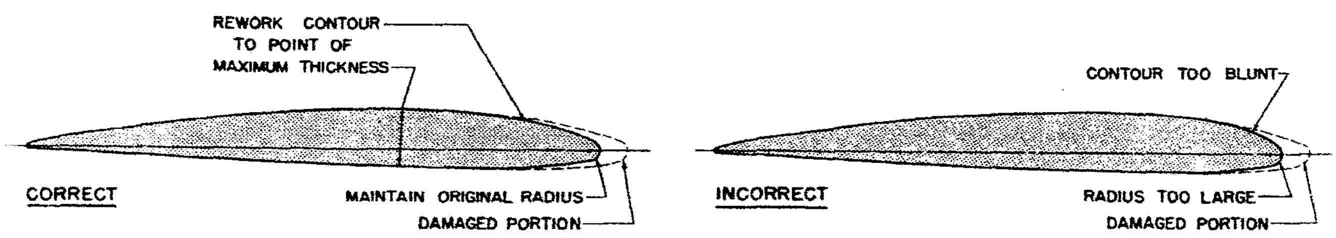


Figure 2-3. Repair of Leading Edges

in such a manner that it is necessary to remove a portion of the tip, it is permissible to shorten the length of the blade a maximum of 7/8-inch from the design length. The tip, within the 7/8-inch, may be cut off to any desired shape; however, if the tip is rounded off similar to the original form, the width of the blade cannot be faired in past the 41-inch station (see figure 2-4). The tip may be cut off square if desired; however, the corners should be rounded off with one inch radii as shown in figure 2-4. Where the tip of one blade is cut off it will be necessary to make a template of the finished tip so that the opposite blade may be cut off to match. A reference station should be marked on each blade so that the template may be properly located on the second blade. This will assure that both blades will be the same length, and have the same tip contour.

NOTE

If it is necessary to shorten the blade in excess of the limits given in figure 2-2 to repair a defect, the blade will be scrapped.

Dents and abrasions in the tip area from the 41-inch station to the 43.125-inch station may be removed provided the thickness or width is not reduced more than the limits shown in figure 2-4.

The blade may be cut off with a hacksaw and then dressed down to proper contour with a sander and files. The blade tip should be smoothed off to remove all file marks with fine sandpaper such as 400 and 600 wet-or-dry paper or fine emery cloth. The side view of the reworked tip should appear as illustrated in figure 2-5.

Identify blades that have been cut off by changing the diameter dash number to the new diameter. See Blade Reidentification.

NOTE

E-35 and F-35 Model Bonanzas equipped with the E225-8 engine and 215-116 and 117 propellers have an authorized minimum propeller of 82 inches. The tip contour for cut-off blade tips to within this minimum diameter shall be squared off like the original tip contour.

Refer to CAA Aircraft Specification A777 for use of 215-213-84 or 215-207-84 propeller blades. The shorter blades are used with engines of a certain serial effectivity and are approved only on certain Bonanza models. Local CAA approval will be required where a Bonanza model is not shown in the specification as the manufacturer has not conducted approval tests.

BLADE REIDENTIFICATION. A propeller blade that has had a blade cut off will have been reworked and altered from its original design dimensions and the dash number in the blade drawing number designating the propeller diameter will be changed to the nearest inch on the blade placard. For example: if 7/8 inch is cut off the tip of a 215-207-88-14 blade and since eighty-eight inches is the original propeller diameter and both blades in the propeller must be reduced by the same amount resulting in a total reduction in diameter of 1-3/4 inches. Two inches is the nearest full inch and the drawing number 215-207-88-14 will be changed to 215-207-86-14.

NOTE

Propeller blades stamped 215-316-88 on the blade butt are 215-207-88 blade assemblies and propeller blades stamped 215-359-88 on the blade butt are 215-207-88-14 blade assemblies. The part numbers 215-316-88 and 215-359-88 are for the blade without the sleeve, bearings, retention nut and counterweight attached.

REPAIR OF BENT OR TWISTED BLADES. The material of the 215 Series Propeller blades is 25ST aluminum. All repairs to the blades must be made with the blade in the "hard" condition. It is not

TABLE I. DESIGN MAXIMUM THICKNESS

(Manufacturing Tolerances Not Included)

STATION	THICKNESS
9	2.033
12	1.165
15	0.820
18	0.680
21	0.624
24	0.554
27	0.493
30	0.436
33	0.368
36	0.325
39	0.276
41	0.256
42	0.218
43	0.157

TABLE II. DESIGN MAXIMUM WIDTH

(Manufacturing Tolerances Not Included)

STATION	WIDTH
9	4.895
12	5.906
15	6.312
18	6.442
21	6.470
24	6.386
27	6.198
30	5.947
33	5.575
36	5.050
39	4.377
41	3.952
42	3.677
43	3.237

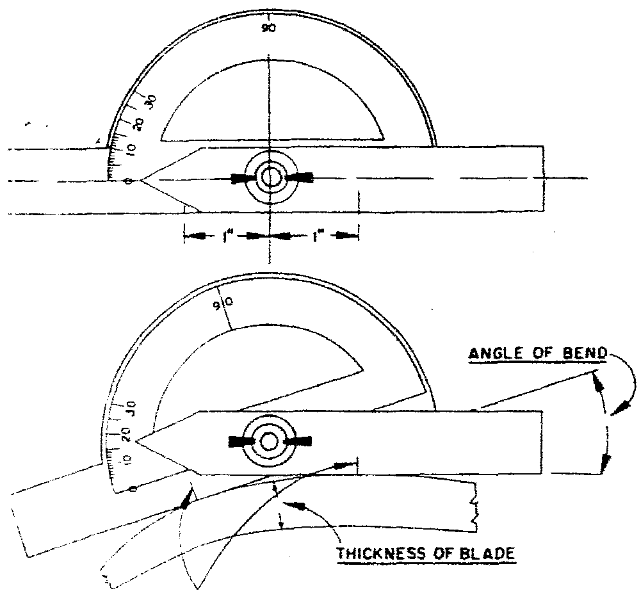


Figure 2-6. Blade Bend Protractor

permissible to anneal a blade. Before attempting to straighten a bent or twisted blade, the damage to the tip should be inspected to determine the amount of reduction necessary to repair the tip damage. If it will be necessary to reduce the blade length to produce a propeller diameter less than those shown in CAA aircraft specification A777, the blade will be scrapped. If the damage to the tip is such that it may be repaired within prescribed limits, check the bent blade to determine the maximum degree of bend using protractor similar to that shown in figure 2-6. The angle should be checked by setting the protractor so that the point of tangency is one inch each side of the centerline of the bend. Check the entire bend area and refer to the bend limit chart, figure 2-7. If the degree of bend does not exceed the limits of the chart in any area, the blade may be straightened.

NOTE

If the degree of bend at any point exceeds 50% of the allowable limit, the blade may be straightened only once and must be indicated by the symbol Z after the blade serial number. If the degree of bend is less than 50%, the symbol S1 will be added after the blade serial number. Each time the blade is straightened, the figure number following the letter S will be changed to represent the number of times the blade has been straightened. After a blade is straightened it must be checked for cracks by use of approved procedures. If any cracks are found, the blade must be scrapped. Blades having bends in the area between the shank and Station 22 will be scrapped.

STRAIGHTENING - PROPELLER BLADE. Bends are straightened with a rolling effect starting at the first bend from the shank and working out to the tip, however, the tip should be straightened first.

