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**HARTZELL**

**MANUAL REVISION TRANSMITTAL**  
**Manual 140 (61-00-40)**  
**Propeller Owner's Manual and Logbook**

**REVISION 3 dated February 2014**

Attached is a copy of Revision 3 to Hartzell Manual 140.

Page Control Chart for Revision 3

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Page No.

**COVER**

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**REVISION HIGHLIGHTS**

pages 5 thru 8

**LIST OF EFFECTIVE PAGES**

pages 17 and 18

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pages 21 thru 24

**INSTALLATION AND REMOVAL**

pages 3-1 and 3-2

pages 3-39 thru 3-60

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pages 3-1 and 3-2

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NOTE 1: When the manual revision has been inserted in the manual, record the information required on the Record of Revisions page in this manual.

NOTE 2: Pages distributed in this revision may include pages from previous revisions if they are on the opposite side of revised page. This is done as a convenience to those users who wish to print a two-sided copy of the new revision.

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Manual No. 140  
61-00-40

Revision 3  
February 2014

# Propeller Owner's Manual and Logbook

**Series:** HC-D2(MV,V)20-3  
HC-D3(MV,V)20-6L  
HC-D2(MV,V)20-7( )  
HC-D2(MV,V)20-8( )  
HC-D3MV20-8D

Hydro-Selective Propellers with Aluminum Blades

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REVISION HIGHLIGHTS

Revision 3 dated February, 2014 incorporates the following:

- Revised [Cover](#), [Revision Highlights](#), [List of Effective Pages](#), and [Table of Contents](#) as applicable to reflect changes

**INSTALLATION AND REMOVAL CHAPTER**

- [Removed Figure 3-7.1, "Diaphragm Installation"](#)
- [Added Figure 3-8.1, "Installation of Diaphragm and Inner Ring"](#)
- [Revised the steps for installing the diaphragm and the inner ring](#)
- [Added Figure 3-8.2, "Installation of the Outer Ring"](#)
- [Revised the steps for installing the outer ring](#)
- [Made other language/format changes](#)

**REVISION HIGHLIGHTS****1. Introduction****A. General**

This is a list of current revisions that have been issued against this manual. Please compare it to the RECORD OF REVISIONS page to ensure that all revisions have been added to the manual.

**B. Components**

- (1) Revision No. indicates the revisions incorporated in this manual.
- (2) Issue Date is the date of the revision.
- (3) Comments indicates the level of the revision.
  - (a) New Issue is a new manual distribution. The manual is distributed in its entirety. All the page revision dates are the same and no change bars are used.
  - (b) Reissue is a revision to an existing manual that includes major content and/or major format changes. The manual is distributed in its entirety. All the page revision dates are the same and no change bars are used.
  - (c) Major Revision is a revision to an existing manual that includes major content or minor content changes over a large portion of the manual. The manual is distributed in its entirety. All the page revision dates are the same, but change bars are used to indicate the changes incorporated in the latest revision of the manual.
  - (d) Minor Revision is a revision to an existing manual that includes minor content changes to the manual. Only the revised pages of the manual are distributed. Each page retains the date and the change bars associated with the last revision to that page.

<u>Revision No.</u>	<u>Issue Date</u>	<u>Comments</u>
Original	Nov/02	New Issue
Revision 1	May/11	Minor Revision
Revision 2	Jun/12	Minor Revision
Revision 3	Feb/14	Minor Revision

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Revision Highlights	7 and 8	Rev. 3	Feb/14
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Record of Temporary Revisions	11 and 12	Original	Nov/02
Service Documents List	13 and 14	Rev. 2	Jun/12
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(32) Attach the hose to the engine with the AN742C12C clamps, as shown in Figure 3-7.

**NOTE:** Measure the depth of the hole in the housing, and measure the same length on the fitting to make sure that no contact is made between the fitting and the oil transfer plug.

(33) Install the vernier control 4 inches (101.6 mm) to the right of the center of the cockpit, just below the dashboard.

(a) The vernier control is part number A-970BLO563 (Gerdes), 3A729-7 (Shakespeare) or A-970-10-0563 (ACS).

(b) The control should go straight forward, through the 3/4 inch (19.05 mm) hole in the fire wall and through the five-piece Beech fireproof grommet.

**NOTE:** The grommet consists of (1) 112436-6 retainer, (2) 112413-4 ball half, and (2) 112412 split grommet.

(c) Route the control over the generator and use the AN742D7C clamp to secure the control to the generator cover.

(d) Route the control through the AN742D7C clamps on the B-197 Bracket. (Refer to Figure 3-6 and 3-7).

(34) Install the B-3368 check nut and the AN276-6 ball joint on the vernier control. Refer to Figure 3-6.

**CAUTION:** THERE MUST BE A MINIMUM OF FIVE THREADS OF THE VERNIER CONTROL IN THE AN276-6 BALL JOINT.

(35) Push the vernier control handle in the cockpit to the forward or "in" position.

(36) Attach the ball joint to the A-199 link with (2) B-3851-0463 washers and (1) B-3308-4 nut, as shown in Figure 3-6.

(37) Tighten the clamps on the B-197 bracket and tighten the check nut against the ball joint.

**NOTE:** The normal position of the pulley wheel on the governor (hands off) is in high RPM position or low pitch (pulley wheel against the stop on governor). While the governor is in this position, the vernier control handle in the cockpit should be forward or "in" position.

