

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

**Hartzell Propeller Inc.**

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As a fellow pilot, I urge you to read this Manual thoroughly. It contains a wealth of information about your new propeller.

The propeller is among the most reliable components of your airplane. It is also among the most critical to flight safety. It therefore deserves the care and maintenance called for in this Manual. Please give it your attention, especially the section dealing with Inspections and Checks.

Thank you for choosing a Hartzell propeller. Properly maintained it will give you many years of reliable service.

A handwritten signature in black ink that reads "Jim Brown". The signature is fluid and cursive, with a long horizontal stroke extending to the right.

Jim Brown  
Chairman, Hartzell Propeller Inc.

# WARNING

People who fly should recognize that various types of risks are involved; and they should take all precautions to minimize them, since they cannot be eliminated entirely.

The propeller is a vital component of the aircraft. A mechanical failure of the propeller could cause a forced landing or create vibrations sufficiently severe to damage the aircraft, possibly causing it to become uncontrollable.

Propellers are subject to constant vibration stresses from the engine and airstream, which are added to high bending and centrifugal stresses.

Before a propeller is certified as being safe to operate on an airplane, an adequate margin of safety must be demonstrated. Even though every precaution is taken in the design and manufacture of a propeller, history has revealed rare instances of failures, particularly of the fatigue type.

It is essential that the propeller is properly maintained according to the recommended service procedures and a close watch is exercised to detect impending problems before they become serious. Any grease or oil leakage, loss of air pressure, unusual vibration, or unusual operation should be investigated and repaired, as it could be a warning that something serious is wrong.

For operators of uncertified or experimental aircraft an even greater level of vigilance is required in the maintenance and

inspection of the propeller. Experimental installations often use propeller-engine combinations that have not been tested and approved. In these cases, the stress on the propeller and, therefore, its safety margin is unknown. Failure could be as severe as loss of propeller or propeller blades and cause loss of propeller control and/or loss of aircraft control.

Hartzell Propeller Inc. follows FAA regulations for propeller certification on certificated aircraft. Experimental aircraft may operate with unapproved engines or propellers or engine modifications to increase horsepower, such as unapproved crankshaft damper configurations or high compression pistons. These issues affect the vibration output of the engine and the stress levels on the propeller. Significant propeller life reduction and failure are real possibilities.

Frequent inspections are strongly recommended if operating with a non-certificated installation; however, these inspections may not guarantee propeller reliability, as a failing device may be hidden from the view of the inspector. Propeller overhaul is strongly recommended to accomplish periodic internal inspection.

Visually inspect metal blades for cracks. Inspect hubs, with particular emphasis on each blade arm for cracks. Eddy current equipment is recommended for hub inspection, since cracks are usually not apparent.

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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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RECORD OF REVISIONS

Rev. No.	Issue Date	Date Inserted	Inserted By

RECORD OF TEMPORARY REVISIONS

TR No.	Issue Date	Date Inserted	Inserted By	Date Removed	Removed By
TR-001	Nov/03	Nov/03	HPI	May/11	HPI
TR-002	Feb/06	Feb/06	HPI	May/11	HPI



SERVICE DOCUMENTS LIST

CAUTION 1: DO NOT USE OBSOLETE OR OUTDATED INFORMATION. PERFORM ALL INSPECTIONS OR WORK IN ACCORDANCE WITH THE MOST RECENT REVISION OF THE SERVICE DOCUMENT. INFORMATION CONTAINED IN A SERVICE DOCUMENT MAY BE SIGNIFICANTLY CHANGED FROM EARLIER REVISIONS. USE OF OBSOLETE INFORMATION MAY CREATE AN UNSAFE CONDITION THAT MAY RESULT IN DEATH, SERIOUS BODILY INJURY, AND/OR SUBSTANTIAL PROPERTY DAMAGE. REFER TO THE APPLICABLE SERVICE DOCUMENT INDEX FOR THE MOST RECENT REVISION LEVEL OF THE SERVICE DOCUMENT.

CAUTION 2: THE INFORMATION FOR THE DOCUMENTS LISTED INDICATES THE REVISION LEVEL AND DATE AT THE TIME THAT THE DOCUMENT WAS INITIALLY INCORPORATED INTO THIS MANUAL. INFORMATION CONTAINED IN A SERVICE DOCUMENT MAY BE SIGNIFICANTLY CHANGED FROM EARLIER REVISIONS. REFER TO THE APPLICABLE SERVICE DOCUMENT INDEX FOR THE MOST RECENT REVISION LEVEL OF THE SERVICE DOCUMENT.

Service Document Number	Incorporation Rev/Date
HC-SB-61-241	Original, Nov/02
HC-SL-61-48A, Rev. 1	Rev. 1, May/11
SB 82, June 2, 1965	Rev. 1, May/11
HC-SL-61-320	Rev. 2, Jun/12
HC-SL-61-324	Rev. 2, Jun/12

SERVICE DOCUMENTS LIST

<u>Service Document Number</u>	<u>Incorporation Rev/Date</u>



## AIRWORTHINESS LIMITATIONS

The Airworthiness Limitations section is FAA approved and specifies maintenance required under 14 CFR §§ 43.16 and 91.403 of the Federal Aviation Regulations unless an alternative program has been FAA approved.

FAA APPROVED

by: Michael Duro date: 5/19/11  
 for Manager, Chicago Aircraft Certification  
 Office,  
 ACE-115C  
 Federal Aviation Administration

Rev. No.	Description of Revision
1	Relocated Airworthiness Limitations pages from Manual 100E

## AIRWORTHINESS LIMITATIONS

1. The FAA establishes specific life limits for certain component parts as well as the entire propeller. Such limits require replacement of the identified parts after a specified number of hours of use.
2. The following data summarizes all current information concerning Hartzell life limited parts, as related to propeller models affected by this manual. These parts are not life limited on other installations; however, time accumulated toward life limit accrues when first operated on aircraft/engine/propeller combinations listed and continues regardless of subsequent installations (that may or may not be life limited).
  - A. Propeller models affected by this manual currently do not have any life limited parts.
  - B. There are no new (or additional) Airworthiness Limitations associated with this equipment and/or installation.

FAA APPROVED

by: Michael Deane date: 5/19/11

*for* Manager, Chicago Aircraft Certification  
Office,  
ACE-115C  
Federal Aviation Administration

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**1. Purpose**

**CAUTION:** KEEP THIS MANUAL WITH THE PROPELLER, OR THE AIRCRAFT UPON WHICH IT IS INSTALLED, AT ALL TIMES. THE LOG BOOK RECORD WITHIN THIS MANUAL MUST BE MAINTAINED, RETAINED CONCURRENTLY, AND BECOME A PART OF THE AIRCRAFT RECORDS AND ENGINE SERVICE RECORDS.

- A. This manual supports steel hub Hydro-Selective and constant speed propellers.
- B. The purpose of this manual is to enable qualified personnel to install, operate, and maintain a Hartzell Propeller Inc. Steel Hub Hydro-Selective or constant speed propeller. Separate manuals are available concerning overhaul procedures and specifications for the propeller.
- C. This manual includes several design types.
  - (1) Sample hub and blade model numbers within this design are included in the Description and Operation chapter of this manual.
  - (2) Parentheses shown in the propeller model designations in this or other Hartzell Propeller Inc. publications indicate letter(s) and/or number(s) that may or may not be present because of different configurations permitted on the various aircraft installations.
  - (3) Definitions of propeller model designations and further details of letters that may be present are shown in the Description and Operation chapter of this manual.

**2. Airworthiness Limits**

- A. Refer to the Airworthiness Limitations chapter of this manual for Airworthiness Limits information.

**3. General****A. Personnel Requirements**

- (1) Personnel performing maintenance are assumed to have sufficient training and certifications (when required by the applicable Aviation Authority) to accomplish the work required in a safe and airworthy manner.
- (2) Compliance to the applicable regulatory requirements established by the Federal Aviation Administration (FAA) is mandatory for anyone performing or accepting responsibility for any inspection and/or repair and/or overhaul of any Hartzell Propeller Inc. product.

**B. Maintenance Practices**

- (1) The propeller and its components are highly vulnerable to damage when they are removed from the engine. Properly protect all components until they are reinstalled on the engine.
- (2) Never attempt to move the aircraft by pulling on the propeller.
- (3) Avoid the use of blade paddles if possible. If blade paddles must be used, use at least two paddles. Put the blade paddle in the thickest area of the blade. Use one blade paddle per blade.
- (4) Use only the approved consumables (e.g., cleaning agents, lubricants, etc.).
- (5) Observe applicable torque values during maintenance.
- (6) Before installing the propeller on the engine, the propeller must be statically balanced. New propellers are statically balanced at Hartzell Propeller Inc. Overhauled propellers must be statically balanced by the overhaul facility before return to service.

**NOTE:** Dynamic balance is recommended, but may be accomplished at the discretion of the operator, unless specifically required by the airframe or engine manufacturer. Dynamic balancing must be accomplished in accordance with the procedures and limitations in the Maintenance Practices chapter of this manual. Additional procedures may be found in the aircraft maintenance manual.



- (7) As necessary, use a soft, non-graphite pencil or crayon to make identifying marks on components.
- (8) As applicable, follow military standard NASMS33540 for safety wire and cotter pin general practices. Use 0.032 inch (0.81 mm) diameter stainless steel safety wire unless otherwise indicated.

**CAUTION:** DO NOT USE OBSOLETE OR OUTDATED INFORMATION. PERFORM ALL INSPECTIONS OR WORK IN ACCORDANCE WITH THE MOST RECENT REVISION OF THIS MANUAL. INFORMATION CONTAINED IN THIS MANUAL MAY BE SIGNIFICANTLY CHANGED FROM EARLIER REVISIONS. USE OF OBSOLETE INFORMATION MAY CREATE AN UNSAFE CONDITION THAT MAY RESULT IN DEATH, SERIOUS BODILY INJURY, AND/OR SUBSTANTIAL PROPERTY DAMAGE. FOR THE MOST RECENT REVISION LEVEL OF THIS MANUAL, REFER TO THE HARTZELL PROPELLER INC. WEBSITE AT [WWW.HARTZELLPROP.COM](http://WWW.HARTZELLPROP.COM).

- (9) The information in this manual supersedes data in all previously published revisions of this manual.
- (10) The airframe manufacturer's manuals should be used in addition to the information in this manual due to possible special requirements for specific aircraft applications.
- (11) Approved corrosion protection followed by approved paint must be applied to all aluminum blades.
  - (a) For information concerning the application of corrosion protection and paint, refer to the Maintenance Practices chapter of this manual.
  - (b) Operation of blades without the specified coatings and finishes, i.e., "polished blades", is not permitted.

**C. Continued Airworthiness**

Operators are urged to keep informed of Airworthiness information via Hartzell Propeller Inc. Service Bulletins and Service Letters, which are available from Hartzell Propeller Inc. distributors or from the Hartzell Propeller Inc. factory by subscription. Selected information is also available on Hartzell Propeller's website at [www.hartzellprop.com](http://www.hartzellprop.com).

**D. Propeller Critical Parts**

The following maintenance procedures may involve propeller critical parts. These procedures have been substantiated based on Engineering analysis that expects this product will be operated and maintained using the procedures and inspections provided in the ICA for this product. Refer to the Illustrated Parts List chapter of the applicable maintenance manual for the applicable propeller model for the identification of specific Propeller Critical Parts.

Numerous propeller system parts can produce a propeller Major or Hazardous effect, even though those parts may not be considered as Propeller Critical Parts. The operating and maintenance procedures and inspections provided in the ICA for this product are, therefore, expected to be accomplished for all propeller system parts.

**4. Reference Publications**

The following publications are referenced within this manual:

Hartzell Propeller Inc. Manual No. 100E (61-10-00) - Hydro-Selective Propeller Overhaul Manual

Hartzell Propeller Inc. Manual No. 127 (61-16-27) - Spinner Assembly Maintenance

Hartzell Propeller Inc. Manual No. 130B (61-23-30) - Governor Overhaul Manual.

Hartzell Propeller Inc. Manual No. 133C (61-13-33) - Aluminum Blade Overhaul

Hartzell Propeller Inc. Manual No. 165A (61-00-65) - Illustrated Tool and Equipment Manual

Hartzell Propeller Inc. Manual No. 159 (61-02-59) - Application Guide - Also available on the Hartzell Propeller Inc. website at [www.hartzellprop.com](http://www.hartzellprop.com)

Hartzell Propeller Inc. Manual No. 165A (61-00-65) - Illustrated Tool and Equipment Manual.

Hartzell Manual No. 202A (61-01-02) - Standard Practices Manual - Volumes 1 through 11

Active Hartzell Propeller Inc. Service Bulletins, Service Letters, Service Instructions, and Service Advisories

Hartzell Propeller Inc. Service Letter HC-SL-61-61Y - Overhaul Periods and Service Life Limits for Hartzell Propellers, Governors, and Propeller Damper Assemblies - Also available on the Hartzell Propeller Inc. website at [www.hartzellprop.com](http://www.hartzellprop.com)

### 5. Definitions

A basic understanding of the following terms will assist in maintaining and operating Hartzell propeller systems.

<u>Term</u>	<u>Definition</u>
Annealed .....	Softening of material due to overexposure to heat.
Blade Angle .....	Measurement of blade airfoil location described as the angle between the blade airfoil and the surface described by propeller rotation.
Brinelling .....	A depression caused by failure of the material in compression.
Chord .....	A straight line distance between the leading and trailing edges of an airfoil.
Cold Rolling .....	Compressive rolling process that provides improved strength and resistance to fatigue.
Constant Force .....	A force which is always present in some degree when the propeller is operating.
Constant Speed .....	A propeller system which employs a governing device to maintain a selected engine RPM.
Corrosion .....	Gradual material removal or deterioration due to chemical action.

<u>Term</u>	<u>Definition</u>
Crack .....	Irregularly shaped separation within a material, sometimes visible as a narrow opening at the surface.
Depression .....	Surface area where the material has been compressed but not removed.
Distortion .....	Alteration of the original shape or size of a component
Erosion .....	Gradual wearing away or deterioration due to action of the elements.
Exposure .....	Leaving material open to action of the elements.
Feathering .....	A propeller with blades that may be rotated to a position parallel to the relative wind, thus reducing aerodynamic drag.
Gouge.....	Surface area where material has been removed
<b>Hazardous Propeller</b>	
Effect .....	The hazardous propeller effects are defined in Title 14 CFR section 35.15(g)(1).
Horizontal Balance .....	Balance between the blade tip and the center of the hub.
Impact Damage .....	Damage that occurs when the propeller blade or hub assembly strikes, or is struck by, an object while in flight or on the ground.
Major Propeller Effect ..	The major propeller effects are defined in Title 14 CFR section 35.15(g)(2).
Nick .....	Removal of paint and possibly a small amount of material.
Onspeed.....	Condition in which the RPM selected by the pilot through the propeller control lever and the actual engine (propeller) RPM are equal.

<u>Term</u>	<u>Definition</u>
Overhaul .....	The periodic disassembly, inspection, repair, refinish, and reassembly of a propeller assembly to maintain airworthiness.
Overspeed .....	Condition in which the RPM of the propeller or engine exceeds predetermined maximum limits; the condition in which the engine (propeller) RPM is higher than the RPM selected by the pilot through the propeller control lever.
Overspeed Damage .....	Damage that occurs when the propeller hub assembly rotates at a speed greater than the maximum limit for which it is designed.
Pitch.....	Same as "Blade Angle" for constant speed propellers.
Pitting.....	Formation of a number of small, irregularly shaped cavities in surface material caused by corrosion or wear.
Propeller Critical Part....	A part on the propeller whose primary failure can result in a hazardous propeller effect, as determined by the safety analysis required by Title 14 CFR section 35.15.
Propeller Repair Station.....	A repair facility that is appropriately licensed and approved by their local aviation authority.
Scratch .....	Same as "Nick".
Single Acting.....	Hydraulically actuated propeller which utilizes a single oil supply for pitch control.
Synchronizing .....	Adjusting the RPM of all the propellers of a multi-engine aircraft to the same RPM.

- Synchrophasing..... A form of propeller synchronization in which not only the RPM of the engines (propellers) are held constant, but also the position of the propellers in relation to each other.
- Track..... In an assembled propeller, a measurement of the location of the blade tip with respect to the plane of rotation, used to verify face alignment and to compare blade tip location with respect to the locations of the other blades in the assembly.
- Underspeed ..... The condition in which the actual engine (propeller) RPM is lower than the RPM selected by the pilot through the propeller control lever.
- Vertical Balance..... Balance between the leading and trailing edges of a two-blade propeller, with the blades positioned vertically.
- Variable Force ..... A force which may be applied or removed during propeller operation.
- Windmilling ..... The rotation of an aircraft propeller caused by air flowing through it while the engine is not producing power.