NOTE

All bends must be straightened in a press; in no case shall a blade be straightened by hammering.

The shank of the blade may be supported on the press bed with a wooden dolly, and padded wooden blocks should be used on both sides of the blade to prevent scarring the surface. Apply pressure on one side of the bend; never apply pressure in the center of a large bend. During the process of

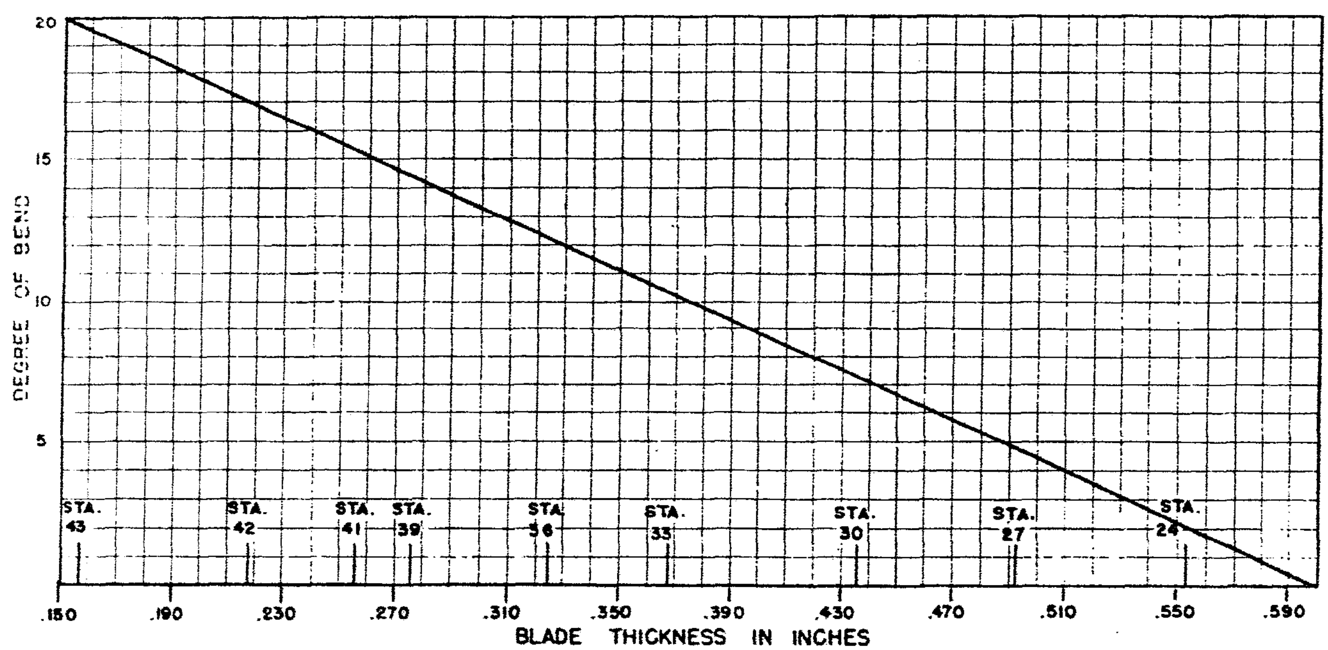
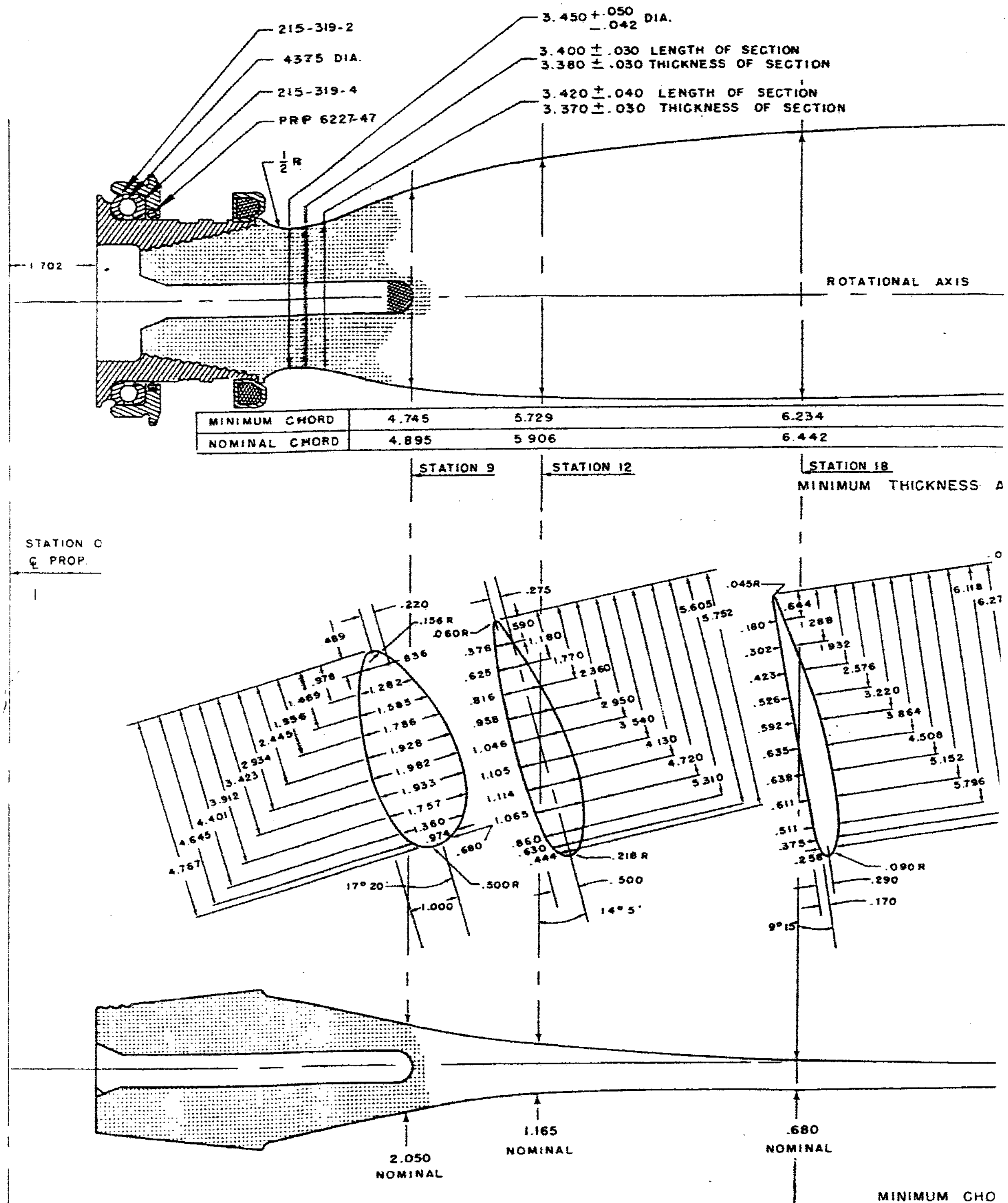