F. Installing the HC-D2(MV,V)20-7( ) Propeller Assembly

**CAUTION:** INSTRUCTIONS AND PROCEDURES IN THIS SECTION MAY INVOLVE PROPELLER CRITICAL PARTS. REFER TO THE INTRODUCTION CHAPTER OF THIS MANUAL FOR INFORMATION ABOUT PROPELLER CRITICAL PARTS. REFER TO THE ILLUSTRATED PARTS LIST CHAPTER OF THE APPLICABLE OVERHAUL MANUAL(S) FOR THE IDENTIFICATION OF SPECIFIC PROPELLER CRITICAL PARTS.

Refer to Figure 2-4 for parts identification and location.

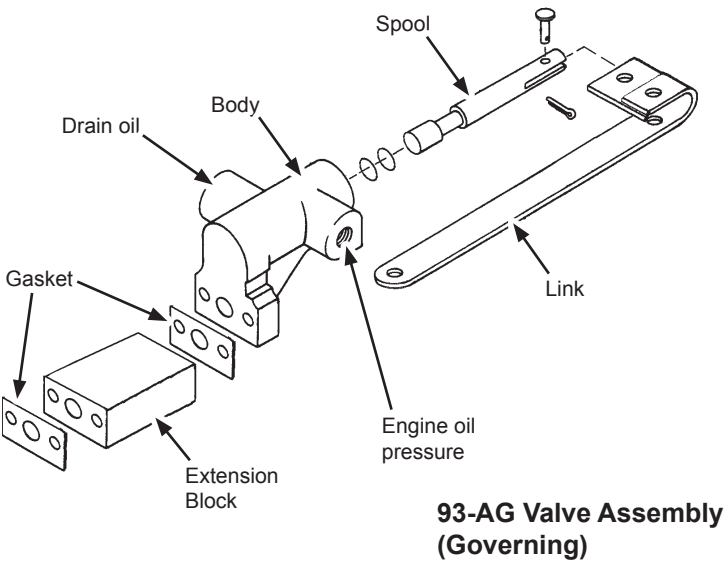
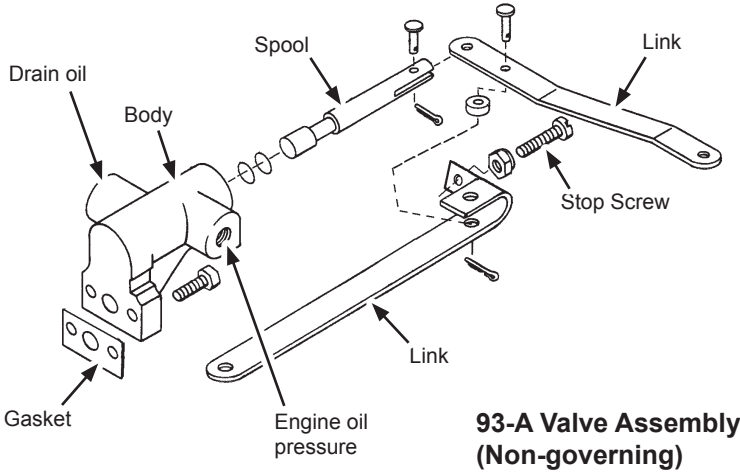
(1) Hydraulic Unit Installation

**WARNING:** CLEANING AGENT MEK IS FLAMMABLE AND TOXIC TO THE SKIN, EYES AND RESPIRATORY TRACT. SKIN AND EYE PROTECTION ARE REQUIRED. AVOID PROLONGED CONTACT. USE IN A WELL VENTILATED AREA.

- (a) Clean the engine case, where the hydraulic unit cylinder mounts, with Quick Dry Stoddard Solvent or MEK. Remove any remaining gasket material from previous installations.
- (b) Remove the piston from the cylinder by sliding it away from the cylinder and off the piston guide rods.

**NOTE:** The jack plate unit will be attached to the piston through the thrust bearing interface with the piston.

APS5099  
APS5099A



**Valve Assemblies for D2(MV,V)20-7, -8 Propellers  
Figure 3-8**

- (c) Expose the inner cavity of the cylinder for installation on the engine case.
  - 1 Remove the screws from the retaining outer ring of the diaphragm.
  - 2 Remove the outer ring from the diaphragm.
  - 3 Remove the screws from the inner ring of the diaphragm.
  - 4 Remove the inner ring.
  - 5 Remove the diaphragm.
- (2) Hydraulic Valve Installation.
  - (a) If not previously installed, install the hydraulic valve assembly (Figure 3-8) on the piston with a gasket and two screws (Table 3-1).
  - (b) Using a No. 51 drill, drill through the side of the valve housing and through the heads of the two A-2038-( ) screws. Safety with 0.032 inch (0.81 mm) safety wire. Refer to Figure 3-1.
  - (c) Perform the following three adjustments:
    - 1 Bottom the piston in the cylinder.
    - 2 Pull the propeller control (for pitch and RPM control) handle out approximately 2.25 inches (57.1 mm) from the instrument panel.
    - 3 Locate the valve spool midway between the cotter pin and the base of the guide pin.
  - (d) Attach the propeller pitch control cable to the hydraulic valve lever on the long end that extends from the valve spool.
  - (e) Safety wire the two screws together with 0.032 inch (0.81 mm) minimum diameter stainless steel wire.
  - (f) Install the gasket.
    - 1 Align the clearance holes of the A-135 gasket with the four mounting studs that protrude from the engine and install the gasket flush against the engine case.

