# HANDBOOK

## Overhaul Instructions

**Propeller Models**

**BHC-92ZF-1D1**

**HC-92ZK-8D, 8L**

**2 BLADE, CONSTANT SPEED**

**F.A.A. Approved**

**Manual 110**

HARTZELL PROPELLER, INC. • PIQUA, OHIO

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*NOTE: Installation, Operation and General Service are subjects which are covered in the Hartzell "Owner's Propeller Manual."*

# PART I-OVERHAUL

## SECTION I

## DESCRIPTION

The BHC-92ZF-1D1 is a 2-blade, constant speed propeller designed for engines in the 150-300 H.P. class having an "F" type mounting flange. The "F" flange utilizes six ½-inch bolts on a 4-inch bolt circle plus two ½-inch diameter dowel pins. The dash 1D1 design operates with governor oil pressure to **reduce** pitch and blade counterweights to **increase** pitch. The "B" preceding the HC in the design indicates that the propeller flange dowel pins are located in the "B" position.

The HC-92ZK-8D, -8L is also a 2-blade, constant speed propeller designed for engines in the 150 to 300 H.P. class, having the "K" type mounting flange. The "K" flange utilizes six ½-inch bolts on a 4¾-inch bolt circle. The dash 8D and 8L operate with governor oil pressure to **increase** pitch and blade centrifugal twisting moment to **reduce** pitch. The dash 8D is a right hand propeller, while the dash 8L is left hand.

## SECTION II
## OVERHAUL INSTRUCTIONS

Table I. - SPECIAL OVERHAUL TOOLS

**Propeller Table**
**Balancing Equipment, Wire or Arbor Types**
**B-884 Tool for Pressing Pilot Tube Into Hub Spider**

### A-1. REMOVAL OF PROPELLER FROM ENGINE — MODEL BHC-92ZF-1D1 (See Fig. 3)

(a) Remove spinner dome (50) by taking out screws (51).

(b) Remove the propeller from the engine by removing bolts (14) and washers (16) from the engine-propeller flanges. Work the propeller off the engine shaft, which is being held by two dowel pins (15), by applying a forward thrust and a fore and aft motion of the blade tips. It may also be possible to drive the dowel pins back, using a punch. Remove "O" ring (13).

(c) Remove the spinner bulkhead (52) by removing nuts (55), washers (54) and bolts (53).

### A-2. REMOVAL OF PROPELLER FROM ENGINE—MODEL HC-92ZK-8D,-8L (See Fig. 4)

(a) Remove spinner dome (44) by removing screws (45).

(b) Remove propeller from engine by removing mounting bolts (12).

(c) Remove "O" ring (11) and shim (13).

### B-1. DISASSEMBLY OF PROPELLER, MODEL BHC-92ZF-1D1 (See Fig. 3)

Mount the propeller on a table, securing the flange to the spindle fixture.

#### REMOVAL OF PISTON

(a) Unscrew nuts (43) from both piston guide rods (37).

(b) Loosen set screws (40) located in forks (39).

(c) Slide the piston-guide rod assembly forward off the cylinder (44), releasing washers (42), rod sleeves (41), and forks (39).

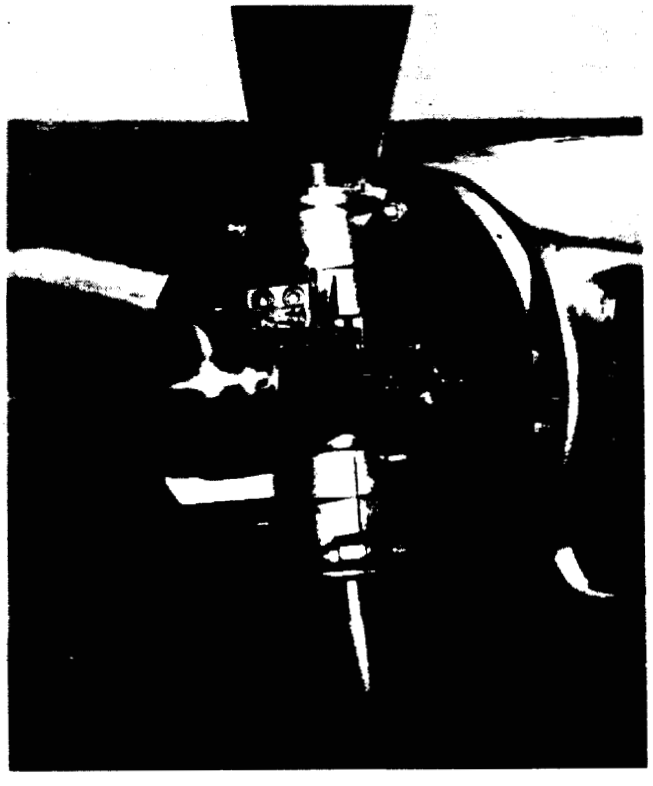

FIGURE 1 - Model BHC-92ZF-1D1

FIGURE 2 - Model HC-92ZK-8D, -8L

(d) Remove felt seal (47) and "O" ring (46) from the piston (34).

**CAUTION**

DO NOT attempt to remove dowel pin (38) or guide rod (37) as these parts are permanently installed at the factory. Also, do not remove plastic bushing (36) from inside the piston.

### REMOVAL OF CYLINDER

(a) Unscrew cylinder (44) using a square bar inserted in the slots provided.
(b) Remove "O" ring (45).

### REMOVAL OF BLADES AND CLAMPS

(a) With ink and scale, mark matching lines on blades (1) and clamps (18). Record blade serial number with clamp number for each side of propeller.
(b) Remove the nuts (30), bolts (29), and (27), and remove clamp halves (18). Remove gaskets (26). Remove blades (1).
(c) From the clamp (18) remove the lubricator fittings (21).
(d) Remove and **discard** counterweight mounting screws (24). These screws should be replaced immediately with new ones. Torque to 65 ft. lb. safety with cotter pin (25).

**CAUTION**

In normal overhaul operations, it is not necessary to remove counterweights (22) from the clamps (18), **unless the parts must be replated,** for which complete disassembly must be made. Since the counterweights are matched to the clamps (by virtue of the dowel pins) it is not possible to interchange these parts. If the counterweight (22) is defective, a new one can be installed; but if the clamp (18) is defective, the entire assembly must be replaced.

(e) Remove and discard linkscrew (19). This can ordinarily be done by unscrewing the linkscrew without removing staking pin (20), as the latter will shear off. After linkscrew is removed, the pin (20) can be removed from the clamp with a small punch.
(f) Install new linkscrew (19) in clamp. Torque to 35-40 ft. lb. Remove linkscrew and examine the cone seat of the screw and clamp to be sure that these parts are 75% seating, as this is extremely important. Reinstall linkscrew and torque to 35-40 ft. lb. Safety with new pin (20), and stake.

### REMOVAL OF BLADE BEARINGS

(a) Place a container beneath the ball bearing (10) to catch the balls when released.
(b) Roll "O" ring (12) out of its groove in the hub spider, using a screw driver. This releases the bearing, allowing the balls to drop out.
(c) Slide the bearing races (10) in towards the center of the hub allowing split rings (11), bearing (10), and "O" ring (12) to be removed. Discard split rings (11).

### REMOVAL OF GUIDE COLLAR UNIT

(a) Drive guide collar dowel pins (8) out thru rear of propeller flange.
(b) Remove the socket head screws retaining the guide collar unit (7) allowing guide collar to be removed from hub spider (3).

### REMOVAL OF SPINNER LUG

(a) Unscrew bolts (6) removing spinner lugs (5).

## B-2. DISASSEMBLY OF PROPELLER, MODEL HC-92ZK-8D, -8L (See Fig. 4)

Mount the propeller on a table, securing the flange to a spindle fixture.