## 6. Abbreviations

<u>Abbreviation</u>	<u>Term</u>
AMM .....	Aircraft Maintenance Manual
AN.....	Air Force-Navy (or Army-Navy)
AOG.....	Aircraft on Ground
FAA.....	Federal Aviation Administration
Ft-Lb .....	Foot-Pound
ID .....	Inside Diameter
In-Lb .....	Inch-Pound

Lbs.....	Pounds
MIL-X-XXX.....	Military Specification
MPI.....	Major Periodic Inspection (Overhaul)
MS.....	Military Standard
NAS.....	National Aerospace Standards
N•m.....	Newton-Meters
OD.....	Outside Diameter
POH.....	Pilot's Operating Handbook
PSI.....	Pounds per Square Inch
RPM.....	Revolutions per Minute
TBO.....	Time Between Overhaul
TSN.....	Time Since New
TSO.....	Time Since Overhaul

**NOTE:** TSN/TSO is considered as the time accumulated between rotation and landing, i.e., flight time.

#### 7. Hartzell Propeller Inc. Product Support

- A. Hartzell Propeller Inc. is ready to assist you with questions concerning your propeller system. Hartzell Propeller Inc. Product Support may be reached during business hours (8:00 a.m. through 5:00 p.m., United States Eastern Time) at (937) 778-4379 or at (800) 942-7767, toll free from the United States and Canada. Hartzell Propeller Inc. Product Support can also be reached by fax at (937) 778-4391, and by email at [techsupport@hartzellprop.com](mailto:techsupport@hartzellprop.com).
- B. After business hours, you may leave a message on our 24 hour product support line at (937) 778-4376 or at (800) 942-7767, toll free from the United States and Canada. A technical representative will contact you during normal business hours. Urgent AOG support is also available 24 hours per day, seven days per week via this message service.
- C. Additional information is available on our website at [www.hartzellprop.com](http://www.hartzellprop.com).

**NOTE:** When calling from outside the United States, dial (001) before dialing the above telephone numbers.

## 8. Warranty Service

If you believe you have a warranty claim, it is necessary to contact Hartzell Propeller's Warranty Administrator. Hartzell Propeller's Warranty Administrator will provide a blank *Warranty Application* form. It is necessary to complete this form and return it to the Warranty Administrator for evaluation **before proceeding with repair or inspection work**. Upon receipt of this form, the Warranty Administrator will provide instructions on how to proceed. Hartzell Propeller Inc. Warranty may be reached during business hours (8:00 a.m. through 5:00 p.m., United States Eastern Time) at (937)-778-4379 or toll free from the United States and Canada at (800) 942-7767. Hartzell Propeller Inc. Warranty Administration can also be reached by fax at (937) 778-4391, or by e-mail at [warranty@hartzellprop.com](mailto:warranty@hartzellprop.com).

**NOTE:** When calling from outside the United States, dial (001) before dialing the above telephone numbers.

## 9. Hartzell Propeller Inc. Recommended Facilities

- A. Hartzell Propeller Inc. recommends using Hartzell Propeller Inc. approved distributors and repair facilities for the purchase, repair, and overhaul of Hartzell propeller assemblies or components.
- B. Information about the Hartzell Propeller Inc. worldwide network of aftermarket distributors and approved repair facilities is available on the Hartzell Propeller Inc. web site at [www.hartzellprop.com](http://www.hartzellprop.com).



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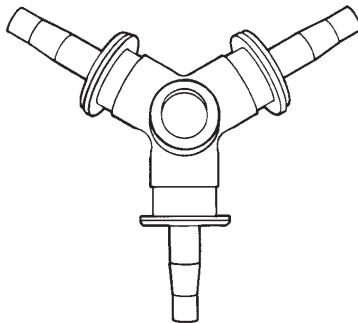
Governor in Overspeed Condition..... [Figure 2-8](#)..... 2-18

**1. Description of Propeller and Systems****A. General Description (Construction)**

- (1) The propellers covered in this manual are capable of either constant speed operation or attain a blade angle through manual selection by the pilot while in flight. All of these propellers use aluminum blades and are intended for use with reciprocating engines.
- (2) The Hartzell Hydro-Selective propeller changes blade pitch through hydraulic actuation that is controlled manually. Manual control allows the pilot to select a blade angle by moving a cockpit control to result in a desired RPM setting. Governed control uses a device called a governor to sense engine RPM and will change blade angle as necessary to maintain the RPM selected by the pilot. Governed control is referred to as constant speed operation.
- (3) Blade angles range from a low positive blade angle to a high positive blade angle or from a high positive blade angle to a reverse blade angle. Feathering is not possible with these propellers.
- (4) The Hartzell Hydro-Selective propeller that uses manual control consists primarily of a propeller assembly, a hydraulic unit, and a valve assembly. The constant speed propeller that uses governor control has a governor, a T-drive unit, and a hydraulic hose connecting the governor and the hydraulic unit.

- (5) A manually controlled propeller assembly consists of a central steel hub (Figure 2-1) that mounts on the engine splined shaft. Blades are attached to the hub and are retained by two piece blade clamps and thrust bearing assemblies. A hydraulic unit consisting of a cylinder, piston, and pitch change linkage is attached to the face of the engine case encircling the splined engine shaft and propeller. A valve assembly is attached to the hydraulic unit and supplies oil to the piston and cylinder. Oil supplied from the engine, or governor for a constant speed propeller, through the valve assembly is pumped into a cavity defined by the engine mounted cylinder and piston. The piston and cylinder do not rotate with the propeller. They remain fixed to the engine, although the piston will move linearly in response to the changing volume of oil. This linear movement is transmitted through a thrust bearing to a jack plate unit that is also part of the hydraulic unit. The thrust bearing allows the non-rotating piston to be linked to the jack plate unit that rotates with the propeller. The jack plate unit acts as the linkage between piston linear movement and blade pitch change. The jack plate unit is attached to knobs on the inboard side of each blade retention clamp and translates the linear piston motion into rotational movement of the blade clamp and blade. This results in blade pitch change while the propeller assembly is rotating.

APS2063A



**Steel Hub  
Figure 2-1**

- (6) A governor control propeller is constructed and configured as described for the manually controlled propeller assembly with the following additions. Many engines on which a governed propeller is mounted are not designed with an accessory drive pad for attachment of a governor. A device identified as a T-drive unit is installed between the engine and the fuel pump to drive the subject accessory and provide an additional accessory drive pad for the attachment of a governor. Governor controlled oil is supplied through external high pressure hosing to a valve attached to the hydraulic cylinder and piston to cause a blade angle change and maintain a constant engine speed.
- (7) Blade retention on early propeller models is designated with a "V" in the propeller model. The "V" blade retention type uses two shoulders on the blade root outside diameter. The blade root shoulders are engaged by a double shoulder blade clamp that encircles the blade root and retains the blade onto a thrust bearing and blade arm of the central hub. Blade retention on later propeller models is designated with an "MV" in the propeller model. This blade retention type uses a single shoulder on the blade root outside diameter. A single shoulder blade clamp encircles the blade root and retains the blade onto a thrust bearing and blade arm of the central hub.

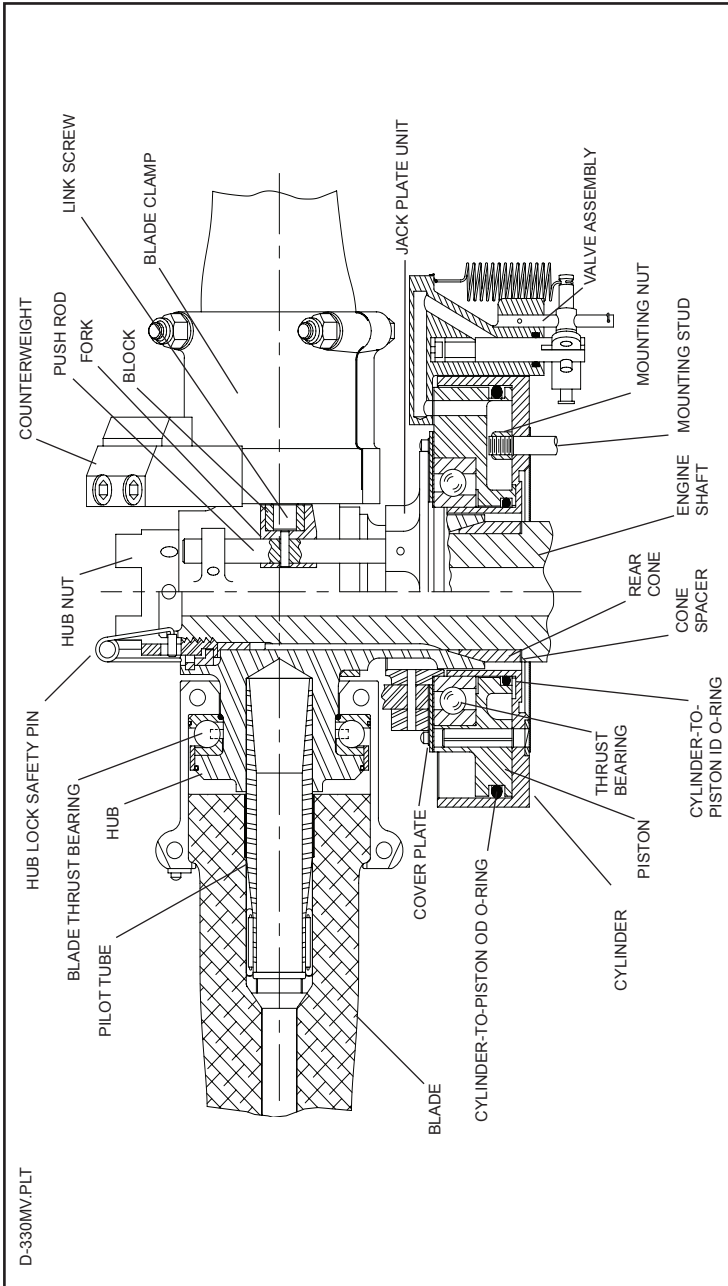
B. General Description (Forces)

While the propeller is operating, the following forces are constantly present: 1) counterweight force, 2) centrifugal twisting moment of each blade, and 3) blade aerodynamic twisting forces. The counterweight forces rotate the blades to higher blade angles, while the centrifugal twisting moment of each blade is toward lower blade angle. Blade aerodynamic twisting force is usually very small in relation to the other forces and can attempt to increase or decrease blade angle.

**C. General Description (Control)**

- (1) The summation of the propeller forces is toward higher pitch (low RPM) and is opposed by a variable force toward lower pitch (high RPM). The variable force is oil controlled from a governor or is engine oil that is pilot controlled through a valve. The variable oil force (oil supply) is supplied under pressure to the hydraulic cylinder and piston on the face of the engine case encircling the splined engine shaft and propeller. Increasing the volume of oil within the piston and cylinder will decrease the blade angle and increase propeller RPM. Decreasing the volume of oil will increase blade angle and decrease propeller RPM. Changing blade angle will vary the load on the engine and result in a change of engine and propeller RPM. On constant speed installations the governor will maintain a constant RPM (within limits) independent of where the throttle is set. On a manually controlled propeller the pilot selects a blade angle through a cable attached to a valve on the hydraulic cylinder and piston to select a higher or lower RPM, as desired. The manually controlled valve will allow engine oil under pressure to enter the piston and cylinder cavity, or will allow oil to leave the piston and cylinder cavity and return to engine drain.
- (2) Reverse blade angle operation is only available on a manually controlled propeller model. The governed propeller model covered by this manual is not reversible.

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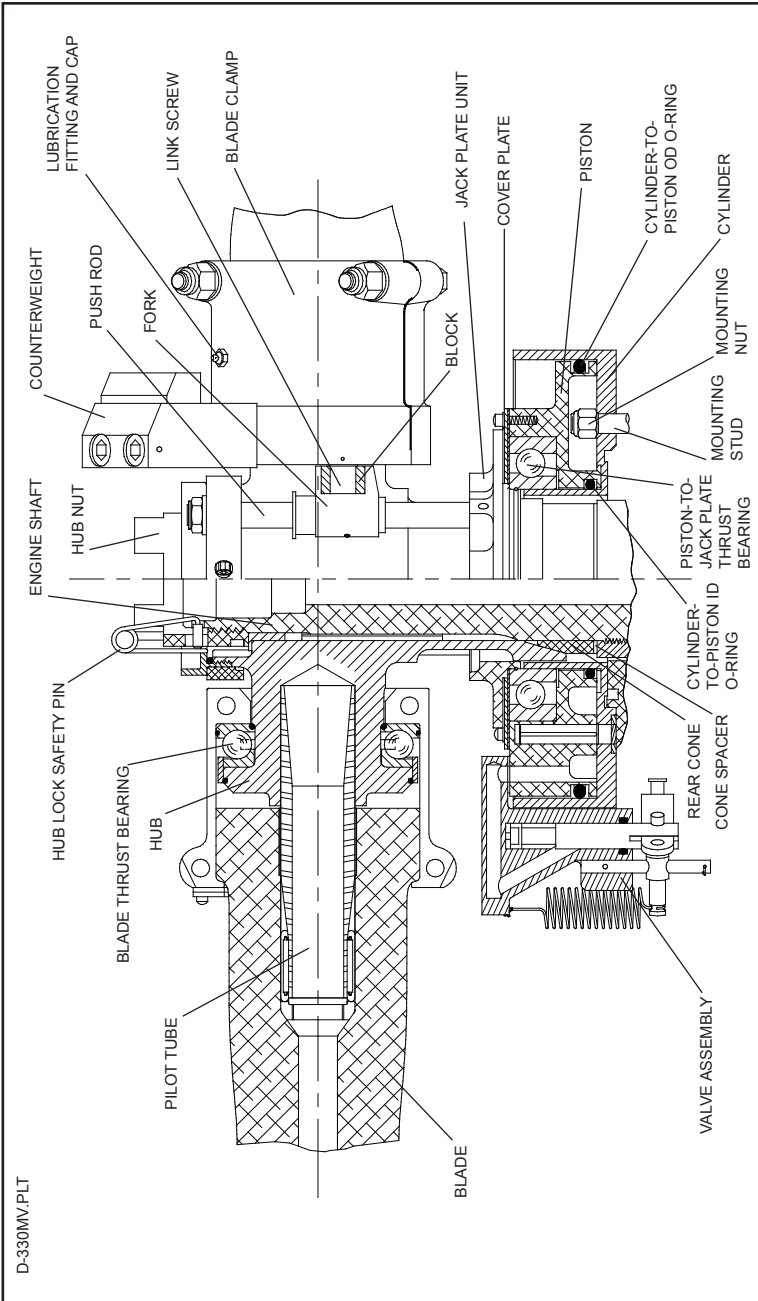


**HC-D2(MV,V)20-3 Propeller Assembly  
Figure 2-2**



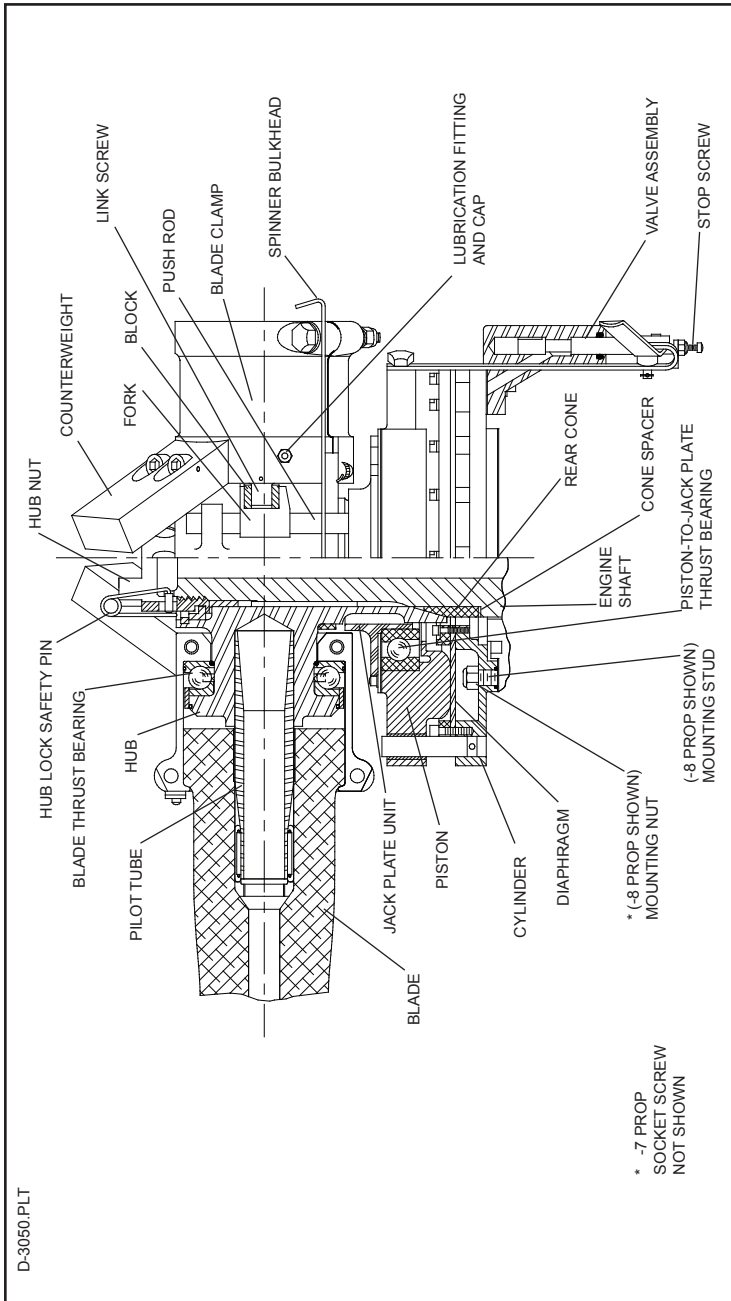
**2. Propeller Description**

- A. Propeller Model HC-D2(MV,V)20-3( ). Refer to Figure 2-2.
- (1) This propeller model uses manual control and is reversing. The basic components of this propeller assembly consist of a propeller, a hydraulic unit, and a valve assembly.
  - (2) A blade angle range up to 33 degrees enables reverse thrust operation for ground or water handling.
  - (3) The hydraulic unit is designed so the cylinder will attach to the engine with an SAE 20 splined thrust plate that uses six attachment points. This requires six holes in the cylinder to receive six studs from the engine and is secured in place with one nut on each stud.