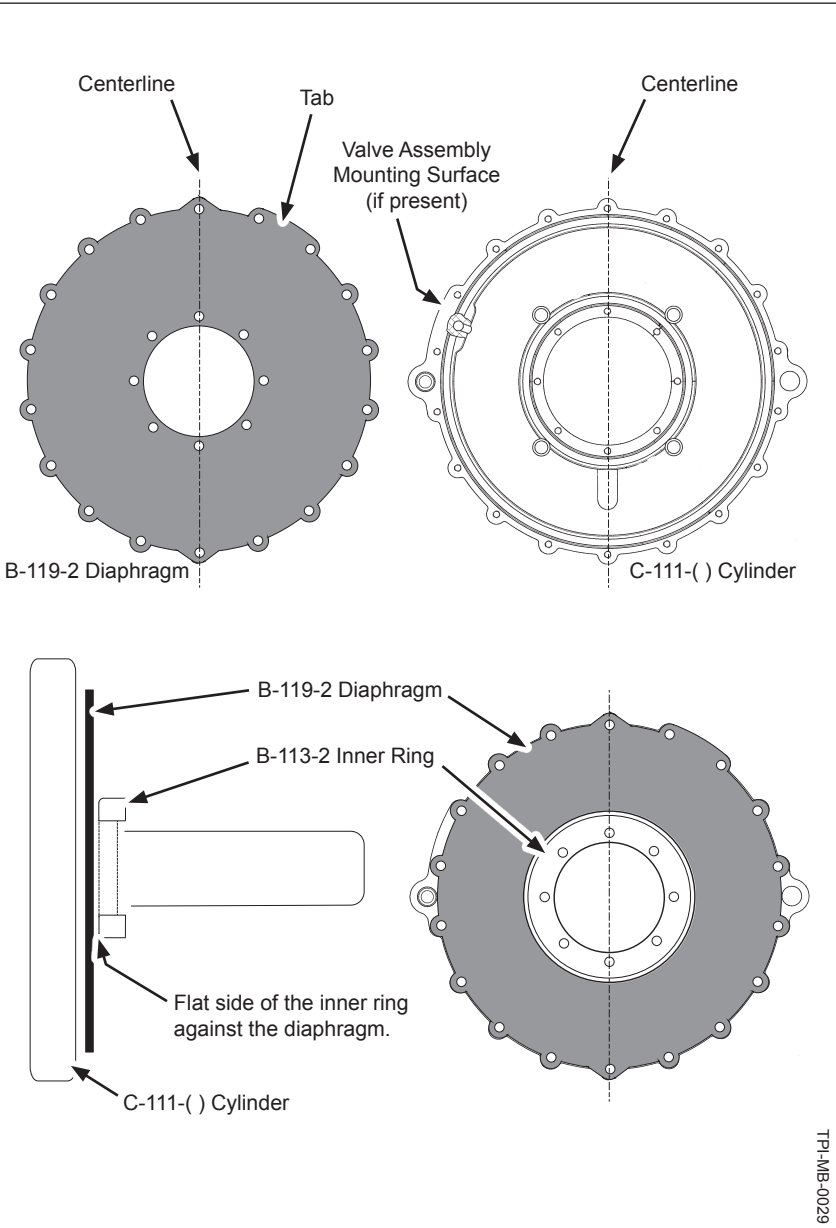
- (g) Install the cylinder
- 1 Install one socket head cap screw in each of four cylinder mounting holes. Position the head of each screw on the piston side of the cylinder.
  - 2 Install one metal washer on each socket head cap screw that protrudes through the cylinder on the engine side of the cylinder.
  - 3 Align the four cylinder mounting holes and installed socket head cap screws with the four engine case threaded holes in the engine case.
  - 4 Position the cylinder flush against the previously installed gasket.

**CAUTION:** MAKE SURE THE METAL WASHER THAT ENCIRCLES EACH SOCKET HEAD CAP SCREW IS NOT DISLODGED, PREVENTING THE CYLINDER FROM RESTING FLUSH AGAINST THE GASKET AND ENGINE CASE SURFACE.

- 5 Torque each socket head cap screw in accordance with Table 3-2.
- 6 Safety wire the socket head cap screws with 0.032 inch (0.81 mm) minimum diameter stainless steel wire.

**CAUTION:** THE HOSE MUST BE LONG ENOUGH TO ALLOW THE VALVE TO MOVE FREELY WITH THE PISTON THROUGH ITS FULL TRAVEL.

- (h) Install a 0.37 to 0.50 inch (9.5 to 12.7 mm) inside diameter (ID) flexible hose, with a minimum pressure capacity of 150 psi, from the engine oil pressure pump supply to the hydraulic valve. Connect the hose to the threaded hole in the valve that is closest to the propeller. This is the pressure supply port.
- (i) Install a 0.37 to 0.50 inch (9.5 to 12.7 mm) ID flexible hose from the engine crankcase to the valve.



**Installation of the Diaphragm and the Inner Ring  
Figure 3-8.1**

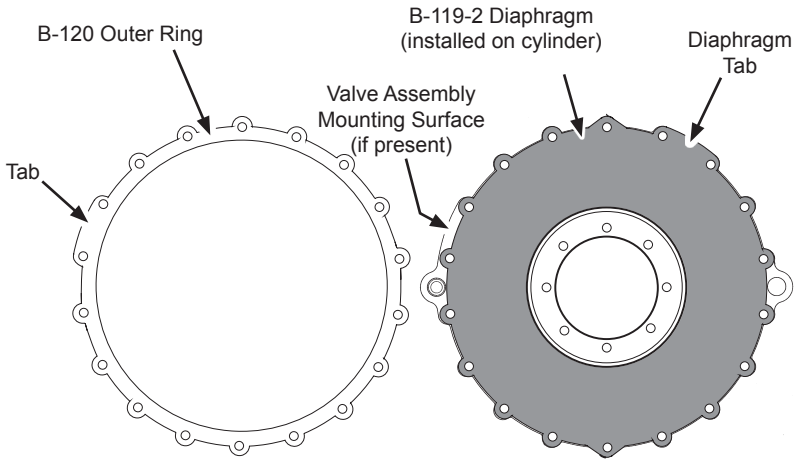
- (j) Install the diaphragm and the inner ring.  
Refer to Figure 3-8.1.