### REMOVAL OF PISTON

(a) Unscrew nuts (36) from both piston guide rods (30).
(b) Loosen set screws (33) located in forks (32).
(c) Slide the piston-guide rod assembly forward off the cylinder (38), releasing washers (35), sleeves (34), and forks (32).
(d) Remove felt seal (39) and "O" ring (37) from inside of piston (27).

**CAUTION**

DO NOT attempt to remove dowel pin (31) or guide rod (30) as these are permanently installed at the factory. Also, do not remove plastic bushing (29) from the piston (28).

### REMOVAL OF CYLINDER

(a) Unscrew cylinder (38) using a square bar inserted in slots provided.
(b) Remove "O" ring (40).

### REMOVAL OF BLADES AND CLAMPS

(a) With ink and scale, mark matching lines on blades (1) and clamps (15). Record blade serial number with clamp number for each side of propeller.
(b) Remove the nuts (23), bolts (22), and (20), and remove clamp halves (15). Remove gaskets (19). Remove blades (1).
(c) From the clamp (15) remove the lubricator fittings (18).
(d) Remove and discard linkscrew (16). This can ordinarily be done by unscrewing the linkscrew without removing staking pin (17), as the latter will shear off. After linkscrew is removed, the pin (17) can be removed from the clamp with a small punch.
(e) Install new linkscrew (16). Torque to 35-40 ft. lb. Remove linkscrew and examine the cone seat of the screw and the clamp to be sure these parts are 75% seating, as this is extremely important. Reinstall linkscrew and torque to 35-40 ft. lb. Safety with new pin (17). and stake.

### REMOVAL OF BLADE BEARINGS

(a) Place a container beneath the ball bearing (8) to catch the balls when released.
(b) Roll the "O" ring (10) out of its groove in the hub spider, using a screw driver. This releases the bearing, allowing the balls to drop out.
(c) Slide the bearing (8) in towards the center of the

hub, allowing split rings (9) to be removed.
(d) Remove bearing (8), and "O" ring (10).

### REMOVAL OF GUIDE COLLAR UNIT

(a) Drive staking dowel pin (6) back thru propeller flange.
(b) Unscrew socket head screws holding guide collar unit (5) together. Remove guide collar (5).

## C. CLEANING

(a) Wipe all dirt and grease off all parts.
(b) Clean all parts, except felt seal (47) or (39) with solvent, and dry.
(c) Apply a rust preventative compound on all parts which are to be stored for any length of time, or shipped.
(d) Keep in clean and dry place before reassembly.

## D. INSPECTION

(a) Inspect all wearing parts according to tolerances specified in TABLE II. Replace parts not coming within specified limits.
(b) Inspect the blades according to the tolerances in TABLE III. Replace a blade which falls below the listed minimum dimensions upon repair.
(c) Visually inspect all metal surfaces. Replace or refinish any bearing or wear surface which has a visible nick, dent or other distortion.
(d) Magnetically inspect all steel parts for cracks not visible to the eye.
(e) Visually inspect the blades for cracks, particularly around the shank retention area and at the leading edge near the tip.
(f) Inspect the bearings for excessive wear or chafing. A certain amount of marking of the balls and races is to be expected and is not necessarily a reason for replacement. Only when the bearings show pit marks which are .002" deep and definitely feel rough are the balls or races to be replaced. Bearing life ordinarily is greater than 1000 hours.
(g) Inspect pilot tube (4) for slippage. The tube should extend out from hub 3¾ inches only. If this distance is greater, the indication is that the tube has slipped out of the hub spider. An oversize tube should replace the one which slipped.

## E. REPAIR AND REPLACEMENT

(a) Remove all rust, galling marks and nicks from the hub spider arms with crocus cloth or fine emery. Rust, galling and nicks are stress raisers which reduce the fatigue life of the hub. Do not polish unless necessary, as the spider arms have been rolled to improve the fatigue strength. (The roll marks are not tool marks and should not be removed.) If the blade pilot tube (4) is to be replaced in the hub, due either to excessive wear, or due to the fact that it has slipped out slightly from the spider, it is necessary to use a new tube having a .002" to .003" oversize diameter over the 2¼" length which presses into the hub spider hole. Press the new tube (4) into the hub spider (3) leaving exactly 3¾ inches of the length exposed. Be sure the heavy end of the tube is inserted into the hub. Test the tube for tightness by applying 5000 lb. force on the tube. If it slips with this force it must be replaced with a larger tube of say .003" to .004" oversize.
(b) Replace the counterweight mounting screws as noted above. Use only the specified parts as they are heat treated to a high strength.
(c) Replace all gaskets, "O" rings, and cotter pins.
(d) Nicks or deep scratches in cylinder (44) or (38) may be cause for replacement, particularly if the marks are in the region of the piston "O" ring during normal cruise-flight. Scratches in the other regions may be tolerated if not too deep.
(e) Replating (cadmium) of steel parts is recommended if the original plating has been worn off or if damaged by nicks or scratches.

**CAUTION**

The hub spider arms (3) and pilot tubes (4) should be masked. After plating the parts, they **must** be baked in an oven at 350° F. plus or minus 25° for 3 hours to eliminate possibility of hydrogen embrittlement. High strength bolts, hub and clamp parts are particularly susceptible to this effect. Failure of the part may result unless this baking is accomplished. If proper plating facilities are not available, the parts should be painted with a suitable aluminum or lacquer paint.

(f) Repair blades according to CAA Manual.
(g) Blade bushings. If the blade bushing is worn beyond specified tolerances, the blades should be returned to the factory to be rebushed. These bushings seldom wear, however, to the point where they must be replaced.

## F-1. ASSEMBLY, MODEL BHC-92ZF-1D1 (See Fig. 3)

Reassemble in reverse order of disassembly.

### ASSEMBLY OF SPINNER LUG ONTO HUB SPIDER

(a) Attach lug (5) to flange of hub spider (3) with screws (6). Wire safety.

### ASSEMBLY OF GUIDE COLLAR UNIT

(a) Install guide collar unit (7) on hub spider (3), using socket head screws to clamp halves together. Before screws are tightened, line up the notch in the collar unit (7) with the dowel pin hole in the hub spider. Tighten screws to 2-4 ft. lb. torque.
(b) Insert dowel pin (8) in flange from rear, until it enters the notch machined into guide collar (7).

**CAUTION**

Do not confuse dowel pin (15), which is used for installing the propeller on the engine with dowel pin (8).

### ASSEMBLY OF BLADE BEARINGS ONTO HUB SPIDER

(a) Mount hub spider (2) on propeller table.
(b) Place a blade mounting "O" ring (12) on each leg of the hub spider (3). Roll the "O" ring back towards the center of the hub.
(c) Install the blade mounting bearing (10) on the hub spider.

**CAUTION**

Be sure the **thin** race is installed **first.**

(d) Install NEW like-numbered blade mounting split rings (11) between the bearing and the spider arm shoulder.
(e) Pull the bearing (10) and split ring (11) outward against the shoulder of the hub spider. Roll the "O" ring (12) into its groove behind the bearing (10).

### CLAMPS AND BLADES

*NOTE: In order to assemble the propeller and set the pitch accurately, it is advantageous to use a special propeller table having a shaft which mates with the propeller hub flange. Air or oil pressure (100 psi min.) should be available in the shaft to actuate the piston.*

(a) Mount the hub on the propeller table shaft, sealing the flange with "O" ring (13). Fasten with bolts or clamps.
(b) Fill the blade pilot hole with a grease as specified under "GREASES RECOMMENDED."