Figure 2-7. Maximum Bend Chart



215-319-2
4375 DIA.
215-319-4
PRP 6227-47
1/2 R
3.450 +.050 −.042 DIA.
3.400 ±.030 LENGTH OF SECTION
3.380 ±.030 THICKNESS OF SECTION
3.420 ±.040 LENGTH OF SECTION
3.370 ±.030 THICKNESS OF SECTION
1.702
ROTATIONAL AXIS
MINIMUM CHORD 4.745 5.729 6.234
NOMINAL CHORD 4.895 5.906 6.442
STATION 9
STATION 12
STATION 18
MINIMUM THICKNESS A
STATION O
℄ PROP.
17° 20'
1.000
.500 R
14° 5'
.218 R
9° 15'
.090 R
2.050 NOMINAL
1.165 NOMINAL
.680 NOMINAL
MINIMUM CHO

.638 min

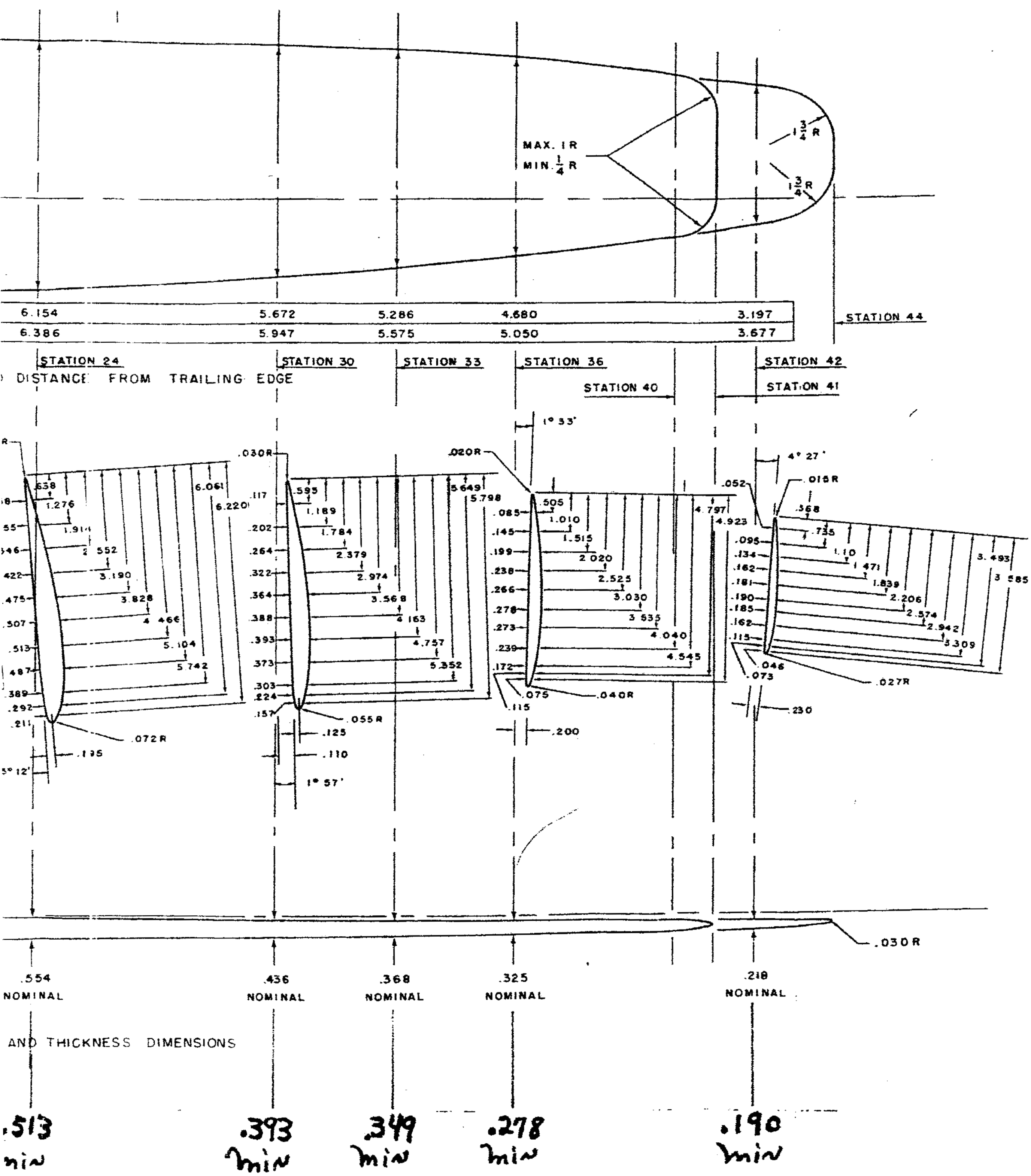


Figure 2-8. Blade Drawing

straightening the blade, check the alignment with a straight edge. Kinks in a blade may be removed by clamping the blade in a vise and applying pressure with a large wrench. The alignment of the blade should be checked on a surface table after completing the straightening procedure. Check the blade angle at the following stations:

Station	Blade Angle
9	17° 20'
12	14° 5'
18	9° 15'
24	5° 12'
30	1° 17'
36	-1° 33'
42	-4° 27'

Blade angles must conform to this chart within -0° 30'. Blade angles are checked with reference to the 33-inch station at 0 degrees. Blade angles from the 22-inch station to the tip may be twisted to the correct angle by use of a blade twisting machine.

NOTE

If a blade is twisted more than 0° 30' from design angle at any station from 22 inches to the shank, the blade should be retired from service. Blades that have been bent and repaired must be inspected for cracks at each 100-hour period.

EDGE ALIGNMENT. Edge alignment may be checked by locating the rotational axis of the blade. This may be accomplished by referring to the blade drawing. See figure 2-8. When laying out the rotational axis line from the width of the blade, the manufacturing tolerance and repaired areas should be considered. If desired, the horizontal line may be located with the blade on a surface table. The width of the blade is determined by a comparison height gage and the correct dimension from the leading edge is then marked on the blade. After several points are established this way, the height gage may be used to determine if the blade is correctly aligned. Set the blade on a surface table so that the edges of the blade are vertical. The marked rotational axis of the blade should be within plus or minus 1/32 inch at the same distance from the surface table as the centerline of the blade shank ferrule.

NOTE

It is not permissible to boost a blade to correct edge alignment.

FACE ALIGNMENT. Face alignment may be checked by setting the blade so that the edges of the blade are horizontal (flat side up) and checking points along the marked rotational axis. The rotational axis intersects Station 24 on the surface on the flat side of the blade. Figure 2-9 illustrates checking the face alignment at Station 33. The rotational axis is 0.060 inch above the flat side surface at Station 27. Refer to the Blade drawing for additional dimensions. The face alignment should be within plus or minus 1/32 inch for the location shown on the blade drawing.