**WARNING:** DO **NOT** ALIGN THE TAB ON THE DIAPHRAGM WITH THE VALVE ASSEMBLY MOUNTING SURFACE ON THE CYLINDER. THIS WILL PREVENT THE DIAPHRAGM FROM SEATING PROPERLY AND MAY CAUSE THE DIAPHRAGM TO FAIL. FAILURE OF THE DIAPHRAGM CAN QUICKLY RESULT IN COMPLETE LOSS OF ENGINE OIL AND RAPID ENGINE SHUTDOWN WITH OIL COVERING THE WINDSCREEN CREATING AN UNSAFE CONDITION THAT **MAY RESULT IN DEATH, SERIOUS BODILY INJURY, AND/OR SUBSTANTIAL PROPERTY DAMAGE.**

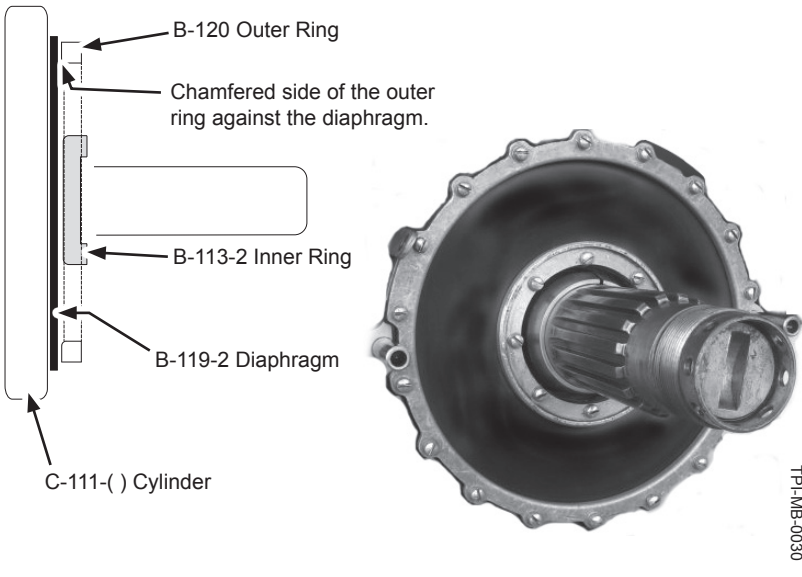
- 1 Align the centerline of the diaphragm with the centerline of the cylinder and position the diaphragm flush against the cylinder.
  - a The centerline is identified by locating the four holes that align. Refer to Figure 3-8.1.
- 2 Position the flat side of the inner ring flush against the diaphragm.
- 3 Align the mounting holes in the inner ring with the holes in the diaphragm and cylinder.
- 4 Install the screws (Table 3-1) through the inner ring and diaphragm and thread into cylinder.

**CAUTION:** THE RING MAY BREAK IF ONLY A FEW SCREWS ARE TIGHTENED IN A LOCALIZED AREA.

- 5 Using a staggered sequence, tighten all of the inner ring screws slightly, then repeat until the diaphragm squeezes out past the inside edge of the inner ring 0.062 inches (1.57 mm).



Some outer rings have a tab as shown in the illustration.  
Align the tab with the valve assembly mounting surface on the cylinder (if present).



**Installation of the Outer Ring  
Figure 3-8.2**



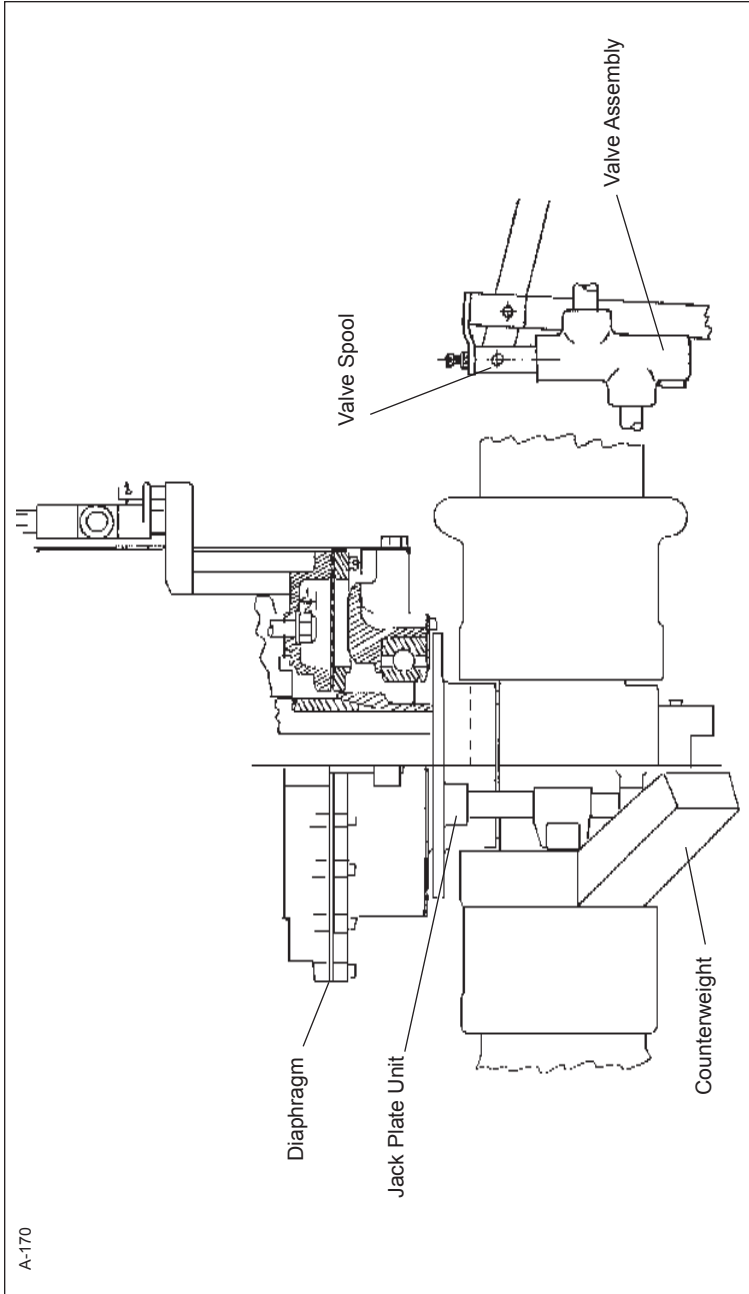
- (k) Install the outer ring. Refer to Figure 3-8.2
- 1 Position the chamfered side of the outer ring flush against the diaphragm.
  - 2 Align the mounting holes in the outer ring with the holes in the diaphragm and cylinder.
    - a If the outer ring has a tab, as shown in Figure 3-8.2, align the tab with the valve assembly mounting surface (if present), not the diaphragm tab.
  - 3 Install the lock washers onto the screws (Table 3-1), then install the screws through the outer ring and diaphragm into the cylinder.