*NOTE: Be sure no air is trapped below the grease as this will upset balance.*

(c) Install blade (1) on the same pilot tube (4) from which it was received. Place a hardening gasket compound (commercial automotive type) around the blade shank in the shoulder radius.
(d) Install the correct matching clamp and counterweight subassembly (17) with new clamp gaskets (26). Fasten the clamp halves together with screws (27), bolts (29), and nuts (30). Tighten these screws and check blade for friction on the hub when rotated. Remove blade, and correct for friction if too tight.

*NOTE: The pitch will be set after the propeller is completely assembled, after which the clamp bolts will be torqued and safetied.*

(e) Install the lubricator fittings (21).

### INSTALLATION OF CYLINDER

(a) Insert "O" ring (45) in the cylinder (44) groove behind the threads. Apply a small amount of non-hardening gasket compound to the threads. Screw cylinder (44) onto hub (3). Use a 1-inch square bar about 3-4 feet long as a wrench, applied to the slot in the cylinder. Tighten the cylinder hard against the hub (about 200-300 ft. lb. torque).
(b) Inspect the inside of the cylinder to be sure the "O" ring (45) is in place.
(c) Inspect around the slots to be sure the bar has not raised the edges which might cut the "O" ring of the piston. Peen edges if necessary.

### INSTALLATION OF PISTON

(a) Install new "O" ring (46) and felt seal (47) in piston (34). Oil these parts.
(b) Fit new pitch change block (48) snug in fork (39) and install block on linkscrew (19).
(c) Install piston assembly (33) over cylinder (44), feeding guide rods (37) thru forks (39), and sleeves (41) which must be fitted into the bushings of guide collar clamp (7). Install washer (42) and nut (43) onto rod (37). Torque to 20 ft. lb.
(d) Tighten set screw (40) 2-3 ft. lb. torque. Prick punch around set screw to safety.

### SETTING BLADE PITCH

(a) Loosen outer clamp screws (29) only. Apply air or oil pressure to piston to force piston against low pitch stop. Hold this position and set **one** blade to proper value specified for aircraft. Tighten outer clamp screws (29) 60-65 ft. lb. torque.
(b) Release pressure and move pitch into high value. Set the second blade to match the first blade, within about .2°. Torque outer screws (29) to 60-65 ft. lb. Torque inner clamp screws to 40 ft. lb. Safety with cotter key thru drilled hole in the head.
(c) Check the blade against turning in the clamp by torquing the blade to 167 ft. lb. Use a blade bar and a weight attached to the end. If the blade moves, or rocks in the clamp, the clamp must be removed and the difficulty rectified. Experience has shown that the clamp gaskets (26) may prevent the clamps from tightening on the blades. The gaskets can be trimmed at the outer hole slightly to allow the clamp to come together closer. Also, the outer corner of the clamps might require filing by .005-.010. (Coat filed area with aluminum lacquer.) (Bulletin 69 also covers this subject.)
(d) Check the blade angle again at high pitch, as torquing of the blade may have moved it.

### CHECK FOR GENERAL OPERATION, FRICTION AND LEAKAGE

(a) Cycle the pitch with the counterweights for possible friction.
(b) Hold full pressure on piston and check for leakage past piston "O" ring (46) and cylinder "O" ring (45). Spread oil around these points, as air bubbles will indicate leakage.

## F-2. ASSEMBLY, MODEL HC-92ZK-8D, 8L (See Fig. 4)

Reassemble in reverse order of disassembly.

### ASSEMBLY OF GUIDE COLLAR UNIT

(a) Install guide collar unit (5), using socket head screws to clamp the two halves together. Before screws are tightened, line up the notch in the collar unit (5) with the dowel pin hole in the hub flange. Tighten screws to 2-4 ft. lb. torque.
(b) Insert dowel pin (6) in flange from rear and until it enters the notch machined into the guide collar (5).

### ASSEMBLY OF BLADE BEARINGS ON HUB SPIDER

(a) Mount hub spider (2) on propeller table.
(b) Place a blade mounting "O" ring (10) on each leg of hub spider (3). Roll the "O" ring back towards the center of the hub.
(c) Install the blade mounting bearing (8) over the hub spider.

**CAUTION**

Be sure the **thin** race is installed **first.**

(d) Install **NEW** like-numbered blade mounting split rings (9) between the bearing and the spider arm shoulder.
(e) Pull the bearing (8) and split ring (9) outward against the shoulder of the hub spider. Roll the "O" ring (10) into its groove behind bearing (8).

### CLAMPS AND BLADES

*NOTE: In order to assemble the propeller and set the pitch accurately, it is advantageous to use a special propeller table having a shaft which mates with the propeller hub flange. Air or oil pressure (100 psi. min.) should be available in the shaft to actuate the piston.*

(a) Mount the hub on the propeller table shaft, sealing the flange with "O" ring (11). Fasten with bolts or clamps.
(b) Fill the blade pilot hole with grease as specified under "GREASES RECOMMENDED."

*NOTE: Be sure no air is trapped below the grease as this will upset the balance.*

(c) Install blade (1) on the same pilot tube (4) from which it was received. Place a hardening gasket compound (commercial automotive type) around the blade shank in the shoulder radius.
(d) Install the correct matching clamp and counterweight subassembly (14) with new clamp gaskets (19). Fasten the clamp halves together with screws (20), bolts (22) and nuts (23). Tighten these screws and check blade for friction on the hub when rotated. Remove blade and correct for friction if too tight.

*NOTE: The pitch will be set after the propeller is completely assembled, after which the clamp bolts will be torqued and safetied.*

(e) Install the lubricator fittings (18).

## INSTALLATION OF CYLINDER

(a) Insert "O" ring (40) in the cylinder (38) groove behind the threads. Apply a small amount of non-hardening gasket compound to the threads. Screw cylinder (38) onto hub (3). Use a 1-inch square bar about 3-4 feet long as a wrench, applied to the slot in the cylinder. Tighten the cylinder hard against the hub (about 200-300 ft. lb. torque).
(b) Inspect the inside of the cylinder to be sure the "O"ring (40) is in place.
(c) Inspect around the slots to be sure the bar has not raised the edges which might cut the "O" ring of the piston. Peen edges if necessary.

## INSTALLATION OF PISTON

(a) Install new "O" ring (37) and felt seal (39) in piston (27). Oil these parts.
(b) Fit new pitch change block (41) snug in fork (32) and install block on linkscrew (16).
(c) Install piston assembly (26) over cylinder (38), feeding guide rods (30) thru forks (32), and sleeves (34), which must be fitted into the bushings of guide collar (5). Install washer (35) and nut (36) onto rod (30). Torque to 20 ft. lb.
(d) Tighten set screw (33) 2-3 ft. lbs. torque. Prick punch around set screw to safety.

## SETTING BLADE PITCH

(a) Loosen outer clamp screws (22) only.
(b) With no air pressure, set low pitch on both blades per aircraft specification. Tighten outer clamp screws (22) to 60-65 ft. lb. torque. Torque inner screws (20) to 40 ft. lb.
(c) With air pressure, increase pitch to high stops and check blade angle.
(d) Check the blade against turning in the clamp by torquing the blade to 167 ft. lb. Use a blade bar and a weight attached to the end. If the blade moves, or rocks in the clamp, the clamp must be removed and the difficulty rectified. Experience has shown that the clamp gaskets (19) may prevent the clamps from tightening on the blades. These gaskets can be trimmed at the outer hole slightly to allow the clamp to come together closer. Also, the outer corner of the clamps might require filing by .005-.010 inch. (Coat filed area with aluminum lacquer.) (Bulletin 69 also covers this subject.)
(e) Check the blade angle in low pitch again, as torquing of the blade may have moved it.