HC-D3(MV,V)20-6( ) Propeller Assembly  
Figure 2-3

- I** B. Propeller Model HC-D3(MV,V)20-6( ). Refer to Figure 2-3.
- (1) This propeller model uses manual control and is reversing. The basic components of this propeller assembly consist of a propeller, a hydraulic unit, and a valve assembly.
  - (2) A blade angle range up to 33 degrees enables reverse thrust operation for ground or water handling.
  - (3) The hydraulic unit is designed so the cylinder will attach to engines with an SAE 20 splined thrust plate that uses six attachment points. This requires six holes in the cylinder to receive six studs from the engine and is secured in place with one nut on each stud.

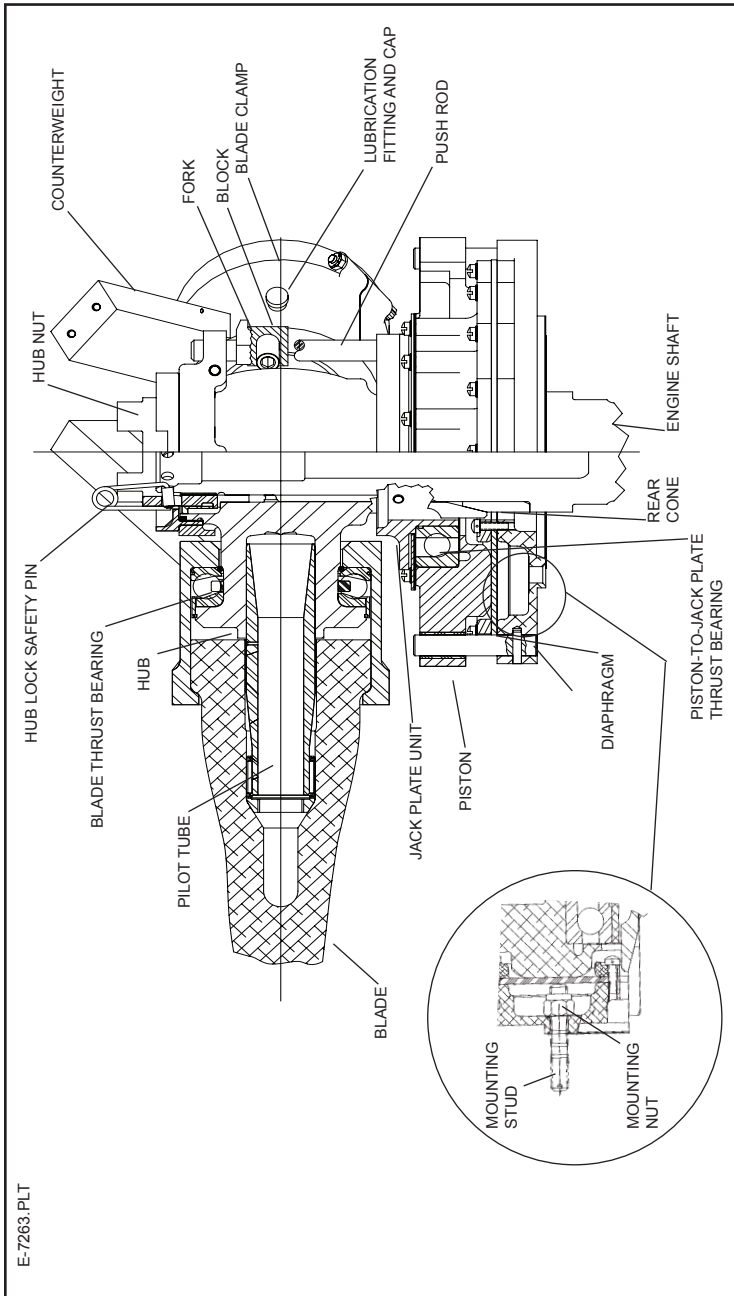


HC-D2(MV,V)20-7( ) and HC-D2(MV,V)20-8( ) Propeller Assembly

Figure 2-4

D-3060.PLT

- C. Propeller Models HC-D2(MV,V)20-7( ) and HC-D2(MV,V)20- 8( ). Refer to Figure 2-4.
- (1) These propeller models may be controlled either manually or by a governor and are always non-reversing. If governing, the basic components consist of a propeller, a hydraulic unit, a valve assembly, a governor, and a T-drive unit. If manual control is used, the basic components consist of a propeller, a hydraulic unit, and a valve assembly.
  - (2) This propeller model series is capable of approximately 14 degrees of blade angle range and uses a diaphragm to seal between the piston and the cylinder.
  - (3) On HC-D2(MV,V)20-7( ) models the hydraulic unit is designed so the cylinder of the hydraulic unit will attach to Continental E-185 and E-225 engines that use four attachment points. This requires 4 holes in the cylinder to receive 4 socket head cap screws that are threaded into the engine.
  - (4) On HC-D2(MV,V)20-8( ) models the hydraulic unit is designed so the cylinder will attach to a Lycoming O-435 engine with an SAE 20 splined thrust plate that uses six attachment points. This requires six holes in the cylinder to receive six studs from the engine and is secured in place with one nut on each stud.



**HC-D3MV20-8D Propeller Assembly  
Figure 2-5**

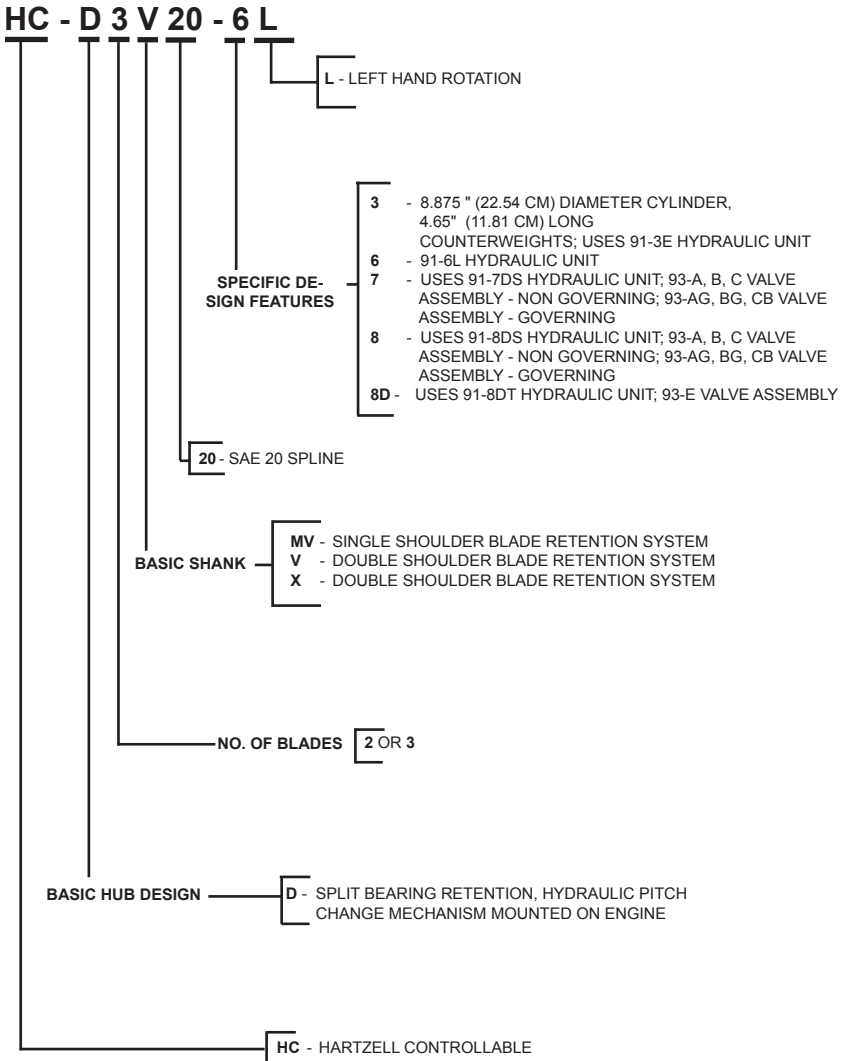
E-7263.PLT

- D. Propeller Model HC-D3MV20-8D. Refer to Figure 2-5.
- (1) This propeller model uses manual control and is non-reversing. The basic components of this propeller assembly consist of a propeller, hydraulic unit, and valve assembly.
  - (2) This propeller model series is capable of approximately 14 degrees of blade angle range and uses a diaphragm to seal between the piston and the cylinder.
  - (3) The hydraulic unit is designed so the cylinder will attach to the engine with an SAE 20 splined thrust plate using six attachment points. This requires six holes in the cylinder to receive six studs from the engine and is secured in place with one nut on each stud.

### 3. Model Designation

The following pages illustrate sample model designations for Hartzell Hydro-Selective propeller hubs and blades.

### STEEL HUB PROPELLER MODEL IDENTIFICATION

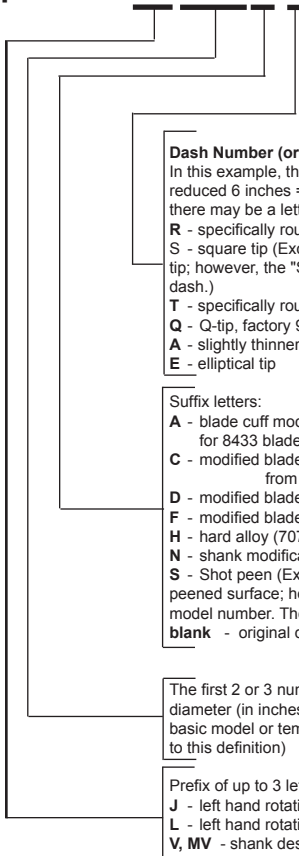


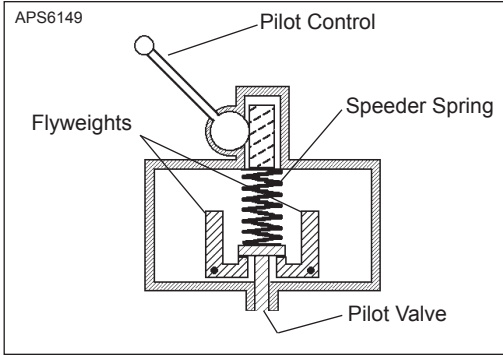


### ALUMINUM BLADE MODEL IDENTIFICATION

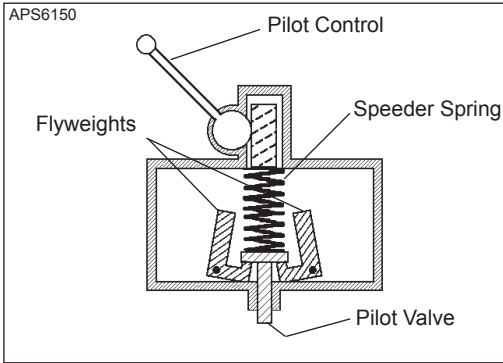
Hartzell Propeller Inc. uses a model designation to identify specific propeller and blade assemblies. Example: HC-D2MV20-8/V8433N-6. A slash mark separates the propeller and blade designations. The propeller model designation is impression stamped on the propeller hub. The blade designation is impression stamped on the blade butt end (internal) and is either on a label or ink stamped on the blade camber side (external).

### prop model/MV8433N-6

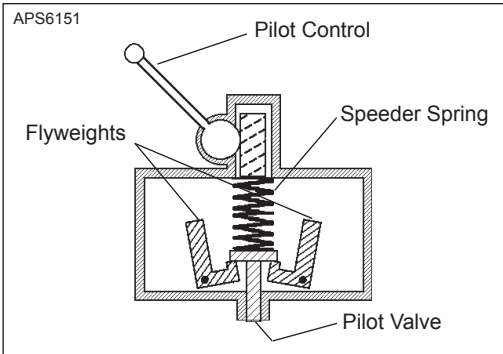




**Governor in Onspeed Condition**  
**Figure 2-6**



**Governor in Underspeed Condition**  
**Figure 2-7**



**Governor in Overspeed Condition**  
**Figure 2-8**

**4. Governors****A. Theory of Operation**

- (1) A governor is an engine RPM sensing device and high pressure oil pump. In a constant speed propeller system, the governor responds to a change in engine RPM by directing oil under pressure to the propeller hydraulic cylinder or by releasing oil from the hydraulic cylinder. The change in oil volume in the hydraulic cylinder changes the blade angle and returns the propeller system RPM to the set value. The governor is set for a specific RPM via the cockpit propeller control, that compresses or releases the governor speeder spring.
- (2) When the engine is operating at the RPM set by the pilot using the cockpit control, the governor is operating **onspeed**. Refer to Figure 2-6. In an onspeed condition, the centrifugal force acting on the flyweights is balanced by the speeder spring, and the pilot valve is neither directing oil to nor from the propeller hydraulic cylinder.
- (3) When the engine is operating below the RPM set by the pilot using the cockpit control, the governor is operating **underspeed**. Refer to Figure 2-7. In an underspeed condition, the flyweights tilt inward because there is not enough centrifugal force on the flyweights to overcome the force of the speeder spring. The pilot valve, forced down by the speeder spring, meters oil flow to decrease propeller pitch and raise engine RPM.
- (4) When the engine is operating above the RPM set by the pilot using the cockpit control, the governor is operating **overspeed**. Refer to Figure 2-8. In an overspeed condition, the centrifugal force acting on the flyweights is greater than the speeder spring force. The flyweights tilt outward, and raise the pilot valve. The pilot valve then meters oil flow to increase propeller pitch and lower engine RPM.

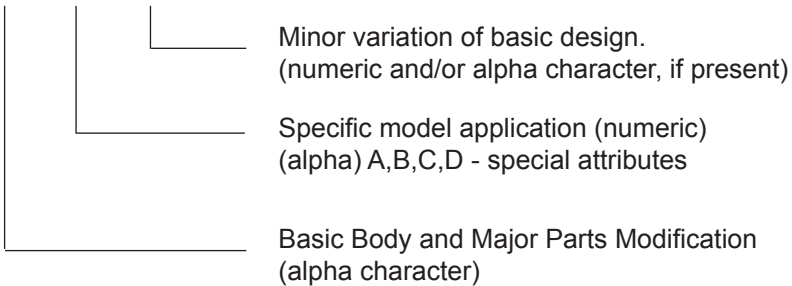
### B. Governor Types

The governors commonly used in Hartzell constant speed propeller systems are supplied either by Hartzell Propeller Inc. or by several other manufacturers. These governor types function in a similar manner.

### C. Identification of Hartzell Propeller Inc. Governors

A Hartzell Propeller Inc. governor may be identified by model number as follows: Example A-1B

**(X) - (X) - (X)**



**NOTE:** Refer to Hartzell Propeller Inc. Manual 130B (61-23-30) for maintenance and overhaul instructions for Hartzell Propeller Inc. governors.

**5. Pilot Operating Instructions****A. Non-governing (Hydroselective Propeller)**

- (1) Push the propeller pitch control forward to increase RPM and pull the propeller pitch control back to decrease RPM. The blade pitch will follow the propeller pitch control command precisely and the propeller RPM will reflect the movement immediately.
- (2) If flight speed or throttle is changed, the RPM will change and a manual adjustment of the propeller pitch control will be required to reacquire the same RPM.
- (3) Constant RPM will not be maintained as with governor controlled propeller blade angle.
- (4) Warm-up  
Perform engine start and warm-up per the Pilot's Operating Handbook (POH). During this process the pitch control should be forward (low pitch position).
- (5) Take-Off  
No pitch control is necessary. The RPM should increase to nearly the desired climbing value by the time the airplane leaves the ground without changing the pitch control.
- (6) Climb  
If RPM exceeds the limit allowed per the Pilot's Operating Handbook (POH), pulling back on the pitch control will decrease RPM until the desired value is reached.
- (7) Cruise  
Pull the pitch control out to select RPM for cruise. Select RPM for best fuel consumption in accordance with Pilot's Operating Handbook (POH).
- (8) Long Range Cruise  
Maximum cruise economy dictates low airspeed, low RPM and fairly high manifold pressure. For these conditions the pitch must be high. Obtain the higher pitch and lower RPM with the pitch control pulled out to obtain a desired value of RPM and manifold pressure per the Pilot's Operating Handbook (POH).