CAUTION: THE RING MAY BREAK IF ONLY A FEW SCREWS ARE TIGHTENED IN A LOCALIZED AREA.

- 4 Using a staggered sequence, tighten all of the outer ring screws slightly, then repeat until the diaphragm squeezes out past the edges of the outer ring 0.062 inches (1.57 mm) and the proper torque is achieved. Refer to Table 3-2, Torque Values.
- 5 After one hour, visually inspect the diaphragm protrusion around the outside of the outer ring, and from the inside of the inner ring.
  - a If the protrusion has receded, retighten all of the outer ring and/or inner ring screws evenly to get the 0.062 inch (1.57 mm) protrusion.

**CAUTION:** DO NOT APPLY GREASE TO THE EXPOSED SURFACE OF THE DIAPHRAGM. GREASE ON THIS SURFACE WILL ATTRACT ABRASIVE MATERIAL HASTENING FAILURE AND CAUSING LEAKAGE OF THE DIAPHRAGM.

- (l) Install the piston and jack plate unit over the cylinder and clock the piston to the cylinder by aligning a number stamped on the piston with a number stamped on the cylinder.
- (m) Align the appropriate holes in the piston with the guide rods in the cylinder.
- (n) Install the jack plate unit and piston assembly on the piston guide rods and against the diaphragm.
- (o) Install the hydraulic valve. Refer to Figure 3-8.
  - 1 Connect the link with the tab and screw attached to the hydraulic piston.
  - 2 Insert the screw (Table 3-1) in the large hole in the link at the end farthest away from the valve and tab.
  - 3 Install the screw into the piston and torque in accordance with Table 3-2.
  - 4 Safety wire the screw by wrapping 0.032 inch (0.81 mm) minimum diameter stainless steel wire around the link. Then safety wire the two screws together with 0.032 inch (0.81 mm) minimum diameter stainless steel wire.
  - 5 Install a 0.37 to 0.50 inch (9.5 to 12.7 mm) inside diameter (ID) flexible hose with a minimum pressure capacity of 150 psi from the engine oil pressure pump supply to the hydraulic valve. Connect the hose to the threaded hole in the valve closest to the engine (pressure supply port).



Hydraulic Unit Travel Adjustment  
Figure 3-9

**CAUTION:** THE DRAIN LINE SHOULD BE AS SHORT AS POSSIBLE.

- 6 Install a 0.37 to 0.50 inch (9.5 to 12.7 mm) inside diameter (ID) flexible hose with a minimum pressure capacity of 150 psi from the engine drain to the threaded hole in the valve closest to the propeller (drain port).
- (2) Adjusting Travel on Hydraulic Unit Without Governor. Refer to Figure 3-9.
- (a) Remove the low pitch stop screw from the valve link.
  - (b) Loosen the screws to free the vernier control.
  - (c) Pull the piston out with the counterweights, until the piston guide arms extend a maximum of 0.50 inch (12.7 mm), for a 0.125 inch (3.17 mm) diaphragm, from the outer diaphragm ring B-120.
  - (d) On Lycoming engines, the clearance between the jack plate and any portion of the hub or spinner ring should be no less than 0.063 inch (1.59 mm) and no greater than 0.125 inch (3.17 mm). On Continental engines, the clearance between the jack plate and any portion of the hub or spinner ring should be exactly 0.125 inch (3.17 mm).

**CAUTION:** DO NOT ALLOW THE HUB NUT TO ENGAGE LESS THAN FIVE FULL THREADS.

- (e) Adjust the spacers behind the rear cone to obtain the applicable clearance. Do not allow the hub nut to engage less than five full threads. Restrict the travel to maintain no less than clearance.
- (f) Move the valve control until the valve spool touches the low pitch stop on the link.

**NOTE:** The spool should extend 1.31 inches (33.3 mm) beyond the valve casting. Bend the stop as necessary to achieve this setting.

- (g) Set the cockpit propeller control to 0.125 inch (3.17 mm) from the bottom of travel.
- (h) Clamp the vernier control with clamp screws.