## CHECK FOR GENERAL OPERATION, FRICTION AND LEAKAGE

(a) Cycle the pitch for possible friction.
(b) Hold full pressure on piston and check for leakage past the piston "O" ring (37) and cylinder "O" ring (40). Spread oil around these points as air bubbles will indicate leakage.

# SECTION III
# BALANCE

(a) Balance the propeller assembly before grease is added to the clamps, and check again after grease is added. Balance with pitch about midway between low and high pitch.
(b) Either a suspension system or an arbor mounted on knife edges may be used for balancing. In the event the suspension system is used, it is essential that the center of gravity of the propeller be located at or slightly below the pivot of the balance equipment; otherwise inaccuracies will result.
(c) Remove the end play from the blade clamp assemblies by driving identical small wedges between the blade clamps and hub spider, at identical locations.
(d) Bolt propeller to balance arbor, or wire balancer.

*NOTE: The following balance procedure applies only to balance arbor method.*

(e) Check horizontal balance by laying slugs in corner of blade and clamp. Record number of slugs required for balance.
(f) With the propeller in horizontal position, apply 50-100 lb. downward force to each blade tip. This takes up the clearance between hub and blades in one direction.
(g) Check vertical balance with heavy blade up. Add weight slugs to light side of clamps. Record number required for balance.
(h) Rotate blade 180° from horizontal position as noted in "f" above and apply 50-100 lb. to each blade tip. This takes up the clearance opposite to that noted under "f".
(i) Again check vertical balance. Record number of weight slugs.
(j) The final number of weight slugs can now be determined for vertical balance. If the slugs under "g" and "i" are added to the **same** side of the blade, the total slugs required for vertical balance is the **average** of "g" and "i". If the slugs under "g" and "i" are added to **opposite** sides of the blade the **difference** between the two numbers is added to the side requiring the greatest number.
(k) Horizontal balance determined under "e" must be maintained by properly dividing the slugs required under "j" between the two blades.
(l) Attach the slugs to the clamps with screws and again check horizontal balance. Safety with wire. Do not attach more than 4 slugs with each pair of screws.
(m) Add equal amounts of grease to each blade, holding horizontal balance constant, until clamps are completely full, as evidenced by grease starting to come out around circumference of hub spider at "O" ring. Avoid blowing out "O" ring and gaskets with excessive pressure.

# SECTION IV. WEAR TOLERANCES

## Table II. - TOLERANCES OF WEARING SURFACES

### MODELS BHC-92ZF-1D1 & HC-92ZK-8D, -8L

| Item No. | Part or Description of Measurement | Specified | | Replace if Dimension is Above or Below | |
|---|---|---|---|---|---|
| | | Max. | Min. | Max. | Min. |
| 1 | A-1308 Pilot Tube O.D. { Inner 1¼ inch / Outer 1 inch | 1.7185<br>1.7203 | 1.7180<br>1.7197 | ---<br>--- | 1.7165<br>1.7187 |
| 2. | A-1308 Pilot Tube Extension Beyond Hub Spider | 3¾ +1/16 | 3¾ −1/16 | 3¾ +⅛ | --- |
| 3. | Blade Bushing I. D. | 1.7225 | 1.7215 | 1.7240 | --- |
| 4. | A-862 Plastic Bushing in Piston, I. D. | 3.782 | 3.780 | 3.790 | --- |
| 5. | 8-806 Cylinder, O. D. | 3.778 | 3.776 | --- | 3.773 |
| 6. | 834-9 Bushings in Guide Collar, I. D. | .506 | .504 | .510 | --- |
| 7. | A-827-1 Rod Sleeve, O. D. | .5002 | .4998 | --- | .4995 |
| 8. | A-821 Fork | Fit A-95-A Block to Fork | | | |
| 9. | Balance Tolerance | 1 slug A-1305 | --- | --- | --- |
| 10. | Blade Track | ±1/16 | --- | --- | --- |
| 11. | Blade End Play | .060 | --- | --- | --- |
| 12. | Blade Fore and Aft Movement of Tip | .100 | .068 | .110 | --- |

## TABLE III. - BLADE REPAIR TOLERANCES

| Radius | Angle Min. | Angle Max. | Face Alignment Min. | Face Alignment Max. | Width (Min.) | Thickness (Min.) |
|---|---|---|---|---|---|---|
| **8447 & 8447-12A (Exclude 36)** | | | | | | |
| 8 | | | | | 4.110 | 2.667 |
| 12 | | | | | 5.587 | 1.304 |
| 18 | 31.3 | 31.9 | .158 | .222 | 6.321 | .798 |
| 24 | 25.7 | 26.3 | −.032 | .032 | 6.091 | .517 |
| 30 | 21.9 Setup | 21.9 | −.152 | −.098 | 5.460 | .354 |
| 36 | 18.8 | 19.2 | −.227 | −.163 | 4.196 | .231 |
| **8847** | | | | | | |
| 8 | | | | | 4.110 | 2.668 |
| 14 | | | | | 5.928 | 1.304 |
| 20 | 30.5 | 31.5 | .158 | .222 | 6.318 | .757 |
| 26 | 25.5 | 26.1 | −.072 | −.008 | 6.080 | .497 |
| 32 | 21.9 Setup | 21.9 | −.192 | −.128 | 5.448 | .355 |
| 38 | 18.8 | 19.2 | −.242 | −.178 | 4.188 | 2.33 |

## TABLE IV. - TORQUE VALUES FOR IMPORTANT SCREWS, NUTS, AND THREADED PARTS

| PART | Torque Value Ft. Lb. |
|---|---|
| Outer Clamp Bolts, ½-20 | 60-65 |
| Inner Clamp Socket Screws, ⅜-24 | 40 |
| Counterweight Screw, 7/16-20 | 65 |
| "F" and "K" Mounting Screws, ½-20 | 60-70 |
| Cylinder | 200-300 |
| Piston Guide Rod Nut, 7/16-20 | 20 |
| Linkscrew, ½-20 | 45-50 |

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## SECTION V
## LUBRICATION

### A. General Properties of Grease Required

Any grease used must have the following properties:

(a). Waterproof.

(b). Temperature range between —15° F and 150° F; or -40° to 100° F if operation is in cold climate.

(c). Freedom from separating oil from soap base due to centrifugal force or high temperature.

(d). Low friction.

### B. List of Approved Greases, by Spec. or Name

1. [redacted]
2. Stroma HT-1 (Z-801 Grease)
   Union Oil Co. of California.
3. Gulflex Moly for blade bushings.
4. Gulflex A.
   This grease is recommended for the blade ball bearings as it will not bleed oil in hot weather.
5. RPM Aviation Grease No. 2
   Standard Oil Co. of California.
6. Stroma LT-1 (Z-815 Grease)
   Union Oil Co. of California.
7. Lubriplate 630 AA
   Fiske Brothers, Toledo, Ohio.
   This grease will bleed oil in hot weather. It is recommended only for lubrication of the blade pilot tubes but not the blade bearings.
8. RPM Aviation Grease No. 1
   Standard Oil Co. of California.
9. Lubriplate 707
   Fiske Brothers, Toledo, Ohio.
10. Mobilgrease Aero Lo-Hi PD-535-K
    Socony Vacuum Oil Co.
11. No. 84 Medium Grease
    Keystone Lubricating Co.
12. Texaco Regal Starfax Special.
13. Molub-Alloy No. 2 Grease —10° F.
    No. 1 Grease —25° F.
    Imperial Oil & Grease Co.
    Los Angeles, California.
14. Germany—Calypsol H729
    German Calypsol Company, Dusseldorf.