**(9) Landing**

Push the pitch control forward before landing to enable an emergency takeoff again if necessary.

**(10) Taxi**

Taxi with the pitch control fully forward for lowest blade angle.

**(11) Reverse Pitch Operation (HC-D2[MV,V]20-[3,-6L])**

- (a) Before attempting to reverse the pitch the RPM must be reduced to 1200 RPM or less for engines with oil pump pressure of less than 50 psi. Higher oil pressure will allow slightly higher RPM to be used.

**CAUTION 1:** DO NOT FORCE REVERSE CONTROL WHEN SELECTING REVERSE BLADE ANGLE OR MOVING BACK TO LOW PITCH.

**CAUTION 2:** DO NOT OPEN THE THROTTLE WHILE THE REVERSE CONTROL IS IN AN INTERMEDIATE POSITION AS OVERSPEED COULD EASILY RESULT.

- (b) Pull the reversing control back slowly. The pilot will feel the control yield to the pressure, indicating that the pitch is changing. Any slight and momentary RPM increase, up to but less than maximum engine RPM, is not a cause for concern as some speed increase will occur when the blade pitch moves through a zero (minimum aerodynamic load) blade angle. When the control is completely back, the blade pitch is in full reverse and the pilot can apply throttle for reverse thrust. If there is any doubt whether the blade pitch is in full reverse blade angle, slowly increase throttle to avoid the possibility of engine overspeed. Never let the engine overspeed in reverse. Always maintain an RPM below the maximum engine RPM.

CAUTION: REDUCE RPM FIRST WHEN MOVING BLADE ANGLE FROM REVERSE PITCH TO LOW PITCH TO AVOID OVERSPEED WHEN MOVING THROUGH ZERO (MINIMUM AERODYNAMIC LOAD) BLADE ANGLE.

- (c) Before coming out of reverse pitch reduce RPM with throttle to approximately 1200 RPM.

NOTE: The higher the RPM, the faster the pitch moves from reverse to low pitch.

- (d) Apply forward pressure to push the reversing control into the dash until it slips into the lock position. Any slight and momentary RPM increase, up to but less than maximum engine RPM, is not a cause for concern as some speed increase will occur when the blade pitch moves through a zero (no load) blade angle.

**B. Governing (Constant Speed Operation)**

- (1) Push the governor RPM control forward to increase RPM and pull it back to decrease RPM. The governor will follow the command precisely and RPM will change immediately.
- (2) If flight speed or throttle is changed the RPM will remain constant.
- (3) Warm-up

Perform engine start and warm-up per the Pilot's Operating Handbook (POH). During this process the governor RPM control should be forward, or maximum RPM position.

NOTE: When throttle is reduced engine power will not be sufficient to rotate the propeller at maximum RPM.

- (4) Take-Off  
Set the governor RPM control to maximum RPM. RPM will remain constant during the takeoff roll and rotation.
- (5) Climb  
Adjust the governor RPM control per the Pilot's Operating Handbook (POH).

- (6) Cruise  
Select RPM for best fuel consumption in accordance with Pilot's Operating Handbook (POH).
- (7) Landing  
Push the governor RPM control forward for maximum RPM before landing to enable an emergency takeoff again if necessary.
- (8) Taxi  
Taxi with the governor RPM control fully forward for lowest blade angle when throttle is reduced.



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**1. Tools, Consumables, and Expendables**

The following tools, consumables, and expendables will be required for propeller removal or installation:

**NOTE:** The steel hub reciprocating propellers covered in this manual are manufactured to install on an SAE Number 20 Spline engine shaft. The spline type is indicated in the propeller model identification number stamped on the hub. For example, HC-D3MV**20**-6L indicates an SAE 20 spline.

**A. Tooling****20 Spline**

- Safety wire pliers
- Torque wrench
- Torque wrench adapter (Hartzell Propeller Inc. P/N BST-2910)

**B. Consumables**

- Quick Dry Stoddard Solvent or Methyl-Ethyl-Keytone (MEK)

**C. Expendables**

- 0.032 inch (0.813 mm) Stainless Steel Aircraft Safety Wire
- O-ring, cylinder-to-stud seal (Table 3-1).

### 2. Propeller Mounting Hardware Identification

Part	Part No.	Usage
Hydraulic Unit Gasket	A-181 A-135	HC-D(2,3)(MV,V)20-(3,6,8)( ) HC-D2(MV,V)20-7( )
Rear Cone	A-50-1	HC-D(2,3)(MV,V)20-( ) ( )
Rear Cone Spacer	A-186	HC-D2(MV,V)20-( ) ( ) HC-D3(MV,V)20-6( )
Hub Nut	A-63B	HC-D(2,3)(MV,V)20-( ) ( )
Valve Screw	A-121	HC-D(2,3)(MV,V)20-(7,8)( )
Pitch Change Block	A-95-A	HC-D(2,3)(MV,V)20-( ) ( )
Hub Safety Pin	A-847	HC-D(2,3)(MV,V)20-( ) ( )
Cylinder Mounting Nut	A-2043-1	HC-D(2,3)(MV,V)20-(3,6,8)( )
Mounting Washer	A-128	HC-D2(MV,V)20-7( )
Socket Head Cap Screw	A-2037-2C	HC-D2(MV,V)20-7( )
Cap Screw, 1/4-28	A-2038-26	93C and CG Valve
Cap Screw, 1/4-28	A-2038-10	All except 93C and CG Valve
Mounting O-ring	C-3317-341 C-3317-012	HC-D(2,3)(MV,V)20-(3,6)( ) HC-D(2,3)(MV,V)20-8( )
Valve Gasket	A-71-2	HC-D(2,3)(MV,V)20-( ) ( )
Sleeve	A-827-7	HC-D3(MV,V)20-6L
Reverse Stop	A-970-2	HC-D3(MV,V)20-6L
O-Ring	C-3317-012	HC-D2(MV,V)20-8( )

**Propeller Mounting Hardware  
Table 3-1**

**3. Pre-Installation****A. Inspection of Shipping Package**

Examine the exterior of the shipping container for signs of shipping damage, especially the box ends around each blade. A hole, tear, or crushed appearance at the end of the box (blade tips) may indicate that the propeller was dropped during shipment, possibly damaging the blades.

**B. Uncrating**

- (1) Place the propeller on a firm support.
- (2) Remove the banding and any external wood bracing from the shipping container.
- (3) Remove the cardboard from the hub and blades. Place the propeller on a padded surface that supports the propeller over a large area. Never stand the propeller on a blade tip.

**C. Inspection after Shipment**

After removing the propeller from the shipping container, examine the propeller components for shipping damage.

**D. Reassembly of a Propeller Disassembled for Shipment**

If a propeller was received disassembled for shipment, it is to be reassembled by trained personnel in accordance with the applicable propeller maintenance manual.

<b>Hub nut</b> A-63B	450 Ft-Lb (610 N•m)*
<b>Piston Rod Nut</b> A-848-2	20-22 Ft-Lb (27-29 N•m)
<b>Mounting Nut</b> A-2043-1	30 Ft-Lb (41 N•m)**
<b>Socket Head Cap Screw</b> A-2037-2C	27-30 Ft-Lb (37-41N•m)**
<b>Nut (Governor- to- "T" drive)</b> B-3808-5	18-20 Ft-Lb (24-26 N•m)**

\* Torque tolerance is  $\pm 10$  Ft-Lb ( $\pm 13.6$  N•m)

\*\* Torque tolerance is  $\pm 10$  percent unless otherwise noted.

NOTE 1: Torque values are based on non-lubricated threads.

NOTE 2: Do not deviate from the torque values specified in this table when installing the propeller and component parts.

**Torque Values  
Table 3-2**

**4. Propeller Assembly Installation****A. Precautions**

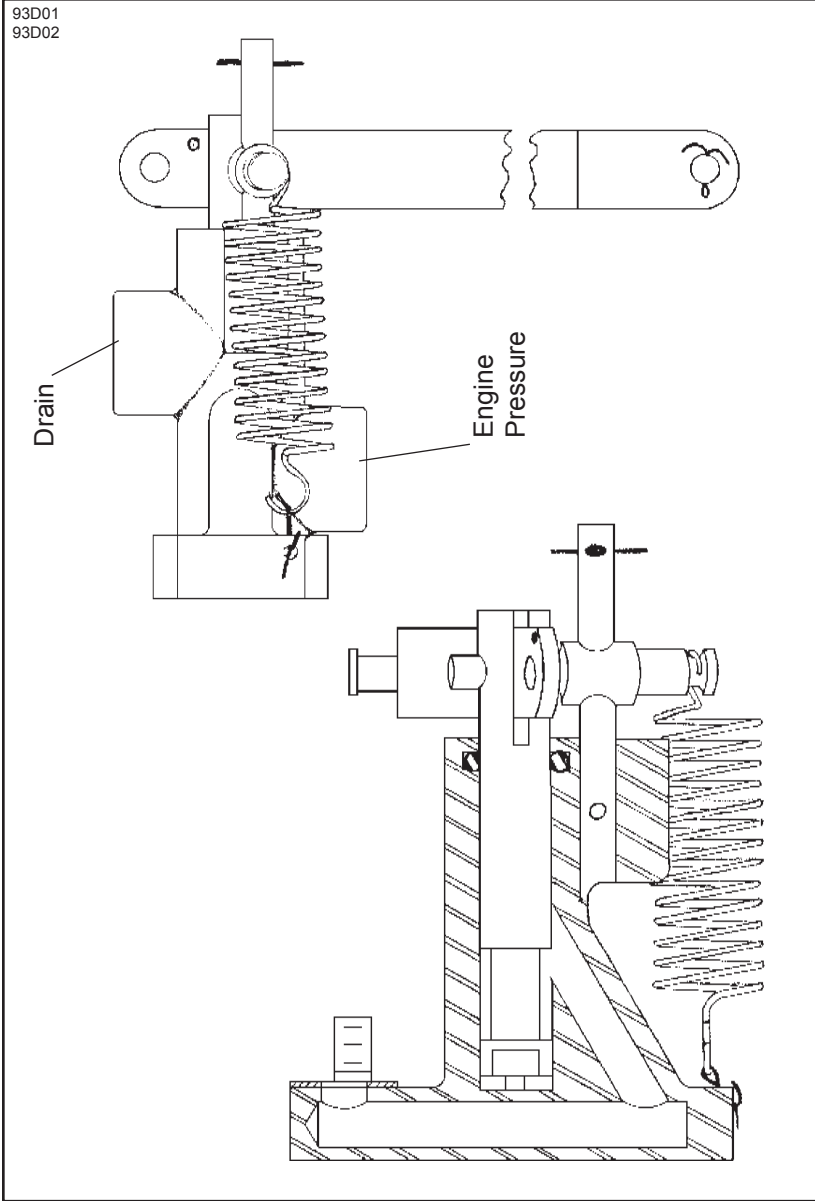
**WARNING 1:** DURING ENGINE INSTALLATION OR REMOVAL, USING THE PROPELLER TO SUPPORT THE WEIGHT OF THE ENGINE IS NOT AUTHORIZED. UNAPPROVED INSTALLATION AND REMOVAL TECHNIQUES MAY CAUSE DAMAGE TO THE PROPELLER THAT MAY LEAD TO FAILURE RESULTING IN AN AIRCRAFT ACCIDENT.

**WARNING 2:** WHEN INSTALLING THE PROPELLER, FOLLOW THE AIRFRAME MANUFACTURER'S MANUALS OR STC HOLDER PROCEDURES, AS THEY MAY CONTAIN ISSUES VITAL TO AIRCRAFT SAFETY THAT ARE NOT CONTAINED IN THIS OWNER'S MANUAL.

- (1) Be sure the propeller is removed before the engine is removed or installed in the airframe.
- (2) Follow the airframe manufacturer's instructions or STC holder instructions for installing the propeller. If such instructions are not in the airframe manufacturer's manual, then follow the instructions in this manual; however, mechanics must consider that this owner's manual does not describe important procedures that are beyond Hartzell Propeller's control. In addition to propeller installation procedures, items such as rigging and preflight testing of flight idle blade angle, and propeller synchronization devices are normally found in the airframe manufacturer's manuals.

**B. O-ring and Propeller Mounting Hardware Identification**

Refer to Table 3-1 for specific part numbers of O-rings and propeller mounting hardware, and propeller model effectivity.



**Valve Assembly for D2(MV,V)20-3 Propeller  
Figure 3-1**



**C. Installing the HC-D2(MV,V)20-3 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 2-2 for part identification and location.

**(1) Hydraulic Valve Installation.**

- (a) If not previously installed, install the hydraulic valve assembly (Figure 3-1) 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).

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

- (c) Secure the control cable clamping bolt tightly against the bracket on the cylinder.

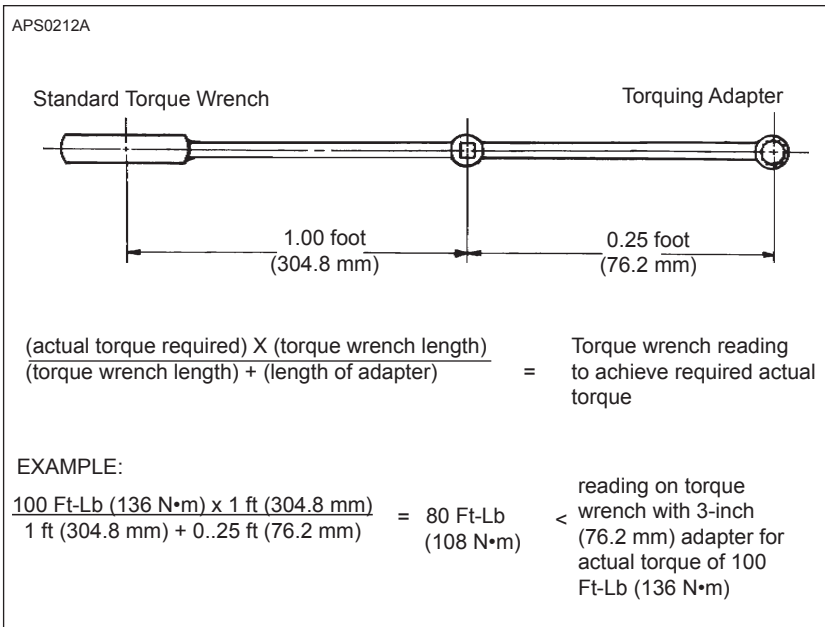
**NOTE:** There should be an increase in cable tension when moving the cockpit reverse control into the locked position (slack is taken up in the cable).

- (d) 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.

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



**Determining Torque Value When Using Torquing Adapter**  
**Figure 3-2**

- (b) Remove the piston from the cylinder by sliding it away from the cylinder and off the piston guide rods.

NOTE 1: When the hydraulic valve is attached to the piston, the valve spool must be positioned at either extreme of travel to allow air to enter or escape from the cylinder and allow movement of the piston by hand.

NOTE 2: The jack plate unit will be attached to the piston with a wire ring through the thrust bearing interface with the piston.

- (c) 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.
- (d) Align the six cylinder mounting holes with the six mounting studs that protrude from the engine case.
- (e) 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 OF THE STUDS MUST NOT EXCEED 0.532 INCH (13.51 MM), OR THE 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 THE MOUNTING NUT WILL NOT HAVE ENOUGH THREAD FOR PROPER ENGAGEMENT.

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

- (h) Verify the installation of both cylinder-to-piston O-rings in the piston. Refer to Figure 2-2 and Table 3-1 for the location and part numbers, if required.
- (i) Position 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 the number stamped on the cylinder.
- (j) 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.

**CAUTION:** DO NOT DAMAGE THE PISTON O-RINGS WHEN INSTALLING THE PISTON INTO THE CYLINDER.

- (k) Install the jack plate unit and piston assembly into the cylinder. Use a rubber mallet as necessary to bottom the piston in the cylinder.
- (l) If not already attached, install the hydraulic valve assembly on the piston, along with a gasket and two screws (Table 3-1).
- (m) Using a No. 51 drill, drill through the side of the valve housing and through the heads of the two screws (Table 3-1). Safety with 0.032 inch (0.81 mm) safety wire.
- (n) Clean the engine shaft with an approved solvent.
- (o) Oil the engine shaft with engine oil.
- (p) 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 static RPM checks, after the propeller is installed.

**WARNING:** MAKE SURE THE SLING IS SUITABLY RATED TO SUPPORT THE WEIGHT OF THE PROPELLER ASSEMBLY DURING INSTALLATION.

- (q) With a suitable crane hoist and sling, carefully move the propeller assembly to the aircraft engine shaft.
- (r) 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.