- (i) Pull the cockpit propeller control into full high pitch and force the piston back to check for washers, screws, or safety wire that may prevent the piston arms from touching the outer diaphragm ring B-120 or high pitch position.
  - (j) In the high pitch position, the valve spool should extend 1.31 inch (33.3 mm) or less (preferably less) beyond the valve body casting.
  - (k) Run the engine up and check the static RPM.
    - 1 For fine adjustment, replace the low pitch stop screw.
    - 2 An adjustment of more than 100 RPM may only be performed by a certified propeller shop.
- (3) Adjusting Travel on Hydraulic Unit With Governor
- (a) Pull the piston out with the propeller counterweights, until the piston guide arms extend a maximum of 0.50 inch (12.7 mm) for a 0.125 inch (3.17 mm) diaphragm or a maximum of 0.44 inch (11.18 mm) for a 0.063 inch (1.59 mm) diaphragm from the outer diaphragm ring B-120.
  - (b) On Lycoming engines, the clearance between the jack plate and any portion of the hub or spinner ring should be no less than 0.063 inch (1.59 mm) and no greater than 0.125 inch (3.17 mm). On Continental engines, the clearance between the jack plate and any portion of the hub or spinner ring should be exactly 0.125 inch (3.17 mm).

**CAUTION:** DO NOT ALLOW THE HUB NUT TO ENGAGE LESS THAN FIVE FULL THREADS.

- (c) Adjust the spacers behind the rear cone to obtain the applicable clearance. Do not allow the hub nut to engage less than five full threads. Restrict the travel to maintain no less than clearance.

- (d) The spool should extend 1.31 inches (33.3 mm) beyond the valve casting.

NOTE: To obtain the proper dimension, remove the link, grip the small end in a vise, and bend it until the distance between the two holes on the link has changed the required amount to obtain 1.31 inches (33.3 mm) on the spool length.

- (e) Pull the cockpit propeller control into full high pitch and force the piston back to check for washers, screws, or safety wire that may prevent the piston guide arms from touching the outer diaphragm ring B-120 or high pitch position.

### (3) Propeller Installation

- (a) Clean the engine shaft with an approved solvent.
- (b) Oil the engine shaft with engine oil.
- (c) Install the spacer(s) and rear cone (Table 3-1).

NOTE: Install the same number of spacers as previously installed if the same propeller is reinstalled. If a different propeller is installed, install one spacer. The need for additional spacers will be determined during the static RPM checks after the propeller is installed.

WARNING: USE A SUITABLY RATED SLING TO SUPPORT THE WEIGHT OF THE PROPELLER ASSEMBLY DURING INSTALLATION.

- (d) With a suitable crane hoist and sling, carefully move the propeller assembly to the aircraft engine shaft.
- (e) Install the propeller hub on the engine shaft.

CAUTION 1: USE THE MARKINGS MADE DURING BENCH ASSEMBLY TO MATCH THE FORKS, BLOCKS, AND LINKSCREWS THAT WERE PREVIOUSLY MATED.

CAUTION 2: MAINTAIN THE SAME BLOCK ORIENTATION THAT WAS ESTABLISHED DURING BENCH ASSEMBLY AND ADJUSTMENT.

- (f) Install a pitch change block on each link screw.
- (g) Grip the blade counterweight on each blade clamp and, at the same time, rotate the blades to high pitch.
- (h) Rotate the blades until the push rods that protrude from the jack plate unit stop short of the two bushing lugs on the hub.
- (i) Rotate the jack plate unit to allow each fork to engage each pitch change block and to align each push rod with each hub bushing.

CAUTION: DO NOT USE EXTREME FORCE TO INSTALL THE HUB ON THE ENGINE SHAFT AND REAR CONE.

- (j) Grip the blade counterweight on each blade clamp, and at the same time, rotate the blades to install the push rods through the hub guide lug bushing.
- (k) Install the hub on the rear cone.

CAUTION: MAKE SURE THE HUB NUT THREADS HAVE PROPERLY ENGAGED.

- (l) Install the hub nut on the engine shaft.
- (m) Torque the hub nut on the engine shaft using tool BST-2910. Refer to Table 3-2 and Figure 3-2 to determine the proper torque value to which the torque wrench must be set.

- (n) Check the travel of the piston.
  - 1 Grip the blade counterweights and, at the same time, rotate to linearly move the jack plate and piston.
  - 2 Travel should be 0.375 inch (9.52 mm) or 0.187 inch (4.75 mm) on either side of the neutral position of the diaphragm.
  - 3 If the distance is not sufficient, remove the propeller and install or remove shim(s) between the rear cone and the engine to obtain the desired travel capability.
- (o) Using a hub nut safety pin, safety the hub nut to the engine shaft. Refer to Table 3-1.
  - NOTE: The hub nut safety pin is normally supplied in a bag when the propeller is shipped new from the factory.
- (4) Connecting the Propeller Pitch Control Cable to Hydraulic Valve Lever
  - (a) Position the piston in forward position (toward propeller).
    - NOTE: When in the forward position, the piston should extend 0.12 inch (3.0 mm) out in front of the outer ring. When in neutral position, the piston should be 0.06 inch (1.5 mm) behind the face of the outer ring.
  - (b) Position the valve spool approximately 0.37 inch (9.5 mm) from the valve link tab (near mid position).
  - (c) Pull the cockpit propeller pitch control knob back approximately 0.12 inch (3.0 mm).
  - (d) Connect the propeller pitch control cable to the lever that extends from the hydraulic valve.
- (5) Adjusting the Propeller Control for Proper Ground or Static RPM
  - (a) Start the engine and allow it to warm up.
  - (b) Check the propeller action with the propeller pitch control (RPM control).
  - (c) Set the pitch control to provide maximum RPM on the ground.