### C. Proper times and amounts of grease are mentioned during assembly procedures

## SECTION VI SERVICE TROUBLES AND REMEDIES

| *Trouble* | *Probable Cause* | *Remedy* |
|---|---|---|
| **FAILURE OF PITCH TO CHANGE** | If rpm fails to increase but will reduce: Low oil pressure. | Set relief valve in governor to provide necessary pressure, up to 275 psi. |
| | If rpm change in both directions is sluggish: Excessive friction in hub mechanism. | See "Excessive Friction in Hub Mechanism," below. Isolate friction in each blade by uncoupling piston and testing each blade separately, before tearing propeller down. |
| | Newly-installed governor has wrong direction of rotation, or has bypass plug in wrong hole. | Check and correct. |
| **EXCESSIVE FRICTION IN HUB MECHANISM** | Pilot tube has slipped out slightly and is rubbing hard against end of hole in blade. | Tear down and check distance pilot tube extends from hub spider. Should be 3¾ inches. If more, remove pilot tube and replace with a tube .002 in. oversize at the hub end. |
| | Blade bushing seized on pilot tube. | Polish pilot tube and blade bushing with fine emery paper and reassemble. |
| | Blade ball bearings unusually rough or broken. | Replace bearing. |
| | Friction in various moving parts of pitch control mechanism. | Check parts individually. If tightness is encountered in sliding parts, increase clearances slightly. Apply oil externally to moving parts. |
| **IMPROPER RPM** | Static rpm too low. | Governor has high rpm stop, as well as propeller low pitch stop. Either the governor or the propeller stop may limit maximum rpm. To determine which is causing trouble, open the throttle and move governor control back and forth slowly.<br>If maximum rpm is reached BEFORE governor stop is reached, propeller stop is probably limiting rpm. If this is the case, loosen blade clamp outer bolts and rotate blades in clamps. Reduce blade angle about 1° for each 100 rpm increase. (1° equals 1/32 inch circumference at blade root.)<br>If maximum rpm is reached AT SAME TIME as governor stop is reached, governor stop is probably limiting the maximum rpm. Readjust governor stop to obtain proper rpm. One turn of governor stop screw equals about 17 rpm. Turn stop screw out to increase rpm.<br>Governor stop should limit high rpm, with propeller stop reached at 50 to 100 rpm beyond. This allows for variations in engine power without affecting maximum rpm. |

| *Trouble* | *Probable Cause* | *Remedy* |
|---|---|---|
| | Static rpm too high | Reduce by screwing governor stop in, one turn for each 17 rpm reduction. |
| **SURGING (When governor control is changed rapidly or rough air is encountered.)** | Air trapped in propeller actuating piston or in engine shaft. | Provision should be incorporated in engine to allow trapped air to escape from system during one half of the pitch change cycle. Exercise propeller by changing pitch or feathering before each flight. |
| | Governor pressure too low. | Adjust governor relief pressure so that rate of pitch change is the same in both directions. |
| | Excessive friction in pitch change mechanism. | See "Excessive Friction in Hub Mechanism." |
| | Governor lacks sufficient dampening. | Change or adjust speeder spring. This gives governor more stability, but makes pitch control more sensitive, which, may in turn require rerigging of control to offset higher spring rate. Changing to stiffer speeder spring should be done only after all other factors are checked and corrected. |
| **OIL LEAKAGE** | Faulty "O" ring seals as follows: Front of rear cone between engine shaft and hub. Between hub and cylinder. Between piston and cylinder at front of piston. | Disassemble and inspect "O" rings and the surfaces they seal. Replace "O" rings if defective. Replace cylinder if surface is scratched or nicked in area where "O" ring slides. Use gasket compound on cylinder threads when replacing. Peen down raised places caused by tightening of cylinder with bar. |
| **GREASE LEAKAGE (Only source of grease leakage is blade bearings.)** | Grease leaks past clamp seal gaskets. | Loosen clamp bolts and replace gaskets. Standard thickness of gasket is .050, but .060 gaskets are available in case .050 gaskets are not compressed sufficiently to hold. |
| | Grease leaks from between blade and clamp. | Inscribe blade with ink or pencil to assure correct blade angle on reassembly, and remove blade and clamp. Add gasket compound in radius of blade butt. Replace blade and clamp. |
| **END PLAY IN BLADES** | Buildup of manufacturing tolerances. | Total end play of .060 is permissible. |
| **BLADE TRACK** | | Tolerance of 1/8 inch is allowed. |
| **BLADE FIT ON HUB PILOT TUBE** | | With manufacturing tolerances, the maximum that the blade tip can be moved fore and aft is .068, without grease in blade clamps and bearings. With grease, the movement is nil. If blade tip fore-and-aft movement increases to .100 dry, blade requires factory rebushing. |

# PART II — PARTS LISTS

## SECTION I
## INTRODUCTION

The first column in each parts list is the figure and index number. This refers to the illustration and index number of each part. For example, if you are ordering a blade clamp assembly and want to see how and where it locates on the general assembly, this column indicates Figure 3 index number 17. Looking at Figure 3 in the group assembly Parts List, index number 17, the appearance and location of the clamp assembly may be easily found, also the details of all parts contained in this subassembly.

If you do not know the part number, you may refer to the applicable illustration and then find the index number assigned to it(17). Look in the parts listing, and read the part number, 838-48.

## HOW TO ORDER

It is important that the Part Number, Part Name and Model Number be given when ordering parts.

# SECTION II

## GROUP ASSEMBLY PARTS LIST

### Model BHC-92ZF-1D1

| Code No. | Part No. | Description | No. Required |
|---|---|---|---|
| 1 | — — — | Blade | 2 |
| 2 | 840-48 | HUB SPIDER UNIT | 1 |
| 3 | C-1304-6 | Spider, Hub | 1 |
| 4 | A-1308 | Tube, Pilot | 2 |
| 5 | A-1338 | Lug, Spinner | 2 |
| 6 | AN74-5 | Bolt, Hex Head | 4 |
| 7 | 834-9 | Guide Collar Unit | 1 |
| 8 | A-957-1 | Pin, Guide Collar Dowel | 2 |
| — | — — — | ASSOCIATED PARTS, HUB | |
| 10 | A-1303A | Bearing, Blade | 2 |
| 11 | A-1331 | Ring, Split | 2 |
| 12 | PRP-909-7 | "O" Ring, Blade | 2 |
| 13 | PRP-909-6 | "O" Ring, Shaft | 1 |
| 14 | AN8H7A | Bolt, Hex Head, Hub Mounting | 6 |
| 15 | .5002x1 | Pin, Danley Dowel | 2 |
| 16 | AN960-816 | Washer | 6 |
| 17 | 838-48 | ASSEMBLY, CLAMP | 2 |
| 18 | C-1301-1 | Clamp | 2 |
| 19 | A-295 | Linkscrew | 2 |
| 20 | A-285 | Pin, Linkscrew Staking | 2 |
| 21 | #5010 | Fitting, Zerk | 2 |
| 22 | B-1354-3 | Counterweight | 2 |
| 23 | A-65 | Pin, Counterweight Staking | 2 |
| 24 | 7/16-20x3 1/4 | Screw, Counterweight Socket | 4 |
| 25 | A-285 | Pin, Counterweight Socket Screw Staking | 4 |
| 26 | A-1306 | Gasket, Clamp | 4 |
| 27 | A-282 | Screw, Clamp Socket | 4 |
| 28 | AN380-3-2 | Pin, Socket Screw Cotter | 4 |
| 29 | 7/16-20x2 1/8 | Screw, Clamp Ferry | 4 |
| 30 | AN363-720H.T. | Nut, Clamp Flexlock | 4 |
| — | — — — | ASSOCIATED PARTS, CLAMP | |
| 31 | A-1305 | Weights, Balance | As Needed |
| 32 | AN501A10-6 | Screws, Weight | 4 |
| 33 | B-828 | ASSEMBLY, PISTON | 1 |
| 34 | B-966 | Piston Unit | 1 |
| 35 | B-966 Det. #1 | Piston | 1 |
| 36 | A-862 | Bushing, Plastic | 1 |
| 37 | A-826-1 | Push Rod | 2 |
| 38 | A-114-F | Pin, Rod Staking | 2 |
| 39 | A-821-1 | Fork | 2 |
| 40 | 1032x3/16 | Socket Head Screw, Fork | 2 |
| 41 | A-827-1 | Sleeve, Rod | 2 |
| 42 | A-965 | Washer | 2 |
| 43 | AN364-720 | Nut, Flexlock | 2 |
| — | — — — | ASSOCIATED PARTS, HYDRAULIC | |
| 44 | B-806 | Cylinder | 1 |
| 45 | PRP-909-13 | "O" Ring, Cylinder | 1 |
| 46 | PRP-902-46 | "O" Ring, Piston | 1 |
| 47 | A-810 | Seal, Dust | 1 |
| 48 | A-95-A | Block, Pitch Change | 2 |
| 49 | 837-3 | ASSEMBLY, SPINNER | 1 |
| 50 | C-1337 | Dome | 1 |
| 51 | AN526C1032R7 | Screws, Dome Mounting | 10 |
| 52 | C-1336 | Bulkhead | 1 |
| 53 | AN74-5 | Bolt, Hex Head | 4 |
| 54 | AN960-416L | Washer | 4 |
| 55 | AN364-428 | Nut, Flexlock | 4 |
| 49 | 837-4 | ASSEMBLY, SPINNER | 1 |
| 50 | C-1337-1 | Dome (Polished) | 1 |
| 51 | AN526C1032R7 | Screws, Dome Mounting | 10 |
| 52 | C-1336 | Bulkhead | 1 |
| 53 | AN74-5 | Bolt, Hex Head | 4 |
| 54 | AN960-416L | Washer | 4 |
| 55 | AN364-428 | Nut, Flexlock | 4 |