- (s) Install a pitch change block on each link screw.
- (t) Grip the blade counterweight on each blade clamp and, at the same time, rotate the blades to high pitch until the push rods that protrude from the jack plate unit stop short of the two bushing lugs on the hub.
- (u) 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.
- (v) Grip the blade counterweight on each blade clamp, and at the same time, rotate both blades to low pitch by hand.
- (w) Rotate the blades to install the push rods through the hub bushings.

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

- (x) Install the hub on the rear cone.
- (y) Install the hub nut on the engine shaft. Make sure the threads have engaged properly.
- (z) 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.

- (aa) Check the available piston travel by measuring between the jack plate and the hub shoulder. Travel should be 1.062 inch to 1.094 inch (26.97 to 27.79 mm). If the distance is not sufficient, remove the propeller and install additional shims or remove shims between the rear cone and engine, to obtain the desired travel capability.
- (ab) Safety the hub nut to the engine shaft using a hub nut safety pin. 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.
- (ac) 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.
- (ad) Install a 0.37 to 0.50 inch (9.5 to 12.7 mm) ID flexible hose from the engine crankcase to the valve.
- (ae) With the cockpit reverse pitch control cable forward, but just short of the locked position, connect the other end of the cable to the propeller hydraulic valve lever on the short end that extends from the valve spool.

NOTE: Two cables from two separate cockpit controls will be attached to opposite ends of the hydraulic valve lever. The first cable connected to the hydraulic valve lever is for reverse control; the second cable is for positive blade pitch control to control RPM in flight.

- (3) Adjusting Propeller Control For Proper Ground Or Static RPM

**CAUTION:** A CALIBRATED TACHOMETER MUST BE USED TO MAKE SURE OF THE ACCURACY OF THE RPM CHECK.

- (a) Determine Static RPM

- 1 Start the engine and allow it to warm up.
- 2 Check the propeller action with the propeller pitch control (RPM control).
- 3 Determine the full throttle maximum static RPM obtained with the cockpit propeller control full forward for lowest pitch. Refer to the airframe manufacturer's manual or the STC paperwork for the applicable static RPM.

- (b) Static RPM Incorrect

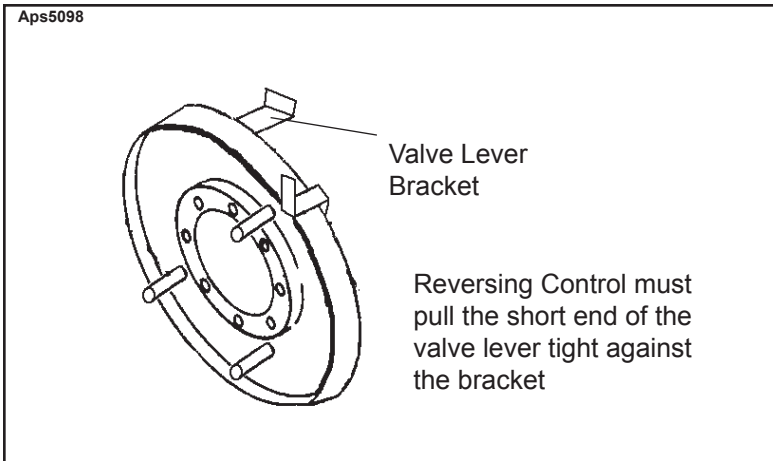
- 1 Low pitch adjustment has been made at the factory, according to published information.
- 2 The readjustment of low pitch should not be required. Refer to the Static RPM Adjustment section in the Maintenance Practices chapter of this manual for adjustment information.

(4) Reverse Pitch Hardware Adjustment

**CAUTION:** REVERSING CONTROL MUST PULL THE SHORT END OF THE VALVE LEVER TIGHT AGAINST THE BRACKET. REFER TO FIGURE 3-3.

(a) Adjust the lever

- 1 Loosen the clamp that holds the push-pull reverse control housing.
- 2 Install the housing away from the propeller until the lever is hard against the bracket.



**Reverse Pitch Hardware Adjustment  
Figure 3-3**



- 3 Tighten the clamp.
  - a With the cockpit reverse control line forward (in the case of the reversible propeller) and just off the locked position, attach this control line at the propeller to the short end of the lever on the valve. Make sure that the clamping bolt is tight against the bracket on the cylinder.

**NOTE:** When moving the cockpit reverse control lever into the locked position, there should be an increase in tension due to the slack being taken up in the lines.

- (b) Secure the reverse control housing

**CAUTION:** MAINTAIN A MINIMUM CLEARANCE OF 0.12 INCH (3.2 MM) BETWEEN THE JACK PLATE AND THE HUB SHOULDER TO PREVENT EXCESSIVE LOADING OF THE THRUST BEARINGS IN THE PROPELLER AND ENGINE.

- (c) Make sure there is a minimum 0.12 inch (3.2 mm) clearance between the jack plate and the hub shoulder when in full reverse.
- (d) If the clearance is not sufficient, place a shim(s) between the rear cone and engine.
- (5) Slowly turn the propeller on the engine shaft to identify if there is clearance between the blade clamp assemblies and the valve assembly.

- (6) If there is interference, continue with the following steps:
- (a) Identify a dimension required to space the clamp assembly and valve assembly apart and reestablish positive clearance.
  - (b) Increase the thickness of the reverse stop with the dimension required to reestablish positive clearance between the clamp assembly and the valve assembly.
    - 1 Refer to Table 3-3 for a listing of reverse stop thicknesses.
    - 2 Select a single spacer with the required thickness.
  - (c) Twist the counterweights toward high pitch to move the push rods and sleeve toward the engine as far as they will travel.
  - (d) Loosen and unthread the hub nut from the engine shaft.

**NOTE:** This will pull the propeller away from the engine and allow the push rods to slide out of the guide lugs on the hub.
  - (e) Allow the jack assembly push rods to completely slide out of the guide lugs.
  - (f) Turn the jack plate unit until the pitch change forks disengage from the pitch change blocks.
  - (g) Install the reverse stop with the new dimension thickness onto the sleeve and push rod.
  - (h) Position the jack plate unit and the hub to engage the pitch change blocks.
  - (i) Position the blades so the forks can slide onto the pitch change blocks.
  - (j) With the propeller blades at high pitch, align the push rods and sleeves with the guide lugs by rotating the propeller hub or jack plate unit relative to each other.
  - (k) Slide the push rods and sleeves through the guide lugs by rotating the blades to reverse pitch.

CAUTION: NEVER USE FORCE TO START THE HUB NUT.

- (l) Thread the hub nut onto the engine shaft. Make sure the threads have engaged properly.
  - (m) Torque the hub nut on the engine shaft. Refer to Torque Values Table 3-2.
  - (n) Rotate the blades by hand to reverse pitch position.
  - (o) Slowly turn the propeller on the engine to verify if there is clearance between the blade clamp assemblies and the valve assembly.
- (7) Repeat steps 4.D.(5) through 4.D.(6)(o) until clearance between the blade clamp assemblies and the valve assembly is achieved.

- (8) Model HC-D2MV20-3 only:
- (a) Rotate the blades by hand toward low pitch until the jack plate contacts the spacer ring. Confirm that there is a minimum of 0.025 inch (0.63 mm) clearance between each clamp and the valve.
  - (b) If there is insufficient clearance between the clamps and the valve, measure the gap to determine how much clearance is needed. Remove and reassemble the propeller in accordance with this chapter, using the alternate spacer ring that will provide adequate clearance.
    - 1 Refer to Table 3-3 for reverse blade angle changes that will result from the installation of alternate spacer rings.
    - 2 Remove the propeller in accordance with the propeller removal instructions in this chapter.

<b>Part Number</b>	<b>Height</b>	<b>Effect on Reverse Blade Angle</b>
A-165-6	0.478 ± 0.010 (12.14 ± 0.25 mm)	Set Up
A-165-5	0.543 ± 0.010 (13.79 ± 0.25 mm)	~1.5 - 2.0 degree less reverse than A-165-6
A-165-4	0.513 ± 0.010 (13.03 ± 0.25 mm)	~0.6 - 1.0 degree less reverse than A-165-6

**Spacer Selection  
Table 3-3**

**WARNING:** DO NOT RESET BLADES IN CLAMPS TO COMPENSATE FOR REVERSE BLADE ANGLE CHANGE.

- 3 Reassemble the propeller in, using the correct dash number spacer ring (see Table 3-3) to provide 0.025 inch (0.63 mm) minimum clearance between each clamp and the valve.
  - 4 Reinstall the propeller in accordance with this chapter.
- (c) Confirm the proper high pitch blade angle as follows:

**CAUTION:** THE VALVE MUST BE IN HIGH PITCH POSITION TO BLEED AIR INTO THE CYLINDER.

- (d) Rotate the blades by hand toward high pitch, until travel is limited by the hydraulic unit.
- (e) Measure the high pitch blade angle to confirm that it is a minimum of 19.5 degrees.
- (f) If the high pitch blade angle is less than 19.5 degrees, follow steps 4.C.(8)(f)1 through 4.C.(8)(f)4 below, to remove the propeller and install additional spacer(s) to achieve the desired high pitch blade angle.

1 Remove the propeller in accordance with the removal instructions in this chapter.

2 Remove the rear cone and spacer.

**NOTE:** Each additional spacer will increase high pitch angle by approximately 1.5 degrees.

3 Reinstall the rear cone with additional spacer(s) to achieve 19.5 degrees minimum.

**NOTE:** It is recommended that the minimum number of spacers be used to achieve the required blade angle.

4 Reinstall the propeller in accordance with instructions in this chapter.

**D. Installing the HC-D3(MV,V)20-6L 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 2-3 for part identification and location.

**(1) Propeller 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 of the piston guide rods.

**NOTE 1:** When the hydraulic valve is attached to the piston, the valve spool must be positioned at either extreme of travel to allow air to enter or escape from the cylinder and to allow movement of the piston by hand.

**NOTE 2:** The jack plate unit will be attached to the piston through the thrust-bearing interface with the piston.

- (c) Align the clearance holes of the A-181 gasket with the six mounting studs that protrude from the engine.
- (d) Install the gasket flush against the engine case.
- (e) Align the six cylinder mounting holes with the six mounting studs that protrude from the engine case.

- (f) 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 OF THE STUDS 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 STUDS ABOVE THE INSIDE SURFACE OF THE CYLINDER MUST NOT BE LESS THAN 0.468 INCH (11.89 MM) OR THE MOUNTING NUT WILL NOT HAVE ENOUGH THREADS FOR PROPER ENGAGEMENT.

- (g) Install one mounting nut (Table 3-1) on each of the six studs to secure the hydraulic cylinder to the engine.
- (h) Torque each mounting nut in accordance with Table 3-2.
- (i) Position 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 a number stamped on the cylinder.
- (j) 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.

**CAUTION:** DO NOT DAMAGE THE PISTON O-RINGS WHEN INSTALLING THE PISTON INTO THE CYLINDER.

- (k) Install the jack plate unit and piston assembly into the cylinder. Bottom the piston in the cylinder.
- (l) Install one sleeve (Table 3-1) on each push rod, with the shoulder against the fork.

- (m) Install one reverse stop (Table 3-1) on each sleeve and push rod against the sleeve shoulder.
- (n) Clean the engine shaft with an approved solvent.
- (o) Oil the engine shaft with engine oil.
- (p) Install the engine shaft 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 static RPM checks, after the propeller is installed.

**WARNING:** MAKE SURE THE SLING IS SUITABLY RATED TO SUPPORT THE WEIGHT OF THE PROPELLER ASSEMBLY DURING INSTALLATION.

- (q) With a suitable crane hoist and sling, carefully move the propeller assembly to the aircraft engine shaft.
- (r) 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.

- (s) Install a pitch change block on each clamp link screw.
- (t) Grip the blade counterweight on each blade clamp, and, at the same time, rotate the blades to high pitch until the push rods that protrude from the jack plate unit stop short of the three bushings in the guide collar near the hub nut.
- (u) Rotate the jack plate unit to allow each fork to engage each pitch change block and to align each push rod with each guide collar bushing.



- (v) Grip the blade counterweight on each blade clamp, and at the same time, rotate all three blades to low pitch.
- (w) Install the push rods through the guide collar bushings.
- (x) Install one washer on the threaded end of each of the three push rods that protrude through the guide collar.
- (y) Install a lock nut on the threaded end of each of three push rods that protrude through the guide collar.
- (z) Torque the lock nuts on the push rods in accordance with Table 3-2.
- (aa) Tighten the fork set screw in each fork.
- (ab) Safety each fork set screw by peening the edge of each screw hole.

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

- (ac) Install the hub on the rear cone.
- (ad) Install the hub nut on the engine shaft. Make sure the threads have engaged properly.
- (ae) 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.
- (af) Check the available piston travel by measuring between the jack plate and the hub shoulder. Travel should be 1.032 inch minimum (26.21 mm). If the distance is not sufficient, remove the propeller and install additional shims between the rear cone and the engine to obtain the desired travel capability.
- (ag) Using a hub nut safety pin, safety the hub nut to the engine shaft. Refer to Table 3-2 and Figure 3-1.

**NOTE:** The hub nut safety pin is normally supplied in a bag when the propeller is shipped new from the factory.

- I (2) Model HC-D3(MV,V)20-6L Hydraulic Valve Installation.
- (a) If not previously installed, install the hydraulic valve assembly 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.

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

- (c) 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).
- (d) With the cockpit reverse pitch control cable forward, but just short of the locked position, connect the other end of the cable to the propeller hydraulic valve lever on the short end that extends from the valve spool.

**NOTE:** Two cables from two separate cockpit controls will be attached to opposite ends of the hydraulic valve lever. The first cable connected to the hydraulic valve lever is for reverse control; the second cable to be connected is for positive blade pitch control to control RPM in flight.

- (e) Secure the control cable clamping bolt tightly against the bracket on the cylinder.

**NOTE:** There should be an increase in cable tension when moving the cockpit reverse control into the locked position (slack is taken up in the cable).

- (f) 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.
- (g) Attach the propeller pitch control cable to the hydraulic valve lever on the long end that extends from the valve spool.
- (3) Adjusting Propeller Control For Proper Ground or Static RPM
  - (a) Determine the Static RPM
    - 1 Start and warm up the engine.
    - 2 Check the propeller action with the propeller pitch control (RPM control).
    - 3 Determine the full throttle maximum static RPM that is obtained with the cockpit propeller control full forward for lowest pitch. Refer to the airframe manufacturer's manual or STC for the applicable static RPM setting.
  - (b) Static RPM Incorrect
    - 1 Low pitch adjustment has been made at the factory, according to published information.
    - 2 The readjustment of low pitch should not be required. Refer to the Static RPM Adjustment section in the Maintenance Practices Chapter of this manual for adjustment information.

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**(4) Reverse Pitch Hardware Adjustment**

**CAUTION:** REVERSING CONTROL MUST PULL THE SHORT END OF THE VALVE LEVER TIGHT AGAINST THE BRACKET. REFER TO FIGURE 3-3.

**(a) Adjust the lever**

- 1** Loosen the clamp that holds the push-pull reverse control housing.
- 2** Install the housing away from the propeller until the lever is hard against the bracket.
- 3** Tighten the clamp.
  - a** With the cockpit reverse control line forward (in the case of the reversible propeller) and just off the locked position, attach this control line at the propeller to the short end of the lever on the valve. Make sure that the clamping bolt is tight against the bracket on the cylinder.

**NOTE:** When moving the cockpit reverse control lever into the locked position, there should be an increase in tension due to the slack being taken up in the lines.

**(b) Secure the reverse control housing**

**CAUTION:** MAINTAIN A MINIMUM CLEARANCE OF 0.12 INCH (3.2 MM) BETWEEN THE JACK PLATE AND THE HUB SHOULDER TO PREVENT EXCESSIVE LOADING OF THE THRUST BEARINGS IN THE PROPELLER AND ENGINE

- (c)** Make sure there is a minimum 0.12 inch (3.2 mm) clearance between the jack plate and the hub shoulder when in full reverse.
  - (d)** If the clearance is not sufficient, place a shim(s) between the rear cone and engine.
- (5)** Slowly turn the propeller on the engine shaft to identify if there is clearance between the blade clamp assemblies and the valve assembly.

- (6) If there is interference, continue with the following steps:
- (a) Identify a dimension required to space the clamp assembly and valve assembly apart and reestablish positive clearance.
  - (b) Increase the thickness of the reverse stop with the dimension required to reestablish positive clearance between the clamp assembly and the valve assembly.
    - 1 Refer to Figure 3-3 for a listing of reverse stop thicknesses.
    - 2 Select a single stop with the required thickness.
  - (c) Remove the nuts and washers, if applicable, from the ends of the three push rods protruding from the jack assembly.

**NOTE:** Keep the nuts and washers with the propeller and jack assembly.
  - (d) Twist the counterweights toward high pitch to move the push rods and sleeve toward the engine as far as they will travel.
  - (e) Loosen and unthread the hub nut from the engine shaft.