- (d) Shut off the engine and adjust the low pitch stop screw in the tab of the valve link to just contact the valve spool.
- (e) Adjust the jam nut to lock the low pitch stop screw in place.
- (f) Start the engine and cycle the propeller pitch control to a higher pitch and then back to lowest pitch to make sure the maximum RPM static on the ground is not exceeded.
- (g) Repeat the low pitch stop screw adjustment procedure until the maximum RPM is not exceeded.

**CAUTION:** CLEARANCE BETWEEN THE JACK PLATE AND THE HUB RING OR ANY PART OF HUB MUST BE MAINTAINED TO PREVENT EXCESSIVE LOADING OF THE JACK PLATE-TO-PISTON THRUST BEARING AND PREMATURE FAILURE. EXCESSIVE LOAD ON THE ENGINE NOSE CASE THRUST BEARING WILL ALSO RESULT.

- (h) Verify that the jack plate is maintaining a correct distance away from the ring encircling the hub and on the engine side of the blade arms.
- (i) After running the engine at maximum static RPM, shut the engine down
- (j) With the engine stopped, pull the propeller control all the way out.
- (k) Check the clearance between the jack plate and the ring encircling the hub on the engine side of the blade arm. The clearance must be a minimum of 0.06 inches (1.5 mm) and a maximum of 0.12 inches (3.0 mm) for Lycoming engines and exactly 0.12 inches (3.0 mm) for Continental engines.

**CAUTION:** DO NOT ALLOW THE HUB NUT TO ENGAGE LESS THAN FIVE FULL THREADS.

- (l) Adjust the spacers behind the rear cone to obtain the applicable clearance. Do not allow the hub nut to engage less than five full threads. Restrict the travel to maintain no less than clearance.

(m) While static on the ground, check the high pitch travel using the following procedure:

- 1 Pull the propeller pitch control back to the movement limit.
- 2 Grip the blade counterweights by hand and, at the same time, rotate the blades to high pitch to force the hydraulic piston back into the diaphragm.
- 3 Verify that the valve lever has sufficient travel to allow the valve spool to be positioned at the center of its travel while the piston is at the maximum high pitch position or end of its 0.37 inch (9.5 mm) travel.

NOTE: This is a check make sure full pitch control and RPM range is achieved during flight.

(6) Install the spinner dome (if applicable) as follows:

CAUTION 1: TO PREVENT DAMAGE TO THE BLADE AND BLADE PAINT, WRAP THE BLADE SHANKS IN SEVERAL LAYERS OF MASKING OR DUCT TAPE BEFORE INSTALLING THE SPINNER DOME. REMOVE THE TAPE AFTER THE SPINNER IS INSTALLED.

CAUTION 2: THE SPINNER DOME WILL WOBBLE IF NOT ALIGNED PROPERLY, AND MAY AFFECT THE BALANCE OF THE PROPELLER.

NOTE: The following instructions relate to Hartzell Propeller Inc. spinners only. If the airframe manufacturer produced the spinner assembly, refer to the airframe manufacturer's manual for spinner installation instructions.

- (a) Carefully install the spinner dome over the reassembled propeller.
- (b) Secure the spinner dome to the spinner bulkhead with the supplied screws and washers.

**G. Installing the HC-D(2,3)(MV,V)20-8( ) Propeller Assemblies**

**CAUTION:** INSTRUCTIONS AND PROCEDURES IN THIS SECTION MAY INVOLVE PROPELLER CRITICAL PARTS. REFER TO THE INTRODUCTION CHAPTER OF THIS MANUAL FOR INFORMATION ABOUT PROPELLER CRITICAL PARTS. REFER TO THE ILLUSTRATED PARTS LIST CHAPTER OF THE APPLICABLE OVERHAUL MANUAL(S) FOR THE IDENTIFICATION OF SPECIFIC PROPELLER CRITICAL PARTS.

**(1) Hydraulic Unit Installation**

**WARNING:** CLEANING AGENT MEK IS FLAMMABLE AND TOXIC TO THE SKIN, EYES AND RESPIRATORY TRACT. SKIN AND EYE PROTECTION ARE REQUIRED. AVOID PROLONGED CONTACT. USE IN A WELL VENTILATED AREA.

- (a) Clean the engine case, where the hydraulic unit cylinder mounts, with Quick Dry Stoddard Solvent or MEK. Remove any remaining gasket material from previous installations.
- (b) Remove the piston from the cylinder by sliding it away from the cylinder and off the piston guide rods.

**NOTE:** The jack plate unit will be attached to the piston through the thrust bearing interface with the piston.

- (c) Expose the inner cavity of the cylinder for installation on the engine case.
  - 1** Remove the screws from the retaining outer ring of the flexible diaphragm.
  - 2** Remove the outer ring from the flexible diaphragm.
  - 3** Remove the screws from the retaining inner ring of the flexible diaphragm.
  - 4** Remove the inner ring.
  - 5** Remove the flexible diaphragm.

- (d) Install the hydraulic valve assembly on the piston with a gasket and two screws (Table 3-1).
- (e) Using a No. 51 drill, drill through the side of the valve housing and through the heads of the two A-2038-( ) screws. Safety with 0.032 inch (0.81 mm) safety wire. Refer to Figure 3-8.
- (f) Install the gasket.
  - 1 Align the clearance holes of the A-181 gasket with the six mounting studs that protrude from the engine and install the gasket flush against the engine case.
  - 2 Install one O-ring (Table 3-1) around each mounting stud, flush against the gasket.
- (g) Install the cylinder
  - 1 Align the six cylinder mounting holes with the six mounting studs that protrude from the engine case and position the cylinder flush against the previously installed gasket.