# SECTION II

## GROUP ASSEMBLY PARTS LIST

### Model HC-92ZK-8D, -8L

| Code No. | Part No. | Description | No. Required -8D | No. Required -8L |
|---|---|---|---|---|
| 1 | — — — | Blade | 2 | 2 |
| 2 | 840-32 | ASSEMBLY, HUB | 1 | |
| 3 | C-1314-3 | Spider, Hub | 1 | |
| 4 | A-1308 | Tube, Pilot | 2 | |
| 5 | 834-8 | Guide Collar Unit | 1 | |
| 6 | A-1332-2 | Pin, Staking | 2 | |
| 2 | 840-32L | ASSEMBLY, HUB | | 1 |
| 3 | C-1314-3 | Spider, Hub | | 1 |
| 4 | A-1308 | Tube, Pilot | | 2 |
| 5 | 834-9 | Guide Collar Unit | | 1 |
| 6 | A-1332-2 | Pin, Staking | | 2 |
| — | — — — | ASSOCIATED PARTS, HUB | | |
| 8 | A-1303A | Bearing, Blade | 2 | 2 |
| 9 | A-1331 | Ring, Split | 2 | 2 |
| 10 | PRP-909-7 | "O" Ring, Blade Seal | 2 | 2 |
| 11 | PRP-902-32 | "O" Ring, Shaft Seal | 1 | 1 |
| 12 | A-1333 | Bolt, Mounting | 6 | 6 |
| 13 | B-1322 | Shim | 1 | 1 |
| 14 | 838-31 | ASSEMBLY, CLAMP | 2 | |
| 15 | C-1301-2 | Clamp | 2 | |
| 16 | A-295 | Linkscrew | 2 | |
| 17 | A-285 | Pin, Linkscrew | 2 | |
| 18 | ±5010 | Fitting, Zerk | 4 | |
| 19 | A-1306 | Gasket, Clamp | 4 | |
| 20 | A-282 | Screw, Socket Head | 4 | |
| 21 | AN380-3-2 | Pin, Cotter | 4 | |
| 22 | 7/16-20x2 1/8 | Screw, Ferry | 4 | |
| 23 | AN363-720 H.T. | Nut, Flexlock | 4 | |
| 14 | 838-35 | ASSEMBLY, CLAMP | | 2 |
| 15 | C-1301-4 | Clamp | | 2 |
| 16 | A-295 | Linkscrew | | 2 |
| 17 | A-285 | Pin, Linkscrew | | 2 |
| 18 | ±5010 | Fitting, Zerk | | 2 |
| 19 | A-1306 | Gasket, Clamp | | 4 |
| 20 | A-282 | Screw, Socket Head | | 4 |
| 21 | AN380-3-2 | Pin, Cotter | | 4 |
| 22 | 7/16-20x2 1/8 | Screw, Ferry | | 4 |
| 23 | AN363-720 H.T. | Nut, Flexlock | | 4 |
| — | — — — | ASSOCIATED PARTS, CLAMP | | |
| 24 | A-1305 | Weight, Balance | As Needed | |
| 25 | AN501A10-6 | Screw, Weight | 4 | 4 |
| 26 | B-828-8L | SUBASSEMBLY, PISTON JACK | 1 | |
| 27 | B-966 | Piston Unit | 1 | |
| 28 | B-966 Det. 1 | Piston | 1 | |
| 29 | A-862 | Bushing, Plastic | 1 | |
| 30 | A-826-8 | Push Rod | 2 | |
| 31 | A-114-F | Pin, Rod Staking | 2 | |
| 32 | A-821L-1 | Fork | 2 | |
| 33 | 1032x3/16 | Screw, Set | 2 | |
| 34 | A-827-1 | Sleeve, Rod | 2 | |
| 35 | A-965 | Washer | 2 | |
| 36 | AN364-720 | Nut, Flexlock | 2 | |
| 26 | B-828-8 | SUBASSEMBLY, PISTON JACK | | 1 |
| 27 | B-966 | Piston Unit | | 1 |
| 28 | B-966 Det. 1 | Piston | | 1 |
| 29 | A-862 | Bushing, Plastic | | 1 |
| 30 | A-826-8 | Push Rod | | 2 |
| 31 | A-114-F | Pin, Rod Staking | | 2 |
| 32 | A-821-1 | Fork | | 2 |
| 33 | 1032x3/16 | Screw, Set | | 2 |
| 34 | A-827-1 | Sleeve, Rod | | 2 |
| 35 | A-965 | Washer | | 2 |
| 36 | AN364-720 | Nut, Flexlock | | 2 |
| — | — — — | ASSOCIATED PARTS, HYDRAULIC | | |
| 37 | PRP-902-46 | "O" Ring, Piston | 1 | 1 |
| 38 | B-806 | Cylinder | 1 | 1 |
| 39 | A-810 | Seal, Felt | 1 | 1 |
| 40 | PRP-909-13 | "O" Ring, Cylinder | 1 | 1 |
| 41 | A-95-A | Block, Pitch Change | 2 | 2 |
| 42 | 835-6 | ASSEMBLY, SPINNER | 1 | 1 |
| 43 | C-885 | Adaptor, Spinner | 1 | 1 |
| 44 | C-888-4 | Dome, Spinner | 1 | 1 |
| 45 | AN526C1032R8 | Screws, Dome Mounting | 14 | 14 |