PAINTING - BLADE REPAIR. Carefully touch up blades having minor paint damage, due to repair operations or wear. Blades requiring complete repainting shall first be stripped of their remaining paint and then painted according to the following instructions:

a. All surfaces to be painted shall be thoroughly cleaned immediately before the application of the primary coat. Use one of the following solvents: benzol, carbon tetrachloride or some other suitable organic solvent. Use same care when applying second topcoat, that preceding topcoat has not become soiled.

b. The flat face of the blade will receive a three-coat application, one primary coat and two topcoats. Mask off the camber face of the blade, using any suitable method. The blade shall not be painted within 3-1/2 inches of the blade butt face.

c. The primer shall be zinc chromate conforming to Specification MIL-P-6889. Use toluol conforming to Specification TT-P-548A as a thinner for the primary coat. Apply the primary coat evenly over the surface of blade avoiding a heavy coat. Allow to dry for at least 30 minutes at room temperature in a dust free atmosphere.

d. Apply the first topcoat so that it will cover the primary coat completely. The topcoat shall be a non-specular lacquer conforming to Specification MIL-L-6805, camouflage black, shade 604, Specification TT-C595, and thinned with cellulose nitrate thinner conforming to Specification MIL-T-6094A. They shall be thoroughly mixed before applying.

e. Allow the first topcoat to dry thoroughly (at

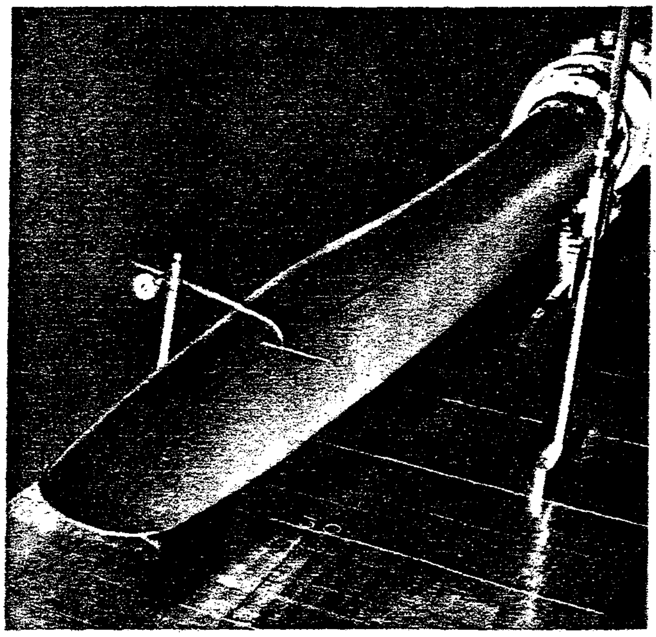


Figure 2-9. Face Alignment Check

TABLE III. MANUFACTURING TOLERANCES

Width	
Blade Shank to Station 24 (Inclusive)	± 3/64 in.
Station 27 to Tip	± 1/32 in.
Thickness (All Stations)	± 0.025 in.
Edge and Face Alignment	± 1/32 in.
Blade Angle (Based on Station 33)	
Shank to Station 30 (Inclusive)	± 0° 30'
Station 33 to Tip	± 0° 12'
Longitudinal Location of Stations	± 0.015 in.

least 15 minutes) and then apply the second topcoat in a similar manner. Allow the final topcoat to dry for at least two hours at a normal room temperature. The blades shall not be considered ready for service until they have dried for a period of 48 hours.

f. Apply a warning stripe at tip of blade using non-specular lacquer conforming to Specification MIL-L-6805, Color 614 Yellow (Munsell 1.5Y 7.5/12). Apply two coats to both sides from station 40 to the tip or three inches from tip (use 3 inch method only if tip has been cut off in repairs). Also apply a stripe of yellow lacquer at the 33 inch reference station on the face side of the blade. This stripe shall be 1/8 inch wide by 2 inches in length. The distance from the blade reference station to the edge of the stripe shall not exceed 1/16 inch, and the distance from the trailing edge to the stripe shall not exceed 1-3/4 inches.

g. Install the bearings information decal on the flat side of the blade, 5-7/16 inches from the hub center line. After the decal has been installed, apply clear lacquer, Specification MIL-L-7178, over the surface of the decal.

h. Paint the entire blade, to within 3-1/2 inches of butt face, with cellulose nitrate, clear lacquer, Specification MIL-L-7178.

i. The balance of painted blades may be corrected by the use of paint only. When thoroughly dry, all painted blades shall be balanced horizontally against a master or against the opposite blade in the hub. Where elevated temperatures have been used to quicken the drying, balance shall not be attempted until blades cool to approximately room temperature. When paint has dried sufficiently, check surface for irregularities such as those resulting from uneven application of the paint materials and for evidence of poor adhesion.

INSTALLATION OF PROPELLER BLADE THRUST BEARINGS. The thrust bearing races contain grooves which are ground in the aft side 180 degrees apart. The groove assists in breaking the race for replacement and was designed for that purpose. All replacement races are factory broken and in matched pairs. After several hours of service a crack may appear at one or both of the grooves in the race. This crack is not detrimental if it is clean and there is no evidence of chipping in the race. The balls

TABLE IV. STATIC RPM AND CORRECT PITCH SETTING

Models	Static RPM	Pitch at 33-Inch Station
MANUAL CONTROL PROPELLER		
35, A35, B35	*Not over 2040 *Not under 1940 **Not over 2165 **Not under 2065	Low 16° High - Not under 30° Low 15° High - Not under 30°
C35, D35	Not over 2230 Not under 2130	Low 13° High - Not under 30°
E35 and F35 with E-225-8 engine with 88" blades.	Not over 2230 Not under 2130	Low 13° High - Not under 30°
E35 and F35 with E-185-11 engine and 84" blades.	Not over 2450 Not under 2150	Low 13-3/4° High - Not under 30°
F35 and G35 with E-225-8 engine and 84" blades.	Not over 2380 Not under 2280	Low 12.5° High - Not under 29.5°
*Engine serials before 5122D	**Engine serials 5122D and after	
CONSTANT SPEED PROPELLER		
C35, D35, E35, F35	Not over 2375 Not under 2275	Low 12° (11°, E35, F35) High - Not under 30°
F35 and G35 with E-225-8 engine and 84" blades.	Not over 2450 Not under 2350	Low 11.5° High - Not under 30°

and races of the thrust bearings are subjected to extreme loads that cause a "brinell" condition. This condition has no effect on the operation of the propeller; however, if the balls show evidence of chipping and the races have deep wear areas, replacement should be made. Replace the blade thrust bearings in the following manner:

a. Place the -2 race in position on the blade ferrule.

b. Apply a coating of grease, MIL-L-7711, (AN-G-15) in the ball groove.

c. Place the balls in the ball groove.

d. Place the -4 race in position on the balls.

e. The -4 and -2 race should be positioned so that breaks are 90 degrees apart.

LUBRICATING THE PROPELLER ACTUATOR BEARING. Lubricate the propeller pitch change bearing in the following manner:

a. Remove the snap rings on both sides of the bearing with needle nose pliers.

b. Push the seal inward and at the same time run a finger around the circumference of the bearing until the seal is raised, allowing it to be lifted out. Remove both seals.

c. Clean the bearing thoroughly in unleaded gasoline or a good grade of grease-dissolving cleaner, such as Stoddard solvent (Federal Specification P-S-661a).

NOTE

Kerosene and carbon tetrachloride should be avoided, since either may cause the bearing to rust.

d. Examine the ball retainer rivets to make certain that all the heads are below the surface of the bronze bearing retainer. Dress any rivets or burrs that appear above the retainer with a riffle file and thoroughly clean the bearing once more.

e. Examine the bearing for roughness after it has been thoroughly cleaned and dried. Hand-load the bearing by holding the inner race stationary and applying an opposing load to the outer race while slowly rotating it. Check the entire circumference by using this method.

NOTE

Do not spin dry bearings at high speed.

f. Lubricate the bearing sparingly with Specification MIL-G-3278 (AN-G-25) grease, rotate rapidly to throw the excess grease to the outside of the bearing retainer. Wipe off excess grease. The bearing will not hold more than four grams of grease.

g. Install new seals and the seal retainer snap rings. The seals must fit well into the groove in the outer race, lie perfectly flat on the bearing retainer, without wrinkles. The snap ring must fit well in the same grooves and must be tight. Check the tightness by attempting to rotate the snap ring and if the snap ring slips in the groove, remove it and expand by peening the inner circumference.

h. When the seal and snap ring are properly installed, rotate the bearing rapidly for about 3 minutes. This may be done by holding the inner race firmly and holding the outer race against a pulley or belt. The seal and the snap ring must remain stationary. After the run-in period, recheck the seal to make certain there are no wrinkles and recheck the seal retainer snap ring for tightness.