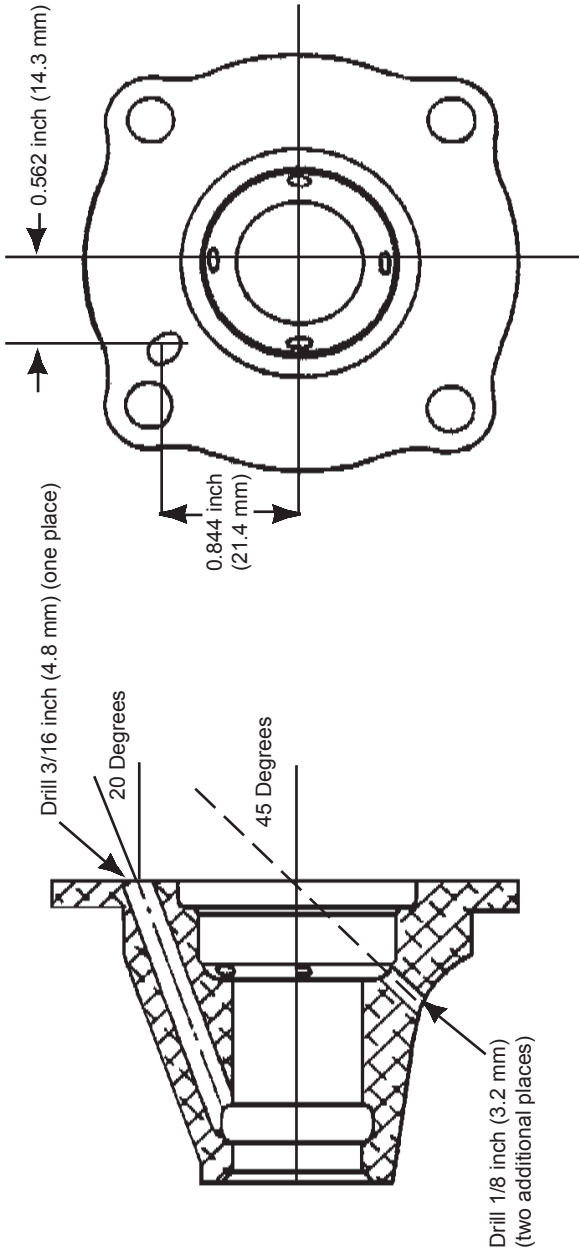
**NOTE:** This will pull the propeller away from the engine and allow the push rods and sleeves to slide out of the guide collar on the engine side of the guide collar.
  - (f) Allow the jack assembly push rods to completely slide out of the guide collar.
  - (g) Turn the jack plate unit until the pitch change forks disengage from the pitch change blocks.
  - (h) Install the reverse stop with the new dimension thickness onto hub.
  - (i) Position the jack plate unit and the hub to engage the pitch change blocks.
  - (j) Position the blades so the forks can slide onto the pitch change blocks.

- (k) With the propeller blades at high pitch, align the push rods and sleeves with the guide collar bushings by rotating the propeller hub or jack plate unit relative to each other.
- (l) Slide the push rods and sleeves through the guide collar bushings by rotating the blades to reverse pitch.

**CAUTION:** NEVER USE FORCE TO START THE HUB NUT.

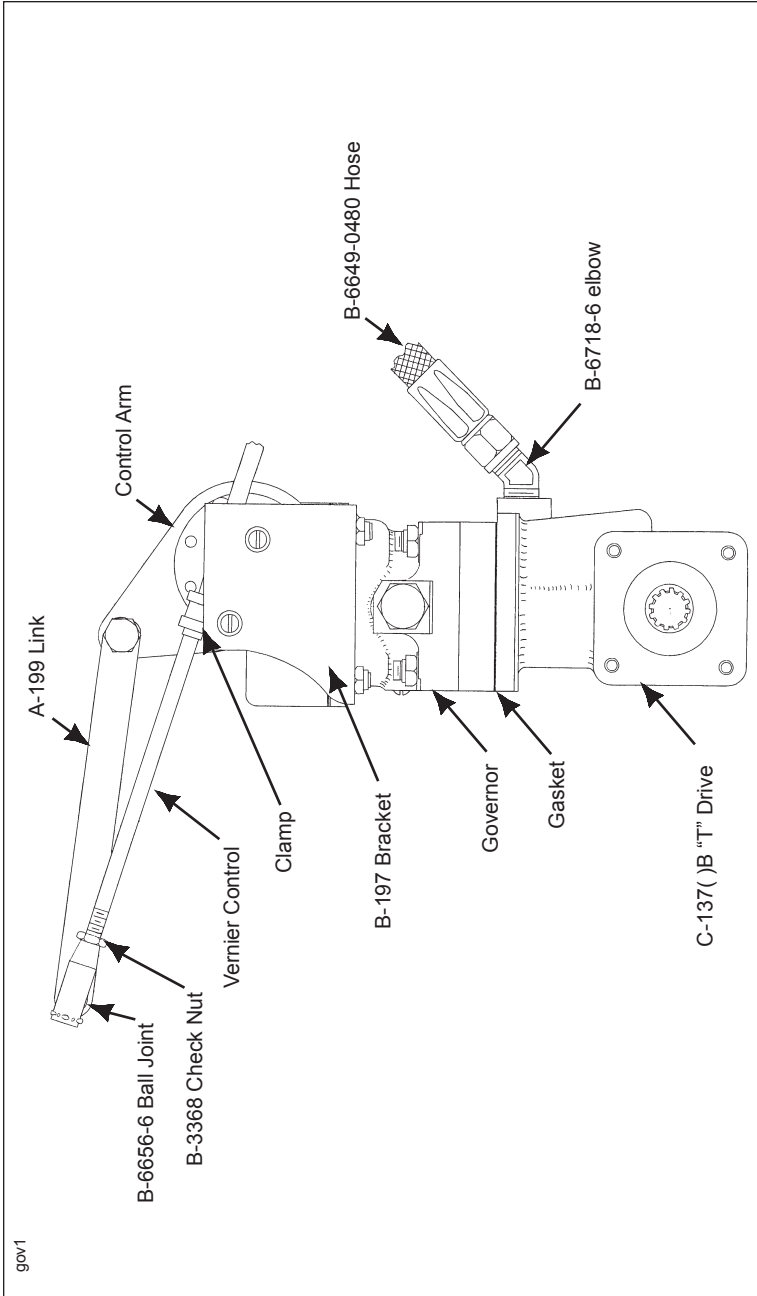
- (m) Thread the hub nut onto the engine shaft. Make sure the threads have engaged properly.
  - (n) Torque the hub nut on the engine shaft. Refer to Torque Values Table 3-2.
  - (o) Install a washer and nut on the end of each push rod protruding through the guide collar bushings
  - (p) Torque the piston rod nuts until in accordance with Table 3-2.
  - (q) Rotate the blades by hand to reverse pitch position.  
**NOTE:** When the propeller is in reverse pitch position, the reverse stop washer will be pinched between the guide collar and the shoulder on the sleeve.
  - (r) Slowly turn the propeller on the engine to verify if there is clearance between the blade clamp assemblies and the valve assembly.
- (7) Repeat steps 4.D.(5) through 4.D.(6)(o) until clearance between the blade clamp assemblies and the valve assembly is achieved.

Fig301



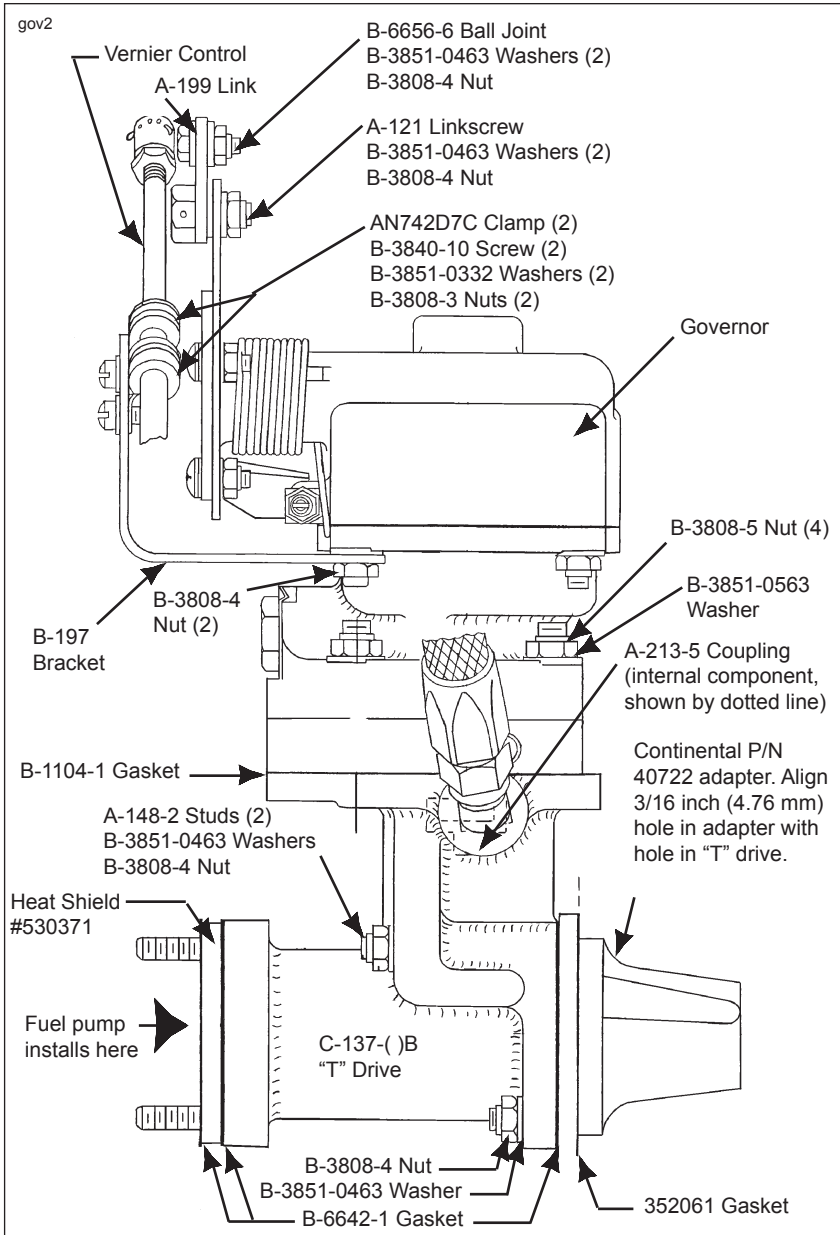
Modification of Shaft Gear Adapter (Continental P/N 40722)  
Figure 3-4





**Installation of Governor and "T"-Drive**  
**Figure 3-5**

gov1



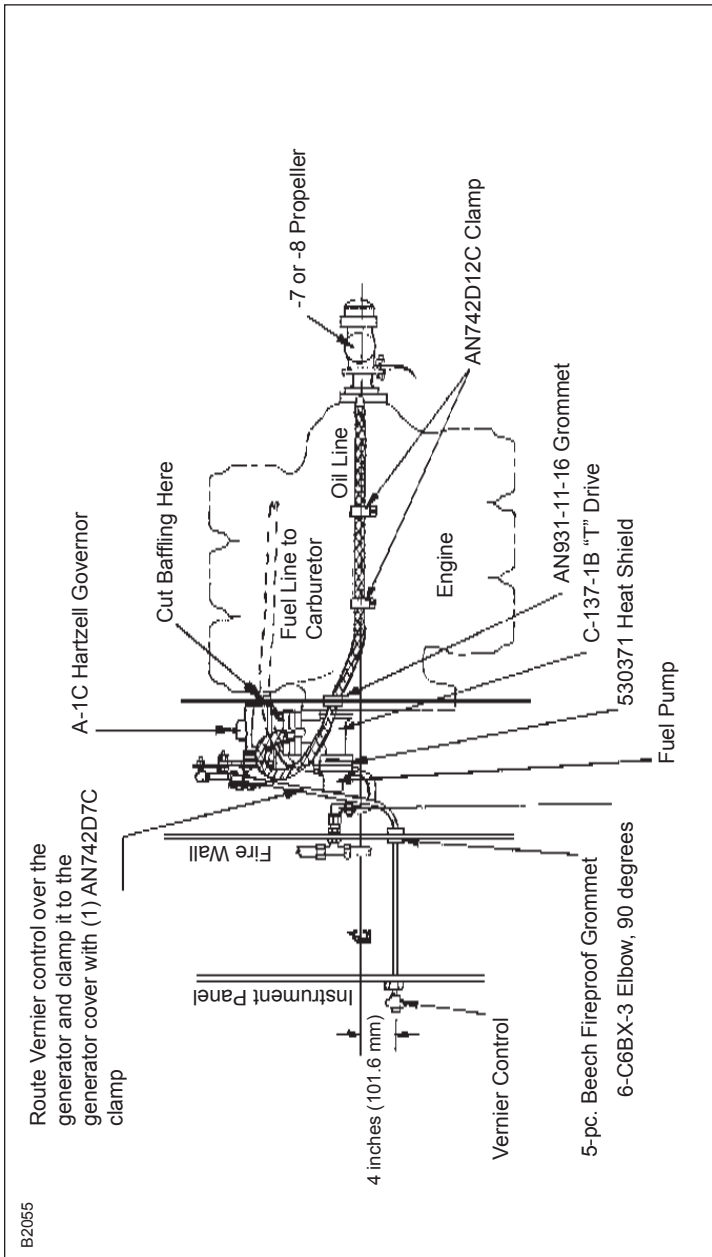
**Installation of Governor and "T"-Drive  
Figure 3-6**

- E. Installation of Governor and "T" Drive (on -7 and -8 Series Propellers Only). Refer to Figures 3-4 through 3-6.

**CAUTION 1:** MAKE SURE THE A-213-5 COUPLING IS IN PLACE BEFORE INSTALLING THE GOVERNOR ON THE "T" DRIVE. REFER TO FIGURE 3-6.

**CAUTION 2:** INSTALL THE GOVERNOR ON THE T-DRIVE BEFORE INSTALLING ON THE AIRCRAFT. CHECK TO MAKE SURE THE T-DRIVE AND GOVERNOR TURN FREELY. DAMAGE TO THE T-DRIVE AND GOVERNOR CAN OCCUR IF THEY ARE NOT ASSEMBLED PROPERLY.

- (1) Install the B-6718-6 elbow (45 degrees) on the C-137-1B "T" drive unit.
- (2) Install the B-197 bracket on the governor, as shown in Figure 3-6.
  - (a) Remove the two (2) B-3808-4 nuts and washers from governor.
  - (b) Install the B-197 bracket on the governor with the two (2) B-3808-4 nuts and washers (Refer to FIGURE 3-6).
- (3) Install the B-1104-1 gasket on the governor pad, as shown in Figures 3-4 and 3-5.
- (4) Install the governor on the governor pad C-137-1B "T" drive, with four (4) B-3808-5 nuts and B-3851-0563 washers.
- (5) Torque the four (4) B-3808-5 nuts in accordance with Torque Values Table 3-2.
- (6) Install the A-199 link on the governor, with the A-121 linkscrew, (2) B-3851-0463 washers, and B-3808-4 nut, as shown in Figure 3-6.
- (7) Install the (2) AN742D7C clamps, with two (2) B-3840-10 screws, two (2) B-3851-0332 washers, and two (2) B-3808-3 Nuts, on the B-197 bracket, as shown in FIGURE 3-6, but do not tighten the screws.



**Installation of Oil Line and Vernier Control  
Figure 3-7**

- (8) Remove the fuel pump from the pad on the engine. Cover the opening of the fuel lines with line caps.

NOTE: Do not stuff material in the lines.

- (9) Remove the adapter (Continental P/N 40722) and gear shaft (Continental P/N 40724).  
(10) Remove the gear shaft from the adapter.

CAUTION: THE SEAL (CONTINENTAL P/N 25102) IS NOT USED WHEN USING THE "T" DRIVE.

- (11) Remove the seal (Continental P/N 25102) from the adapter.  
(12) Modify the shaft gear adapter (Continental P/N 40722) by drilling two additional 1/8 inch (3.17 mm) holes through and one 3/16 inch (4.76 mm) hole, 1.750 inch (44.45 mm) deep. Refer to Figure 3-4.

NOTE: Two holes are already drilled in the adapter by Continental.

- (13) After the drilling operation, thoroughly clean the adapter to remove chips and dirt.  
(14) Use an AN742D4C clamp to secure the cabin heater control line to the fire wall.  
(15) Bend the hydraulic brake reservoir supply line to clear the governor "T" drive-fuel pump assembly.  
(16) Alter the cowl flap mechanism for clearance.  
(a) While the cowl flap is closed, remove the bolt on the right side of the engine that holds the crescent-shaped control arm to the shaft.  
(b) Looking at the left side of the engine, turn the pear-shaped control arm clockwise 75 degrees.  
(c) Mark the position of the new bolt hole on the right side of the engine.  
(d) Remove the shaft and drill a new hole.  
(e) Reassemble the cowl flap mechanism.  
(17) Relocate the fuel pump drain line and bend the fuel pump air blast tube as necessary.  
(18) Remove the fuel lines leading to the fire wall and carburetor.