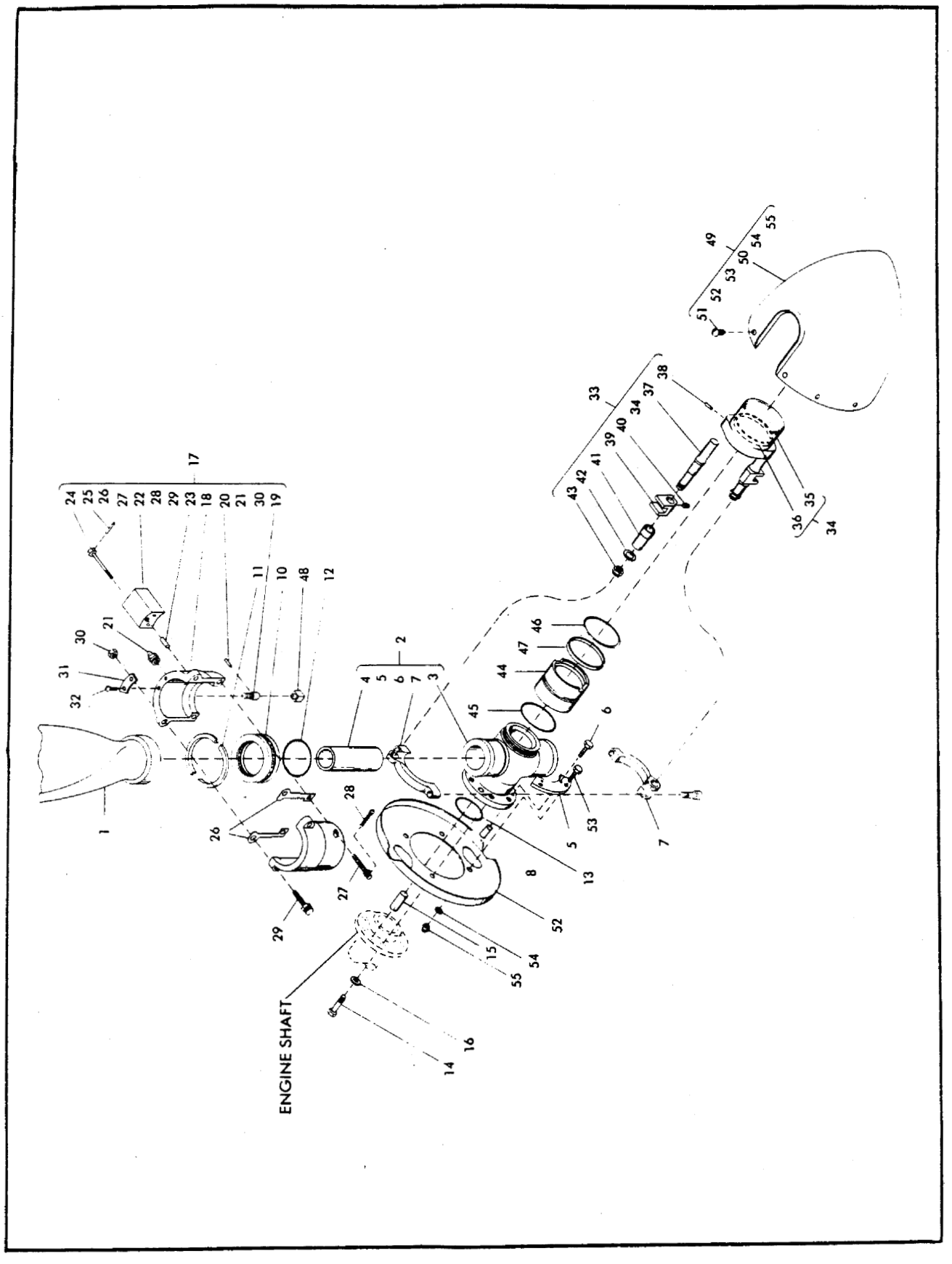


FIGURE 3 - Model BHC-92ZF-1D1 Propeller - Exploded View

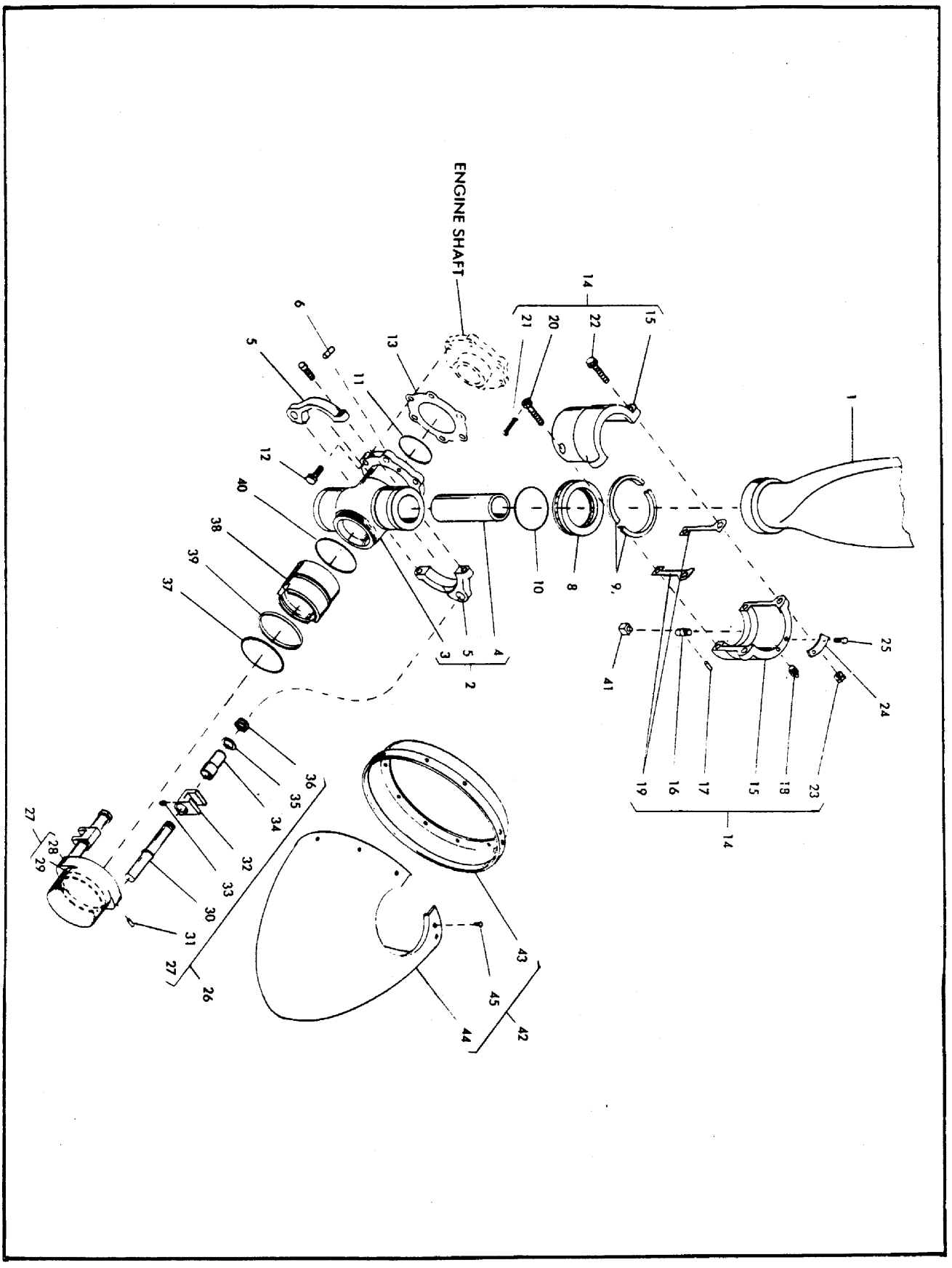


FIGURE 4 - Models HC-92ZK-8D, 8L Propellers - Exploded View

MANUAL NO. 110

(CORRECTIONS)

(1) PAGE 6, TABLE IV. - TORQUE VALUES, STAMP THE FOLLOWING UNDER TABLE IV.:

"ALL TORQUES ARE VALUES BASED
ON NON-LUBRICATED THREADS.
TOLERANCE ON TORQUE IS ± 10%.
UNLESS OTHERWISE STATED."