LUBRICATING THE PROPELLER BLADE BEARING. The propeller blade bearing must be repacked with Specification MIL-L-7711 (AN-G-15) grease every 500 hours. Lubricate according to the following procedure:

a. Wash the bearing thoroughly with gasoline or distillate, and dry.

b. Work the grease into the bearing until it appears on the other side.

c. Rotate the bearing several times and work in more grease.

d. Wipe off all excess grease.

BALANCING

Each propeller blade is balanced individually. This single blade balance procedure results in a perfectly balanced propeller blade both horizontally and vertically at two different blade angles matching a master blade. Lead is added to the hole in the shank of the blade and to the balance ring on the blade sleeve to bring each blade into the same balance and the Number 3 is marked in front of the blade serial number on the blade decal. In this respect all new blades are interchangeable. When two new blades are installed in a hub assembly and the propeller assembly is balanced, the correction for perfect balance must be made on the hub assembly. The lead in the balance ring of a new blade must not be disturbed when balancing the propeller. To do so may result in a rough propeller even though the static balance is correct. After a blade has been repaired it will be necessary to correct its balance to match with the opposite blade, or if both blades have been repaired, the blades should be matched to each other. In either event, unless a repaired blade is balanced to match a new blade the weight Category Number should be crossed out.

SINGLE BLADE BALANCE. A repaired blade should be balanced to an unrepaired blade or a new blade and both must be equipped with counterweight, balance ring, lubricated bearing and the hole in the shank of the metal blades full of MIL-L-7711 grease. The balance ring on the blade to be balanced should be empty of lead.

a. Install the blades in the hub to be used and set each blade at 13 degrees measured at the 75% station. Both blades must be set exactly the same. Balance the blade horizontally using a single piece of lead of the required weight molded to fit the contour of the balance ring and lying loosely on the balance ring; then balance the blade vertically in the upright position with another piece of lead of the required weight lying loosely on the balance ring 90 degrees to the axis of rotation. If more than 1/2 a ring full of lead is required for horizontal balance, pack lead wool in the hole in the center of the shank of the blade.

b. In most instances, the piece of lead required to balance the blade horizontally will be larger than the piece required to balance the blade vertically. However, if the piece for vertical balance is the larger, the condition must be corrected by removing the lead, if any, from the hole in the center of the blade or changing to a lighter counterweight. To achieve the best balance results, more weight must be required for the horizontal balance than for the vertical balance.

c. After the weight required for horizontal and vertical balance is determined, measure the arc of the lead pieces on a four-inch protractor. Lay aside the piece used for vertical balance and subtract the number of degrees it measured from the number of degrees of the lead piece required for horizontal balance. Equally divide the remainder and add one half to the amount required for vertical balance.

EXAMPLE

Lead required for horizontal balance	102°
Lead required for vertical balance	50°
Remainder	52°
One half of remainder	26°

Lead required for balance - One piece 50° +26° = 76° and one piece 26°

d. Lay the cut pieces of lead on balance ring of the light blade and double check for horizontal balance.

e. Lay the cut pieces of lead 180 degrees apart on balance ring and double check for vertical balance.

f. Locate lead accurately for perfect vertical balance with the blade angle at approximately 13 degrees. Mark the position of the lead and change the blade angle of both blades to 30 degrees. Adjust the lead until the vertical balance is perfect at this blade angle. If adjustment was necessary, mark and check the vertical balance again at the same low blade angle first used. Repeat as necessary until the vertical balance at both blade angles is perfect.

g. Mark the position of each ring and solder lead in place. When the lead is soldered in place the added weight of the solder is intentional for minor final balance corrections.

h. Install the balance ring on the blade sleeve and locate it according to the mark. Pry balance ring to its extreme position toward the tip and tighten the attaching screws. Recheck the horizontal and vertical balance. The horizontal balance should show the blade to be slightly heavy but this must be corrected last. If either of the vertical positions (low pitch and high pitch) is out of balance, drill out lead as nearly as possible to the plane of rotation from the heaviest side or rotate the balance ring slightly.

i. If horizontal balance is heavy, drill out equal amounts of lead from each of the two pieces of lead added. The drillings must be located 180 degrees apart.

MATCHING BLADE BALANCE. When matching propeller blades to balance with each other, the single blade balance procedure is used. The location of the lead in the balance ring and the balance ring on the blade being used as the master blade must not have been disturbed since the blade left the factory. Correct the balance of only one blade, matching it with the other and cross out the weight category number on the decal of both blades. This situation should only be encountered when the propeller diameter is reduced; otherwise each blade should be balanced to a new blade.

REASSEMBLY

When reassembling the propeller, care should be taken to reinstall all parts in their original places, and the parts should be free of all dust and dirt. Apply a small amount of MIL-L-7711 (AN-G-15) grease to all moving parts. The following assembly procedure is recommended:

a. Insert the threaded end of the control bolt containing the cotter pin hole through rear boss in hub.

b. Install the nut and yoke, and turn in the control bolt until the leading thread is flush against the nut.

c. Install the other yoke by following the procedure in step b, above.

d. Install the actuator bolts through the yoke (both sides) but do not tighten the nuts at this time.

e. Set the hub and bearing on the dimension setting fixture and slide the guide over the yoke actuator bolt on one side.

f. Turn the control bolt down, finger tight, on the bearing and tighten the jam nut and the control bolt nut. Repeat this procedure for the other side and safety the jam nuts. Check for free operation.

g. Set the hub and bearing on a TK1016 mandrel, install the bronze bushings over the head of the actuator bolts, then insert the blades. Tighten blade retention nuts and back off two notches.

h. Check the blade angles at the 33-inch station. They should be within 1/4 degree of each other. Check the track and length at this point.

NOTE

Should the difference in blade angles be more than 1/4 degree, follow this procedure.

1. Note the blade with the lowest pitch angle.

2. Remove both blades and loosen the jam nut on the control bolt for the blade with the lowest angle. Loosen both actuator bolts.

3. Insert the blades, tighten blade retention nut, and back off two notches.

4. Push control bolts firmly on the bearing lugs, and again check the blade angle of the high blade.

5. Set the protractor on the blade with the low angle and screw the control bolt clockwise until the blade angle is the same as the high blade.

6. Grasp the counterweights, move blades to high pitch, then snap the blades to low pitch and check the blade angles again. Some adjustment of the control bolt may again be necessary to make the blade angles the same.

7. Remove the blades, tighten the jam nut on the control bolt, and safety.

NOTE

Exercise extreme care that the control bolt does not turn when tightening the jam nut.

8. Hold the control bolts firmly on the bearing lugs and tighten the actuator bolts. Check for free operation and insert the blades.

i. Remove the bearing from the hub and install the ring gear and fixed sleeve assembly to it. Install the motor and safety attaching screws.

j. The propeller should be balanced at this time.

k. Fasten the bearing to the control bolt following the reverse of directions given in PROPELLER DISASSEMBLY. Make certain that the bearing is properly aligned on the TK1016 mandrel.