**CAUTION 1:** CHECK THE HEIGHT OF THE STUDS ABOVE THE INSIDE SURFACE OF THE CYLINDER. THE HEIGHT MUST NOT EXCEED 0.532 INCH (13.51 MM) OR PISTON TRAVEL MAY BE LIMITED AND MAY RESTRICT BLADE ANGLE TRAVEL. IF THE STUDS ARE TOO LONG, REMOVE THE CYLINDER AND GASKET AND SHORTEN THE STUDS. REPEAT ALL INSTALLATION STEPS.

**CAUTION 2:** THE HEIGHT OF THE STUDS ABOVE THE INSIDE SURFACE OF THE CYLINDER MUST NOT BE LESS THAN 0.468 INCH (11.89 MM) OR MOUNTING NUT WILL NOT HAVE ENOUGH THREAD FOR ENGAGEMENT.

- 2 Install one mounting nut (Table 3-1) on each of the six studs to secure the hydraulic cylinder to the engine.
- 3 Torque each nut in accordance with Table 3-2.

- (h) Install the diaphragm and the inner ring.  
Refer to Figure 3-8.1.

**CAUTION:** DO **NOT** ALIGN THE TAB ON THE DIAPHRAGM WITH THE VALVE ASSEMBLY MOUNTING SURFACE ON THE CYLINDER (IF PRESENT). THIS WILL PREVENT THE DIAPHRAGM FROM SEATING PROPERLY AND MAY CAUSE THE DIAPHRAGM TO FAIL.

- 1 Align the centerline of the diaphragm with the centerline of the cylinder and position the diaphragm flush against the cylinder.
  - a The centerline is identified by locating the four holes that align. Refer to Figure 3-8.1.
- 2 Position the flat side of the inner ring flush against the diaphragm.
- 3 Align the mounting holes in the inner ring with the holes in the diaphragm and cylinder.
- 4 Install the screws (Table 3-1) through the inner ring and diaphragm and thread into cylinder.

**CAUTION:** THE INNER RING MAY BREAK IF ONLY A FEW SCREWS ARE TIGHTENED IN A LOCALIZED AREA.

- 5 Using a staggered sequence, tighten all of the inner ring screws slightly, then repeat until the diaphragm squeezes out past the inside edge of the inner ring 0.062 inches (1.57 mm).
- (i) Install the outer ring. Refer to Figure 3-8.2
- 1 Position the chamfered side of the outer ring flush against the diaphragm.
  - 2 Align the mounting holes in the outer ring with the holes in the diaphragm and cylinder.
    - a If the outer ring has a tab, as shown in Figure 3-8.2, align the tab with the valve assembly mounting surface (if present), not the diaphragm tab.

- 3 Install the lock washers onto the screws (Table 3-1), then install the screws through the outer ring and diaphragm into the cylinder.

**CAUTION:** THE RING MAY BREAK IF ONLY A FEW SCREWS ARE TIGHTENED IN A LOCALIZED AREA.

- 4 Using a staggered sequence, tighten all of the outer ring screws slightly, then repeat until the diaphragm squeezes out past the edges of the outer ring 0.062 inches (1.57 mm) and the proper torque is achieved. Refer to Table 3-2, Torque Values.
- 5 After one hour, visually inspect the diaphragm protrusion around the outside of the outer ring, and from the inside of the inner ring.
  - a If the protrusion has receded, retighten all of the outer ring and/or inner ring screws evenly to get the 0.062 inch (1.57 mm) protrusion.

**CAUTION:** DO NOT APPLY GREASE TO THE EXPOSED FLEXIBLE DIAPHRAGM SURFACE. GREASE ON THIS SURFACE WILL ATTRACT ABRASIVE MATERIAL HASTENING FAILURE AND CAUSING LEAKAGE OF THE DIAPHRAGM.

- (j) Put the piston and jack plate unit over the cylinder and clock the piston to the cylinder by aligning the number stamped on the piston with the number stamped on the cylinder.
- (k) Align the appropriate holes in the piston with the guide rods in the cylinder.

**NOTE:** Cylinder-to-piston guide rods may bind in the piston if the cylinder and piston combination is changed from that originally supplied.

- (l) Install the jack plate unit and piston assembly on the piston guide rods and against the flexible diaphragm.

NOTE: Use a rubber mallet as necessary to position the piston.

CAUTION: THE HOSE MUST BE LONG ENOUGH TO ALLOW THE VALVE TO MOVE FREELY WITH THE PISTON THROUGH ITS FULL TRAVEL.

- (m) Install a 0.37 to 0.50 inch (9.5 to 12.7 mm) inside diameter (ID) flexible hose with a minimum pressure capacity of 150 psi from the engine oil pressure pump supply to the hydraulic valve. Connect the hose to the threaded hole in the valve closest to the propeller (the pressure supply port).

- (n) Perform the following three adjustments:

- 1 Bottom the piston in the cylinder.
- 2 Pull the propeller control (for pitch and RPM control) handle out approximately 2.25 inches (57.1 mm) from the instrument panel.
- 3 Locate the valve spool midway between the cotter pin and the base of the guide pin.

- (o) Attach the propeller pitch control cable to the hydraulic valve lever on the long end that extends from the valve spool.

- (2) Adjusting Travel on Hydraulic Unit Without Governor. Refer to Figure 3-9.

- (a) Remove the low pitch stop screw from the valve link.
- (b) Loosen the screws to free the vernier control.
- (c) Pull the piston out with the counterweights, until the piston guide arms extend a maximum of 0.50 inch (12.7 mm) for a 0.125 inch (3.17 mm) diaphragm or a maximum of 0.44 inch (11.18 mm) for a 0.063 inch (1.59 mm) diaphragm from the outer diaphragm ring B-120.

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