(2) PAGE 7, SECTION V, LUBRICATION, B. 1.
DELETE "MIL-G-3278".
STAMP IN "MIL-G-23827".

(3) SUPPLEMENT NO. 1 - STAPLED IN BACK.

(4) SUPPLEMENT NO. 2 DATED SEPTEMBER 21, 1965, AND PARTS LIST HC-92WK-1D DATED JANUARY 18, 1965 - STAPLED IN BACK.

ALL MANUALS NOS. 110
CORRECTED AS OF 10/14/66

HARTZELL PROPELLER, INC.

SUPPLEMENT NO. 1
MANUAL NO. 110

# INCLUSION OF PROPELLER MODEL HC-92ZK-1D

INTRODUCTION:

The HC-92ZK-1D propeller is nearly identical to the HC-92ZF-1D1 propeller listed in this manual, except for the shaft mounting provisions and a few other details.

The differences are listed below:

| Code No. | Nomenclature | Model HC-92ZF-1D1 Part Number | Model HC-92ZK-1D Part Number |
|---|---|---|---|
| 2 | Hub Spider Unit | 840-48 | 840-32L |
| 14 | Mounting Bolts | AN8H7A (6) | A-1333(4), A-1333-2 (2 |
| 33 | Piston Assembly | B-828 | B-828-8 |
| 34 | Piston Unit | B-966 | B-966-8 |
| 35 | Piston | B-966 Det.1 | B-966 Det.1 |
| 36 | Bushing, Plastic | A-862 | A-862 |
| 37 | Push Rod | A-826-1 | A-826-8 |
| 38 | Pin, Rod Staking | A-114-F | A-114-G |
| 39 | Fork | A-821-1 | A-821-1 |
| 40 | Screw, Socket | 10-32x3/16 | 10-32x3/16 |
| 41 | Sleeve | A-827-1 | A-827-1 |
| 42 | Washer | A-965 | A-965 |
| 43 | Nut, Flexlock | AN365-720 | AN364-720 |

The spinner is the 835-6P or 835-16 for the HC-92ZK-1D.

HARTZELL PROPELLER, INC.
PIQUA, OHIO

September 21, 1965

SUPPLEMENT NO. 2
MANUAL NO. 110

The HC-92WK-1 is identical to the HC-92ZK-1, except that needle bearings are incorporated into the blade shanks, replacing the outer portion of the bronze bushings. The 840-93 hub spider unit replaces the 840-48, and the A-1884 pilot tubes replace the A-1308. Otherwise, the hubs are identical.

The blade shanks incorporate needle bearings, and the blade model carries the prefix "W" to identify the shank configuration.

Attached is a parts list for the HC-92WK-1D propeller which lists all current parts as of January 18, 1965. Most of the bolts now carry Hartzell part numbers instead of commercial or AN numbers since bolts which are obtained commercially cannot be relied upon to meet the strength requirements imposed.

Table II, Tolerances of Wearing Surfaces is revised to read as follows:

| | Specified | | Replace if dimension is above or below | |
|---|---|---|---|---|
| | Max. | Min. | Max. | Min. |
| 1. A-1884 Pilot Tube O.D. (Inner 1-1/8 inch) | 1.7185 | 1.7180 | -- | 1.7165 |
| 1a. A-1884 Pilot Tube O.D. (Outer 1-1/4 inch) | 1.3760 | 1.3755 | -- | 1.3740 |
| 2. A-1884 Pilot Tube, Length extending beyond hub spider | 3-3/4 + 1/16 | 3-3/4 - 1/16 | 3-3/4 + 1/8 | -- |

All other items listed in Table II remain the same for HC-92WK-1 as for HC-92ZK-1.

SUPPLEMENT NO. 3
MANUAL NO. 110

This supplement is now considered a part of Propeller Maintenance Manual 110.

The purpose of this document is to provide information about the BHC-92WF-1D1 series propeller.

This propeller is similar to the BHC-92ZF-1D1 propeller, except that the BHC-92WF-1D1 propeller employs a different hub unit and uses needle bearings with "W" shank blades.

A parts list for BHC-92ZF-1D1 propeller is in the Parts List section of this manual. The parts list can be used to assemble the BHC-92WF-1D1 propeller when the following parts are substituted:

| Quantity | Component |
|---|---|
| 1 | 840-111 Hub Unit |
| 2 | "W" Shank Blade |
| 2 | B-6684 Needle Bearing<br>C-6252 Needle Bearing (Alternate for oversized blade bore) |

Required Publications

For steel hub overhaul information, refer to Hartzell Standard Practices Manual 202A (61-01-02).

For aluminum blade overhaul information, refer to Hartzell Aluminum Blade Overhaul Manual 133C (61-13-33).

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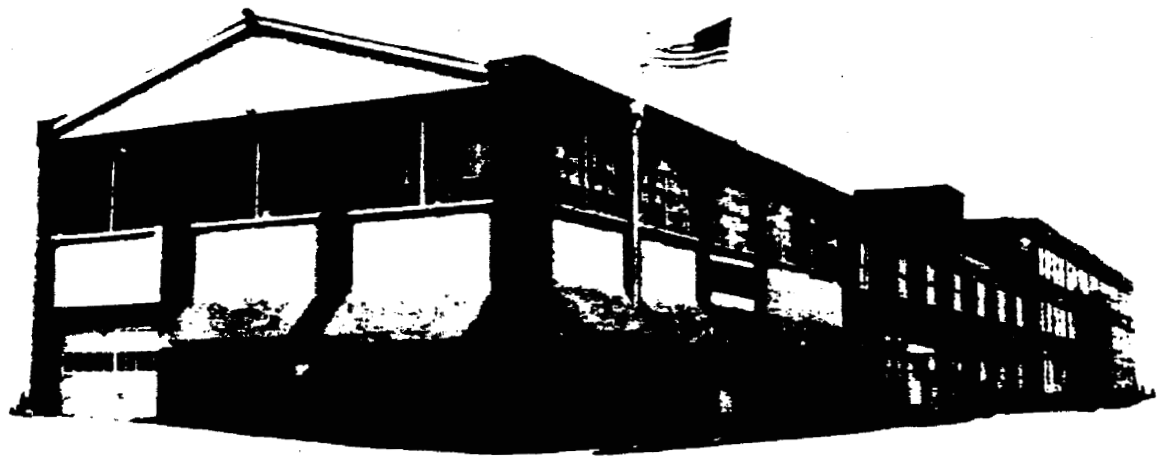
ERRATA SHEET NO. 1
MANUAL NO. 110

Page 3: F-1.--Assembly of Guide Collar Unit.

Change the caution note to read:

Short aluminum pins are inserted in the "A" dowel pin holes to stake the guide collar, while 1 inch long steel dowel pins are installed in "B" holes for installing the propeller on the engine.

# HOME OF *Hartzell* PROPELLERS



This is an invitation to visit the home of Hartzell propellers in Piqua, Ohio. Here you'll see how design know-how . . . large and complete production facilities . . . high standards of workmanship . . . rigid inspection and testing procedures . . . assure unquestioned safe and superior performing propellers. Wherever you may be, you can look with confidence to our worldwide sales and service organization backed by the progressive 40-year-old name of Hartzell.

HARTZELL PROPELLER, INC., PIQUA, OHIO

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