1. Install the bearing on control bolts using a TK1016 mandrel.

2. The propeller retention nut must hold mandrel tight in hub and bearing.

3. Tighten the actuator bearing nuts gradually to prevent binding.

4. Screw the nuts tightly and recheck with a

TABLE V. TORQUE VALUES

Nomenclature	Part Number	Torque
Actuator bearing attaching nuts	207-309	80-90 Inch-pounds
Actuator bolt jam nuts	B200-363	35-40 Foot-pounds
Balance ring attaching screws	1/4-20NC-3 by 1/2 in.	40-60 Inch-pounds
Blade	215-207-88	See note 1
Blade lock bolts	AN4-4A	90 Inch-pounds
Counterweight arm attaching bolts	AN6-13A	350 Inch-pounds
Counterweight arm attaching bolts	AN6-21A	350 Inch-pounds
Counterweight set screws	1/4-20NC-3 by 3/16 in.	40-60 Inch-pounds
Gear retainer ring screw	AN520-10-16	40 Inch-pounds
Hub retention nut	B200-354	400 Foot-pounds
Hub retention nut	B200-416	400 Foot-pounds
Motor and bracket attaching screws	1/4-20NC-3 by 1/2 in.	40-60 Inch-pounds
Motor bracket screw	AN520-10-6	40 Inch-pounds
Mounting bolts	B200-430	*90 Inch-pounds
Mounting plate attaching bolts	R203-339	80-105 Inch-pounds
Pitch control bolts	215-318	150 Inch-pounds
Ring gear attaching bolts	AN3-4A	40 Inch-pounds
Spring stop attaching bolts	AN3-3A	40 Inch-pounds
Spring stop bracket attaching bolts	AN3-5A	40 Inch-pounds

*Without the spacer in the grommet, the bolt must be loose enough to turn the head by hand.
NOTE 1: Tighten blade retention nut in the hub, then back off approximately 1-1/2 notches or until a slight amount of play may be felt between the counterweight and retention nut by moving the blade back and forth.

feeler gage to determine if the bearing is concentric with the land on the sleeve at the bottom of the TK1016 mandrel. The face of the inner race should be snug on the sleeve land within 0.0015 inch.

l. Hold the blade by the tip and tighten the retention nut, one notch at a time until all play (other than axial rotation) disappears from the tip.

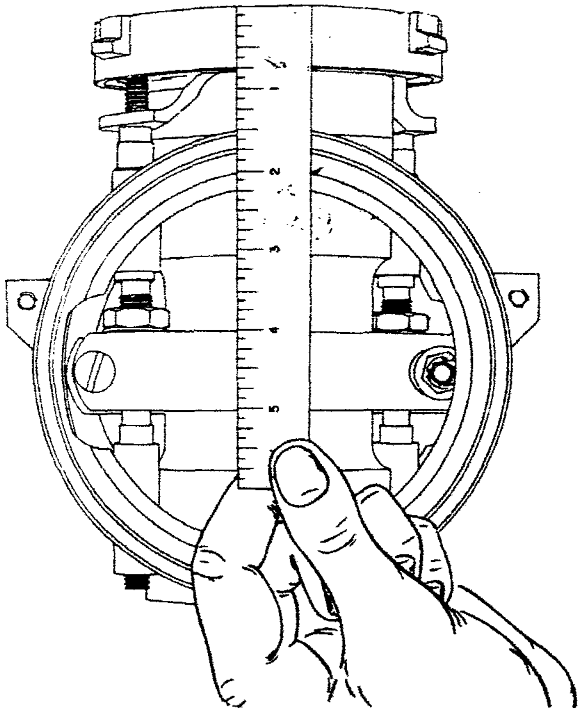


Figure 2-10. Measurement of Yoke

m. Loosen the nut 1 or 1-1/2 notches and lock in position with blade locks. For proper operation of the propeller, a small amount of play at the blade retention nut must be present. Overtightening will damage the bearings.

NOTE

If balls were removed from the blade bearing, be sure that the correct number of balls are reinstalled. The earlier blade bearing had 36 balls of 3/8 inch diameter and the later blades have 7/16-inch balls and require 31 in each bearing.

n. After installation of the blades, set the low pitch according to Table IV.

o. Install the safety low pitch stop nuts temporarily. Final setting should be done on the airplane.

NOTE

When changing blades or any specific part not requiring the removal of the yoke, it is not necessary to disassemble the propeller completely. Therefore, in most cases, it will not be necessary to disturb the yoke setting, and so, when assembling the propeller, it will not be necessary to use Steps 1 through 8.

MEASUREMENT OF YOKE. In order to obtain the correct travel on the blades when they are in operation, the yoke on the 215 Series Propeller should be set a distance of 5.120 inches from the top of the yoke to the bottom of the pitch control bearing as illustrated in figure 2-10.

TESTING

With the propeller assembled, turn the blades from high pitch to low pitch several times by hand, to check for free movement. Install the propeller on a suitable engine. With the engine operating at maximum rpm, run the propeller from low pitch to high pitch several times, then run at maximum rpm for one minute to seat the blade bearing races. During the test, watch for excessive vibration or evidence of binding in the pitch change mechanism. After the test, check the blade torque and adjust as necessary. If vibration was noticed, check for variations in blade length, pitch and track; rebalance if necessary. If binding was observed, check the blade changing mechanism for signs of rubbing or hard contact with mating surfaces. The propeller need not be disassembled for inspection after test unless some rework is required.

SECTION III

ILLUSTRATED PARTS BREAKDOWN

215 Series Propeller

INSERT LATEST REVISED PAGES. DESTROY SUPERSEDED PAGES.

LIST OF EFFECTIVE PAGES

NOTE: The portion of the text affected by the current revision is indicated by a vertical line in the outer margins of the page.

This section consists of the following:

Page No.	Issue	Page No.	Issue	Page No.	Issue
Title	Original				
*A	November 16, 1962				
3-1 thru 3-4	Original				

ALL PAGES LISTED ABOVE ARE **FAA-DER APPROVED** A1

TABLE OF CONTENTS

INTRODUCTION

This illustrated parts breakdown is composed of the Introduction, Group Assembly Parts List, including exploded view illustrations and Numerical Index for the propeller assembly Series 215 for Bonanza Aircraft manufactured by the Beech Aircraft Corporation, Wichita 1, Kansas.

The Group Assembly Parts List lists the main assemblies, subassemblies and detail parts which make up the final assembly. The system of breakdown is arranged in columnar indention form to indicate engineering relationship of all parts.

The quantities listed in the "UNITS PER ASSY" column of the Group Assembly Parts List are, in the case of assemblies, the total quantity used in each assembly. The quantities shown for component parts listed as details of an assembly indicate the number of parts used in each assembly.

To identify a part when part number is known, turn to Numerical Index to obtain the figure and index number where part is illustrated, refer to corresponding figure and index in accompanying text for nomenclature, etc. To identify a part when part number is not known, refer to the exploded view illustration, locate part in illustration and refer to corresponding figure and index in accompanying text for nomenclature, etc.