- (19) Replace the fuel line with AN6260-6-29 hose and reroute the hose under the engine cylinders with (2) AN742D12C clamps.
- (20) Install the 6-C6BX-S elbow on the fuel line fire wall T-fitting and install the original fuel line.
- (21) Remove the two outboard studs on the engine pad and install the longer studs A-148-2, as shown in Figure 3-6.
- (22) Reinstall the gasket 352061 on the pad of the engine, as shown in Figure 3-6.
- (23) Replace the gear shaft in the adapter (Continental P/N 40722).
- (24) Replace this assembly in the engine, aligning the 3/16 inch (4.76 mm) hole with the hole in the "T" drive, as described in Figure 3-6.
- (25) Install the new AN4045-1 gasket on the adapter B-145 (Reworked Continental Engines P/N 40722).
- (26) Install the governor "T" drive-fuel pump assembly on the engine pad using (4) B-3808-4 nuts and (4) B-3851-0463 washers.
- (27) Install a new B-6642-1 gasket on the fuel pump pad of C-137-1B "T" drive.
- (28) Install a heat shield P/N 530371a new B-6642-1 gasket between the heat shield and the fuel pump. Refer to Figure 3-5.
- (29) Install the fuel pump on the "T" drive with the P/N 530371 heat shield between the fuel pump and the "T" drive. Refer to Figure 3-6.
- (30) Remove the caps from the opening of the fuel lines.
- (31) Connect the AN6260-6-48 hose to the fitting in the "T" drive and route it over the center of the engine, through the 1 inch (25.4 mm) diameter hole in the baffling, with grommet AN931-11-16.

(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

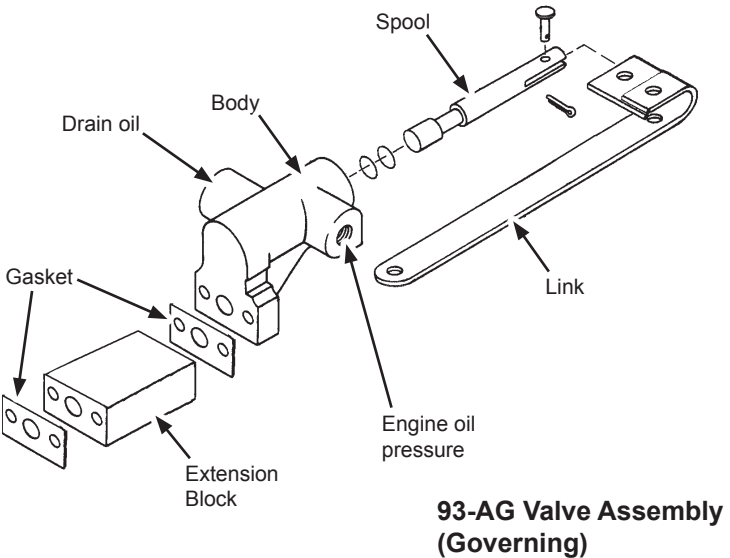
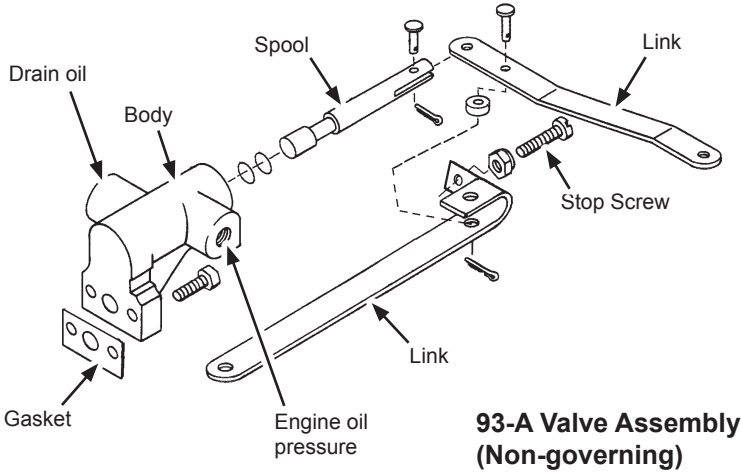
**WARNING:** CLEANING AGENT MEK IS FLAMMABLE AND TOXIC TO THE SKIN, EYES AND RESPIRATORY TRACT. SKIN AND EYE PROTECTION ARE REQUIRED. AVOID PROLONGED CONTACT. USE IN A WELL VENTILATED AREA.

- (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.

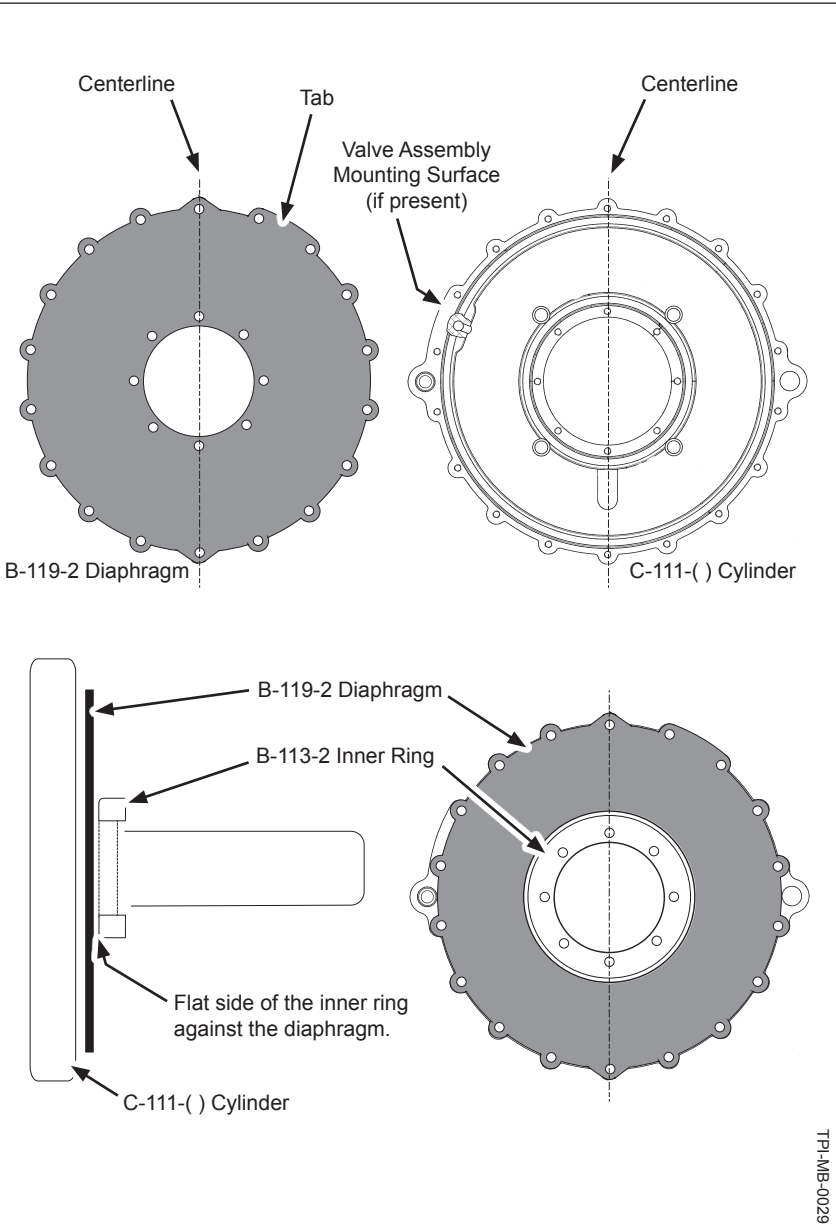
- (g) Install the cylinder
- 1 Install one socket head cap screw in each of four cylinder mounting holes. Position the head of each screw on the piston side of the cylinder.
  - 2 Install one metal washer on each socket head cap screw that protrudes through the cylinder on the engine side of the cylinder.
  - 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**

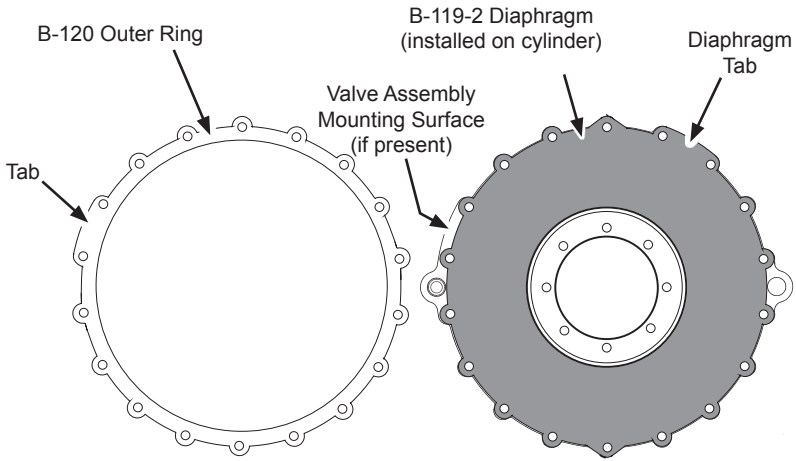
- (j) Install the diaphragm and the inner ring.  
Refer to Figure 3-8.1.

**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.**

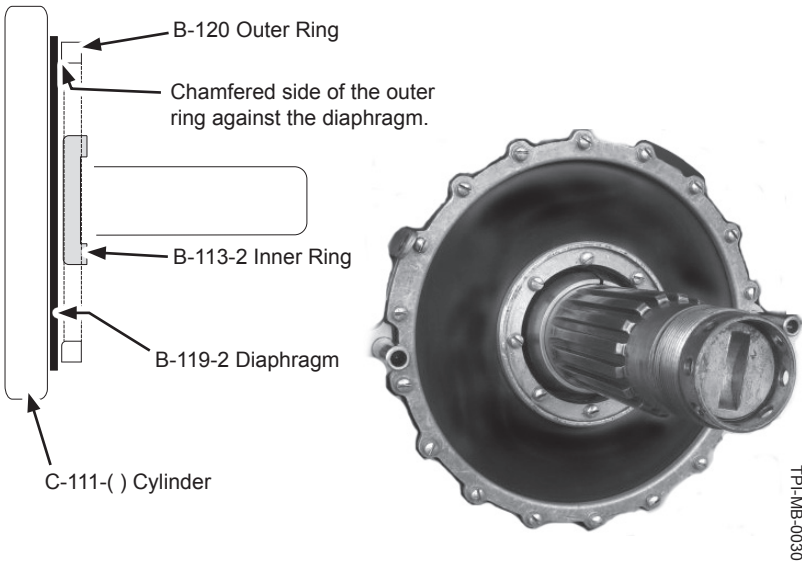
- 1 Align the centerline of the diaphragm with the centerline of the cylinder and position the diaphragm flush against the cylinder.
  - a The centerline is identified by locating the four holes that align. Refer to Figure 3-8.1.
- 2 Position the flat side of the inner ring flush against the diaphragm.
- 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.

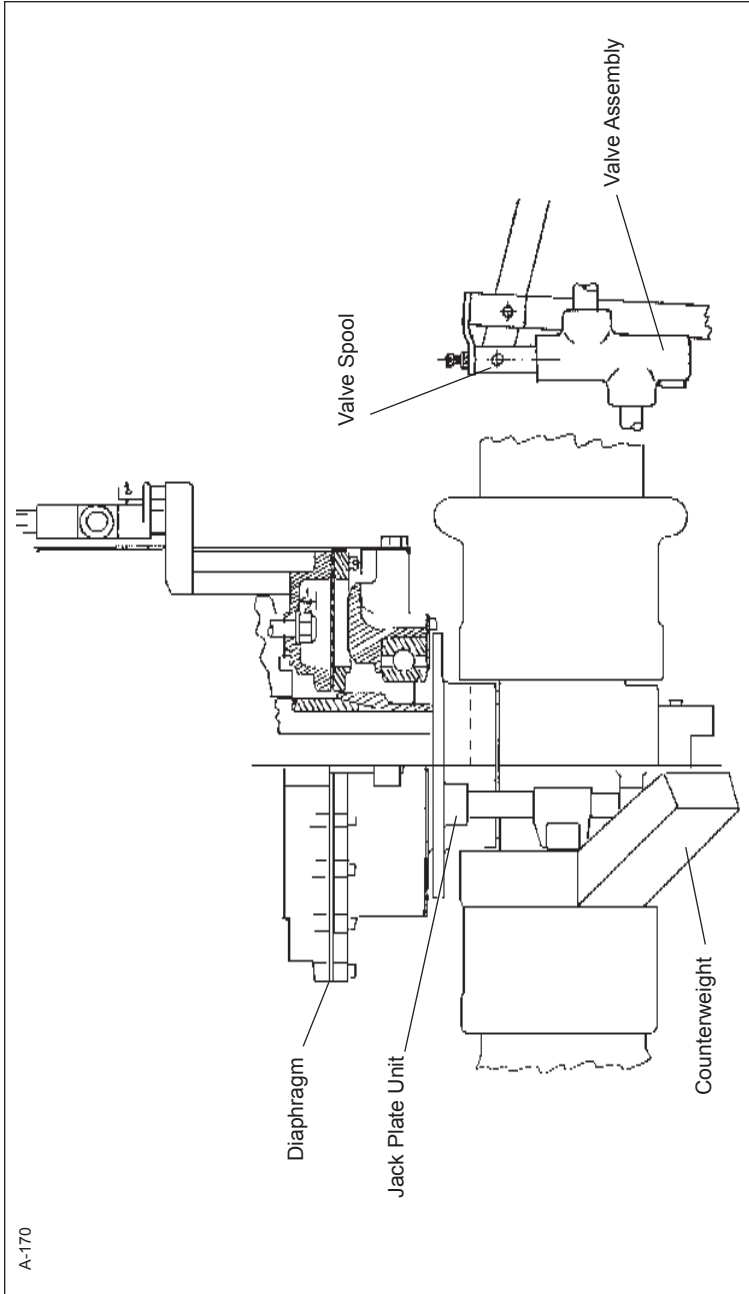
CAUTION: THE RING MAY BREAK IF ONLY A FEW SCREWS ARE TIGHTENED IN A LOCALIZED AREA.

- 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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- (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) 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 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 bushings and install the hub on the rear cone.

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

- (k) Install the hub nut on the engine shaft.
- (l) 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.
- (m) 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.
- (n) 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) 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 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).  

NOTE: Adjust the spacers behind the rear cone to obtain the applicable clearance; however, never allow the hub nut to engage less than five full threads. Restrict the travel to maintain this clearance.
  - (c) 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.
  - (d) 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.

- (5) Connecting the Propeller Pitch Control Cable to Hydraulic Valve Lever
  - (a) Position the piston in forward position (toward the 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 from the dash approximately 0.12 inch (3.0 mm).
  - (d) Connect the propeller pitch control cable to the lever that extends from the hydraulic valve.
- (6) Adjusting the Propeller Control for Proper Ground or Static RPM
  - (a) Start the engine and allow it to warm up.
  - (b) Check 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.
- (l) While static on the ground (engine not running), check the high pitch travel using the following procedure:
  - 1 Pull the propeller pitch control back to the movement limit.
  - 2 Grip the 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 check will provide assurance of full pitch control and RPM range during flight.

(7) 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.

**5. Propeller Removal**

**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.

**A. Removal of the HC-D2(MV,V)20-3 Propeller Assembly****(1) Propeller Removal**

- (a) Disconnect the reverse pitch control cable from the hydraulic valve lever on the short end that extends from the valve spool.
- (b) Disconnect the propeller pitch control cable from the hydraulic valve lever on the long end that extends from the valve spool.
- (c) Remove the hub nut safety pin from the hub nut.
- (d) Completely loosen and unthread the hub nut from the engine shaft threads.

**NOTE:** Because the hub nut is pulling the propeller hub off the tapered rear cone, there will be significant resistance to the loosening of the shaft nut.

- (e) Grip the blade counterweight on each blade clamp and, at the same time, rotate the blades to high pitch
- (f) Rotate the blades until the push rods that protrude from the jack plate unit slide out of each of the two hub lug bushings.
- (g) Rotate the jack plate unit to allow each fork to disengage each pitch change block.
- (h) Remove the pitch change block from each blade clamp link screw.

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

CAUTION: USE ADEQUATE PRECAUTIONS TO PROTECT THE PROPELLER ASSEMBLY FROM DAMAGE WHEN IT IS REMOVED FROM THE AIRCRAFT ENGINE AND WHEN IT IS STORED.