The parts Numbering System used is shown in the following illustration:

Drawing Number

215-108

Model Number

Prefix 1 Major Assembly
2 Subassembly
3 Detail Part
4 Installation Information

GROUP ASSEMBLY PARTS LIST

FIG. & INDEX NO.	PART NO.	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
3-1-	35-960025-601	PROPELLER ASSY, Constant speed D-3999 to D-4866 ..... (E225-8 engine)	1	
	35-960025-3	PROPELLER ASSY, Manual electric D-3999 to D-4866..... (E225-8 engine)	1	
	35-960025-5	PROPELLER ASSY, Manual electric D-3999 to D-4866..... (E185-11 engine)	1	
	215-108	PROPELLER ASSY, Constant speed D-3999 to D-4866 ..... (E225-8 engine)	1	
	215-116	PROPELLER ASSY, Manual electric D-3999 to D-4866..... (used with 35-910175 governor)	1	
	215-117	PROPELLER ASSY, Manual electric D-3999 to D-4866..... without governor	1	
-1	215-207-88	. BLADE ASSEMBLY	2	
	215-207-88-14	. BLADE ASSEMBLY, D-3744 to D-3999	1	
	215-213-84	. BLADE ASSEMBLY, D-3999 and after	1	
	B200-347-3	. . WEIGHT ASSY, Counter balance	1	
-2	B200-347	. . . WEIGHT, (Matched pair with B200-347-1)	1	
-3	B200-347-1	. . . WEIGHT, (Matched pair with B200-347)	1	
-4	215-319-2	. . RACE, (Broken and matched with -4 making -10).....	1	
-5	.4375 Dia.	. . BEARING, Ball (Grade I) (Strom Co, Cicero, Illinois) . .	31	
-6	215-319-4	. . RACE, (Broken and matched with -2 making -10).....	1	
	PRP6227-47	. . SEAL..............................	1	
	B200-313	. . NUT, Retaining (not available)	1	
-7	R201-208	. . RING ASSEMBLY........................	1	
	1/4-20NC-3x1/2	. . . SCREW, (Cadmium plated and magnafluxed)	2	
	R203-328	. . WEIGHT..............................	1	

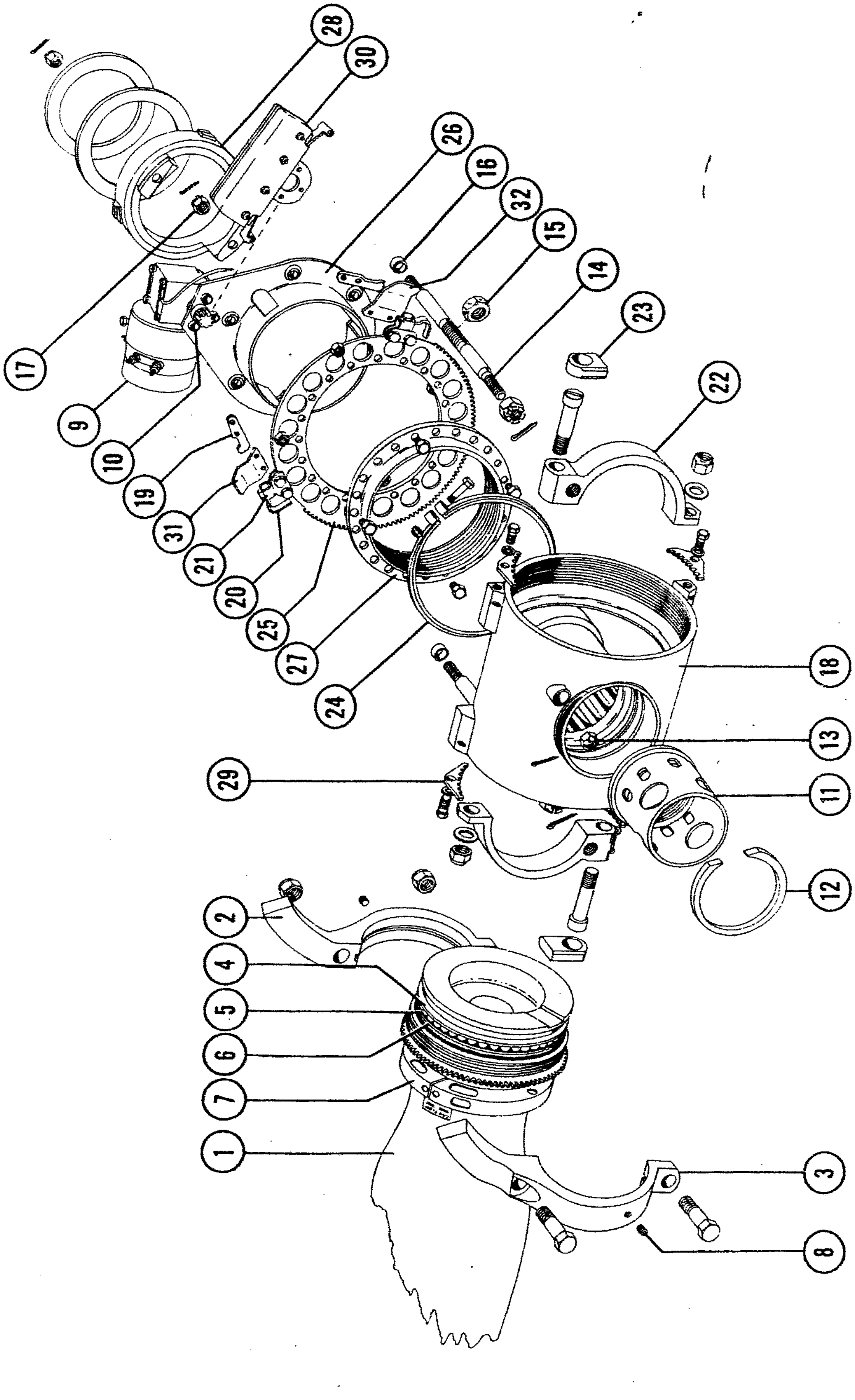


Figure 3-1. 215 Series Propeller

FIG. & INDEX NO.	PART NO.	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
3-1-8	1/4-20NC-3x3/16	. . SCREW, Hex socket set	2	
	215-322	. WEIGHT, (For hub to balance propeller)	8	
	215-109	. HUB ASSY, Prop manual electric	1	
-9	215-210	. . MOTOR ASSEMBLY	1	
	31-408	. . . BRUSH, Commutator	2	
	R203-214	. . MOTOR SUPPORT BRACKET ASSY	1	
-10	215-363-2	. . SCREW, Internal hex hd	3	
-11	B200-416	. . NUT	1	
-12	AN5009-10	. . SNAP RING	1	
-13	AN310-5	. . NUT	2	
-14	B200-373	. . BOLT	2	
-15	B200-363	. . NUT	2	
-16	207-308	. . SLEEVE	2	
-17	207-309	. . NUT	2	
-18	215-208	. . HUB	1	
-19	B200-372	. . CLIP	2	
-20	B200-383	. . STOP SPRING, (Used with B200-384)	1	
	B200-384	. . STOP SPRING, (Used with B200-383)	1	
-21	B200-330	. . BRACKET	2	
	AN3-3A	. . BOLT	2	
	AN3-6A	. . BOLT	4	
	AN365-1032	. . NUT	6	
-22	205-302	. . YOKE	2	
	215-318	. . BOLT	2	
	AN365-524	. . NUT	2	
-23	215-317	. . BUSHING	2	
-24	R200-308	. . RING	1	
	AN520-10-18	. . SCREW	1	
	AN365-1032	. . NUT	1	
-25	B200-334	. . GEAR	4	
	AN3-4A	. . BOLT	4	
	AN365-1032	. . NUT	4	
-26	B200-401	. . SLEEVE	1	
-27	B200-327	. . HUB GEAR	1	
-28	B200-202	. . BEARING ASSEMBLY	1	
-29	B200-303	. . LOCK	2	
	AN4-4A	. . BOLT	2	
	215-324	. . PLACARD, Aluminum blade	1	
		. . . CONSTANT SPEED PROPELLER	1	
	215-361	. . PLACARD, Hub identification	1	
	AN535-0-2	. . SCREW	6	
	215-107*	. HUB ASSY, Prop constant speed	1	
-30	B200-256	. . SWITCH ASSY, Constant speed	1	
	111514	. . . SPRING, Switch actuator	2	
	AN3201-1	. . . SWITCH	2	
-31	B200-422	. . CAM	1	
	B200-422-1	. . CAM	1	

* Same as 215-109 Propeller Hub Assembly, except as noted.

NUMERICAL INDEX

Part No.	Fig. & Index No.	Qty
.4375 Dia.	3-1-5	31
AN3-3A	3-1-21	2
AN3-4A	3-1-25	4
AN3-6A	3-1-21	4
AN310-5	3-1-13	2
AN3201-1	3-1-30	2
AN365-1032	3-1-21	11
	3-1-24	
	3-1-25	
AN365-524	3-1-22	2
AN4-4A	3-1-29	2
AN5009-10	3-1-12	1
AN520-10-18	3-1-24	1
AN535-0-2	3-1-29	6
B200-202	3-1-28	1
B200-256	3-1-30	1
B200-303	3-1-29	2
B200-313	3-1-6	1
B200-327	3-1-27	1
B200-330	3-1-21	2
B200-334	3-1-25	4
B200-347	3-1-2	1
B200-347-1	3-1-3	1
B200-347-3	3-1-1	1
B200-363	3-1-15	2
B200-372	3-1-19	2
B200-373	3-1-14	2
B200-383	3-1-20	1
B200-384	3-1-20	1
B200-401	3-1-26	1
B200-416	3-1-11	1
B200-422	3-1-31	1
B200-422-1	3-1-31	1

Part No.	Fig. & Index No.	Qty
PRP6227-47	3-1-6	1
R200-308	3-1-24	1
R201-208	3-1-7	1
R203-214	3-1-9	1
R203-328	3-1-7	1
1/4-20NC-3x1/2	3-1-7	2
1/4-20NC-3x3/16	3-1-8	2
111514	3-1-30	2
205-302	3-1-22	2
207-308	3-1-16	2
207-309	3-1-17	2
215-107	3-1-	1
215-108	3-1-	1
215-109	3-1-8	1
215-116	3-1-	1
215-117	3-1-	1
215-207-88	3-1-1	2
215-207-88-14	3-1-1	1
215-208	3-1-18	1
215-210	3-1-9	1
215-213-84	3-1-1	1
215-317	3-1-23	2
215-318	3-1-22	2
215-319-2	3-1-4	1
215-319-4	3-1-6	1
215-322	3-1-8	8
215-324	3-1-29	1
215-361	3-1-29	1
215-363-2	3-1-10	3
31-408	3-1-9	2
35-960025-3	3-1-	1
35-960025-5	3-1-	1
35-960025-601	3-1-	1

Excerpt from the American Bonanza Society Newsletter, March 1993, pages 3185 and 3186, retyped

Beech 215 prop blade dimensions.

The January 1993 *ABS Newsletter* (Pages 3147 and 3148) contained a write-up regarding Beech 215 propellers, namely blade dimension information which generated many phone calls to me saying, "Hey, what's this all about?

Any effort to keep these Beech 215 "electric" props going on the "oldie but goodie" airplanes is to be applauded. However, this *article* is the result of a misinterpretation of the procedure outlined in the overhaul manual. Published by Beech as PN 115187A1.

The procedure outlined in the 215 propeller manual begins on page *2-4* and ends on page 2-11. The blade drawing on page 2-9 (figure 2-8) is used by most or possibly all propeller shops as the limits for reduction in blade width and thickness allowable before the blade is retired from service.

There are *two errors* in the blade drawing regarding the minimum blade width and *one error* regarding blade thickness. It is possible that Beech has corrected these errors in a manual revision subsequent to my manual pages. However, all of the prop shops I know of use page 2-9, revised November 1962, which contains the errors.

The procedure allows a percentage of reduction from the design dimension. Some of the confusion which surrounds the procedures stems from Beech's usage of three different terms in the procedure which allude to the same dimension.

The terms are "design thickness or width," "design maximum thickness or width," and "nominal thickness or chord." All mean the starting point for the computations done to arrive at the allowable minimum dimensions.

The blade drawing contains the "minimum chord" and "minimum thickness" dimensions as calculated by the "allowable percentage of reduction" procedure with errors appearing at station 33 in chord and station 42 in both chord and thickness.

The reason for these errors is as follows: After determining the percentage of allowable reduction at the blade *sta*tion in question from the chart (Figure 2-2), an *additional* amount may be subtracted from the percentage calculation. This additional amount *is* taken from Table III, "Manufacturing Tolerances," page 2-11. These amounts are .025" from all thicknesses and .047 in "chord width" from blade shank to station 24 and .031" from station 27 to the blade tip. Don't ask me why. That's the procedure per the example shown on page 2-6.

The errors shown on the blade drawing Figure 2-8 stem from the "calculator" not subtracting the additional amount From Table III.

Also, the blade drawing shows cross-sections of the blade airfoil shape at stations 9-12-18-24-30-36 and 42. Each of these cross-sections has 11 thickness measurements across the blade chord. I *think* that all of the 11 dimensions shown at station 42 are in error by .025*.* The only one I *know* is incorrect is the minimum thickness allowed at station 42 at the crest point of the airfoil section, determined by calculation.

I think the other thickness dimensions shown in the cross-section drawing of station 42 are also .025 too thick because by plotting the dimensions on a graph-type drawing, the crest point calculated dimension takes an "unfair" dip in the graph line when plotted against the other 10 listed dimensions.

I suppose the guy who did the calculations used the pencil and paper or slip stick method, since 1962 was before the small handheld electronic calculators we all take for granted. The final reductions from the percentage reduction results weren't applied at the three points described above.

The following is a listing of the correct minimum blade dimension:

Station	Thickness	Chord
9	1.965	4.745
12	1.114	5.729
15	.776	6.120
18	.638	6.234
21	.582	6.248
24	.512	6.147
27	.451	5.956
30	.393	5.672
33	.324	5.254
36	.278	4.681
39	.227	3.961
41	.202	3.478
42	.165	3.168
43	.112	2.785

About six years ago, I put together a paperwork package detailing a method to measure the Beech 215 blades with the propeller on the airplane. This would allow a person to determine well in advance if the blades are approaching minimum dimensions and to begin a search for replacements without the need to rush and miss a better buy on blades. This paperwork is $8.00 plus $1.60 postage, a total of $9.60.

The tools to perform this procedure are six-inch vernier or dial caliper (.001 resolution), carpenters spirit level, 36" ridged rule, miscellaneous other items.

So that's about it on those blades dimensions, all of which probably bored the hell out of everybody except those few still relying on this unique part of aviation history.

A few years bark, one of our members tried to get enough people to sign up to have new 215 blacks built. The project died on the vine due to probably the 'put up or shut up" requirement of pre-purchase, front money. Can you image what 200 pairs of new 215 blades would be worth in the market place? Ummm, now if we could also get 200 new pitch change bearings . . . !

Lau Gage may be contacted at Sunrise Filters, Inc. 2255 Sunrise Reno: NV 89503, 702/826-7184