- (i) Using the support sling, remove the propeller from the engine splined shaft and lift the propeller from the engine.
  - (j) Remove the rear cone.
  - (k) Remove the spacer(s) from the engine shaft.
  - (l) Place the propeller and associated parts on a cart for transportation.
- (2) Hydraulic Unit Removal for Propeller Model HC-D2(MV,V)20-3

CAUTION 1: USE ADEQUATE PRECAUTIONS TO PROTECT THE HYDRAULIC UNIT FROM DAMAGE WHEN IT IS REMOVED FROM THE AIRCRAFT ENGINE AND WHEN IT IS STORED.

CAUTION 2: OIL WILL BE RELEASED FROM THE CYLINDER AND PISTON CAVITY WHEN THE PISTON IS REMOVED FROM THE CYLINDER. PLACE A PAN UNDER THE HYDRAULIC UNIT TO CATCH RELEASED ENGINE OIL.

- (a) Grip the push rods and forks that protrude from the jack plate unit attached to the hydraulic unit piston.
- (b) Pull the piston and the attached hydraulic valve away from the cylinder until it is free from the cylinder.
- (c) Remove the six locking nuts from the six studs (now exposed) that retain the cylinder to the engine case.
- (d) Place the hydraulic unit piston and cylinder and associated parts on a cart for transportation.

**B. Removal of the HC-D3(MV,V)20-6L 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.

**(1) Propeller Removal**

- (a) Disconnect the reverse pitch control cable from the hydraulic valve lever on the short end that extends from the valve spool.
- (b) Disconnect the propeller pitch control cable from the hydraulic valve lever on the long end that extends from the valve spool.
- (c) Remove the lock nut from the threaded end of each push rod.
- (d) Remove the washer from the threaded end of each push rod.
- (e) Remove the hub nut safety pin from the hub nut.
- (f) Completely loosen and unthread the hub nut from the engine shaft threads.

**NOTE:** Because the hub nut is pulling the propeller hub off the tapered rear cone, there will be significant resistance to the loosening of the shaft nut.

- (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 slide out of each of the guide collar bushings.
- (i) Rotate the jack plate and push rods until each fork disengages from each clamp link screw and pitch change block.



CAUTION: MAKE SURE THE SLEEVE AND THE SPACER ON EACH PUSH ROD REMAIN ON THE PUSH ROD AND ARE NOT LOST.

- (j) Reinstall a washer and lock nut on the threaded end of each push rod to prevent the sleeve and spacer from loss during disassembly.
- (k) Remove the pitch change block from each blade clamp link screw.

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

CAUTION: USE ADEQUATE PRECAUTIONS TO PROTECT THE PROPELLER ASSEMBLY FROM DAMAGE WHEN IT IS REMOVED FROM THE AIRCRAFT ENGINE AND WHEN IT IS STORED.

- (l) Using a support sling, remove the propeller from the engine splined shaft and lift the propeller from the engine.
- (m) Remove the rear cone from the engine shaft.
- (n) Remove the spacer(s) from the engine shaft.
- (o) Place the propeller and associated parts on a cart for transportation.

- (2) Hydraulic Unit Removal for Propeller Model  
HC-D3(MV,V)20-6L

CAUTION 1: USE ADEQUATE PRECAUTIONS TO PROTECT THE HYDRAULIC UNIT FROM DAMAGE WHEN IT IS REMOVED FROM THE AIRCRAFT ENGINE AND WHEN IT IS STORED.

CAUTION 2: OIL WILL BE RELEASED FROM THE CYLINDER AND PISTON CAVITY WHEN THE PISTON IS REMOVED FROM THE CYLINDER. PLACE A PAN UNDER THE HYDRAULIC UNIT TO CATCH RELEASED ENGINE OIL.

- (a) Grip the push rods and forks that protrude from the jack plate unit attached to the hydraulic unit piston.
- (b) Pull the piston and the attached hydraulic valve away from the cylinder until it is free from the cylinder.
- (c) Remove the six locking nuts from the six studs that retain the cylinder to the engine case.
- (d) Place the hydraulic unit piston and cylinder and associated parts on a cart for transportation.

**C. Removal of 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.

**(1) Propeller Removal**

**CAUTION:** TO PREVENT DAMAGE TO THE BLADE AND BLADE PAINT, WRAP THE BLADE SHANKS IN SEVERAL LAYERS OF MASKING OR DUCT TAPE BEFORE REMOVING THE SPINNER DOME (IF INSTALLED).

**(a) Spinner dome removal (if installed)**

- 1** Remove the screws and washers that secure the spinner to the spinner bulkhead.
- 2** Remove the spinner dome.

**(b)** On non-governing propellers only, disconnect the propeller pitch control cable from the hydraulic valve lever on the long end that extends from the valve spool.

**(c)** Remove the hub nut safety pin from the hub nut.

**(d)** Completely loosen and unthread the hub nut from the engine shaft threads.

**NOTE:** Because the hub nut is pulling the propeller hub off the tapered rear cone, there will be significant resistance to the loosening of the shaft nut.

**(e)** Grip the blade counterweight on each blade clamp and rotate the blades to high pitch.

**(f)** Rotate the blades until the push rods that protrude from the jack plate unit slide out of each of the guide lug bushings in the hub.

- (g) Rotate the jack plate unit to allow each fork to disengage each pitch change block.
- (h) Remove the pitch change block from each blade clamp link screw.

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

**CAUTION:** USE ADEQUATE PRECAUTIONS TO PROTECT THE PROPELLER ASSEMBLY FROM DAMAGE WHEN IT IS REMOVED FROM THE AIRCRAFT ENGINE AND WHEN IT IS STORED.

- (i) Using the support sling, remove the propeller from the engine splined shaft and lift the propeller from the engine.
  - (j) Remove the rear cone from the engine shaft.
  - (k) Remove the spacer(s) from the engine shaft.
  - (l) Place the propeller and associated parts on a cart for transportation.
- (2) Hydraulic Unit Removal for Propeller Model HC-D2(MV,V)20-7( )

**CAUTION 1:** USE ADEQUATE PRECAUTIONS TO PROTECT THE HYDRAULIC UNIT FROM DAMAGE WHEN IT IS REMOVED FROM THE AIRCRAFT ENGINE AND WHEN IT IS STORED.

**CAUTION 2:** OIL WILL BE RELEASED FROM THE CYLINDER AND PISTON CAVITY WHEN THE PISTON IS REMOVED FROM THE CYLINDER. PLACE A PAN UNDER THE HYDRAULIC UNIT TO CATCH RELEASED ENGINE OIL.

- (a) Grip the push rods and forks that protrude from the jack plate unit attached to the hydraulic unit piston.
- (b) Pull the piston away from the cylinder until it is free from the cylinder.

- (c) Remove the screws and washers from the inner and outer rings that retain the diaphragm to the cylinder.
- (d) Remove the inner and outer rings that retain the diaphragm.
- (e) Remove the four socket head cap screws that retain the cylinder to the engine case.
- (f) Place the hydraulic unit piston and cylinder and associated parts on a cart for transportation.

**D. Removal of the HC-D(2,3)(MV,V)20-8( ) Propeller Assemblies****(1) Propeller Removal**

**CAUTION:** TO PREVENT DAMAGE TO THE BLADE AND BLADE PAINT, WRAP THE BLADE SHANKS IN SEVERAL LAYERS OF MASKING OR DUCT TAPE BEFORE REMOVING THE SPINNER DOME (IF INSTALLED).

- (a) Spinner dome removal (if installed):
  - 1** Remove the screws and washers that secure the spinner to the spinner bulkhead.
  - 2** Remove the spinner dome.
- (b) On non-governing propellers only, disconnect the propeller pitch control cable from the hydraulic valve lever on the long end that extends from the valve spool.
- (c) Remove the hub nut safety pin from the hub nut.
- (d) Completely loosen and unthread the hub nut from the engine shaft threads.

**NOTE:** Because the hub nut is pulling the propeller hub off the tapered rear cone, there will be significant resistance to the loosening of the shaft nut.

- (e) Grip the blade counterweight on each blade clamp and rotate the blades to high pitch
- (f) Rotate the blades until the push rods that protrude from the jack plate unit slide out of each of the guide lug bushings on the hub.
- (g) Rotate the jack plate unit to allow each fork to disengage each pitch change block.

- (h) Remove the pitch change block from each blade clamp link screw.

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

**CAUTION:** USE ADEQUATE PRECAUTIONS TO PROTECT THE PROPELLER ASSEMBLY FROM DAMAGE WHEN IT IS REMOVED FROM THE AIRCRAFT ENGINE AND WHEN IT IS STORED.

- (i) Using the support sling, remove the propeller from the engine splined shaft and lift the propeller from the engine.
- (j) Remove the rear cone from the engine shaft.
- (k) Remove the spacer(s) from the engine shaft.
- (l) Place the propeller and associated parts on a cart for transportation.

- (2) Hydraulic Unit Removal for Propeller Models  
HC-D(2,3)(MV,V)20-8( )

CAUTION 1: USE ADEQUATE PRECAUTIONS TO PROTECT THE HYDRAULIC UNIT FROM DAMAGE WHEN IT IS REMOVED FROM THE AIRCRAFT ENGINE AND WHEN IT IS STORED.

CAUTION 2: OIL WILL BE RELEASED FROM THE CYLINDER WHEN THE DIAPHRAGM IS REMOVED FROM THE CYLINDER. PLACE A PAN UNDER THE HYDRAULIC UNIT TO CATCH RELEASED ENGINE OIL.

- (a) Grip the push rods and forks that protrude from the jack plate unit attached to the hydraulic unit piston.
- (b) Pull the piston away from the cylinder until it is free from the cylinder.
- (c) Remove the screws and washers from the inner and outer rings that retain the diaphragm to the cylinder.
- (d) Remove the six locking nuts from the six studs that retain the cylinder to the engine case.
- (e) Place the hydraulic unit piston and cylinder and associated parts on a cart for transportation.

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**1. Operational Tests**

Following propeller installation, and before the first flight of the day, the propeller system must be purged of air and proper operation verified.

**WARNING:** REFER TO THE AIRCRAFT MAINTENANCE MANUAL OR THE STC FOR ADDITIONAL PROCEDURES THAT MAY BE REQUIRED AFTER PROPELLER INSTALLATION.

**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.

**A. Initial Run-Up**

- (1) Perform engine start and warm-up per the Pilot's Operating Handbook (POH).
- (2) Cycle the propeller control throughout its operating range from low to high (or as directed by the POH).
- (3) Repeat this procedure at least three times to purge air from the propeller hydraulic system and to introduce warmed oil to the cylinder.

**NOTE:** Pitch change response on the first operation from low to high blade angle may be slow but should speed up on the second and third cycles.

- (4) Verify proper operation from low pitch to high pitch and throughout operating range.
- (5) Shut down engine in accordance with the POH.

**NOTE:** Air trapped within the propeller hydraulic cylinder will cause pitch control to be imprecise and may result in propeller surging.

**B. Static RPM Check (Governing Propeller)**

- (1) Perform this operational check after installation, maintenance, or propeller adjustment.

**CAUTION:** A CALIBRATED TACHOMETER MUST BE USED TO MAKE SURE OF THE ACCURACY OF THE RPM CHECK.

- (a) Set the brakes and chock the aircraft or tie the aircraft down.
  - (b) Back the governor Maximum RPM Stop out one turn.
  - (c) Start the engine.
  - (d) Advance the propeller control lever to MAX (max RPM), then retard the control lever one inch (25.4 mm).
  - (e) SLOWLY advance the throttle to maximum manifold pressure.
  - (f) Slowly advance the propeller control lever until the engine speed stabilizes.
    - 1 If the engine speed stabilizes at the maximum power static RPM specified by the TC or STC holder, then the low pitch stop is set correctly.
    - 2 If the engine speed stabilizes above or below the rated RPM, the low pitch stop may require adjustment. Refer to the Troubleshooting section of this chapter.
  - (g) Stop the engine.
  - (h) Return the governor Maximum RPM Stop to the original position, or adjust the governor to the rated RPM with the Maximum RPM Stop screw.
- C. Static RPM Check (Non-governing Propeller)
- (1) Start the engine and allow it to warm up.
  - (2) Check the propeller action with the propeller pitch control (RPM control).
  - (3) Determine the full throttle maximum static RPM obtained with the cockpit propeller control full forward for lowest pitch. Refer to the airframe manufacturer's manual or the STC paperwork for the applicable static RPM.
- D. Post-Run Check
- After engine shutdown, check the propeller for signs of engine oil leakage.

**2. Troubleshooting**

**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.

**A. Insufficient RPM Control (Non-governing Propeller)****(1) Adjust the movement of the cockpit control**

**NOTE:** The push-pull control lines must have sufficient travel to actuate the piston through the full stroke.

- (a) Start and warm up the engine.
- (b) Observe whether the piston moves through its stroke in response to the push-pull control movement.
- (c) Rework the control until sufficient travel is obtained.
  - 1 Bottom the piston in the cylinder.
  - 2 Pull out the cockpit propeller control approximately 2.25 inches (57 mm) from the instrument panel.
  - 3 Locate the valve spool midway between the cotter pin and the base of the guide pin.
  - 4 Attach the propeller pitch control line to the valve lever.

**B. Maximum RPM (Static) is Low (Governing Propeller)****(1) Engine Power is low**

- (a) Follow aircraft POH and/or AMM recommended checks to determine if the engine power is low.
- (b) If the engine power is low, refer to a certificated engine repair station or the engine manufacturer.
- (c) If the engine power is within acceptable limits, examine the maximum RPM stop setting of the governor.

- (d) Governor Maximum RPM Stop Setting
- 1 Increase the maximum RPM stop screw of the governor by one turn.
  - 2 Advance the propeller RPM control to maximum RPM and reduce the control by one inch (25 mm).
  - 3 Set the brakes and chock the wheels of the aircraft, or tie the aircraft down.
  - 4 Start the engine.
  - 5 Slowly advance the throttle to maximum manifold pressure.
  - 6 Slowly advance the propeller control lever until the engine speed stabilizes.
  - 7 If the engine speed stabilizes at a higher RPM than it was previously running, then the governor maximum RPM stop setting is incorrectly set.
    - a Make additional fine adjustments to the governor maximum RPM stop setting until the rated maximum RPM is reached.
    - b If engine speed stabilizes above or below the rated RPM, the low pitch stop may require adjustment. Refer to the Maintenance Practices chapter of this manual.

C. Static RPM too low - HC-D2(MV,V)20-3 Propeller Model

- (1) Stop the engine.

**CAUTION:** NEVER OPERATE THE PROPELLER WITH THE JACK PLATE AGAINST THE SHOULDER. THE MINIMUM CLEARANCE IS 0.012 INCH (0.30 mm).

- (2) If no more adjustment of the low pitch stop screw is available, check to determine if the jack plate is against the shoulder of the hub.
- (a) Correct by removing the propeller and adding or removing shims, as required, between the rear cone and the engine to attain a lower pitch.

**NOTE:** Removing shims will increase engine RPM. Installing shims will decrease engine RPM.

- (3) If the valve lever stop is not controlling the travel of the push pull control because it is limited in the cockpit, correct using the following steps:
  - (a) Loosen the control housing clamp next to the valve.
  - (b) Move the control housing toward the propeller until the stop on the lever limits the lever movement.
  - (c) Adjust the stop to achieve proper static RPM.
- D. Static RPM too low - HC-D3(MV,V)20-6L Propeller Model
  - (1) Adjust the stop that controls the valve lever travel so the proper RPM is obtained.
  - (2) Start and warm up the engine and check propeller action.
    - (a) The full throttle maximum static rpm, with cockpit propeller control full forward, should be held to the limits listed in the Aircraft Type Certificate Data Sheet.
  - (3) Stop the engine and back off on the low pitch stop screw.
    - (a) For -6 models, the screw adjusts directly against the valve body.
  - (4) Run the engine up. If the static RPM is still low, stop the engine and further adjust the low pitch stop screw.

**CAUTION:** NEVER OPERATE THE PROPELLER WITH THE JACK PLATE AGAINST THE SHOULDER. THE MINIMUM CLEARANCE IS 0.120 INCH (3.05 MM).

- (5) If no more adjustment of the low pitch stop screw is available, and the jack plate is against the shoulder of the hub, perform the following steps:
  - (a) Remove the propeller and add shims, as required, between the rear cone and the engine to attain a lower pitch.
  - (b) Reset the blade pitch approximately one degree, or 0.031 inch (0.78 mm) for each 100 RPM desired.
- (6) If the valve lever stop is not controlling the travel of the push pull control because it is limited in the cockpit, loosen the control housing clamp next to the valve and move the control housing toward the propeller until the stop on the lever limits the lever movement. Adjust the stop to achieve proper static RPM.

- E. Maximum RPM (Static) is High (Governing Propeller)
- (1) Engine power is high
    - (a) Follow the aircraft POH and/or AMM recommended engine checks to determine if the engine power is high.
    - (b) If the engine power is high, refer to an appropriately licensed engine repair station or to the engine manufacturer.
    - (c) If the engine power is within acceptable limits, examine the maximum RPM stop setting of the governor.
- F. Static RPM too high - HC-D2(MV,V)20-3 Propeller Model
- (1) Start and warm up the engine and check propeller action. The full throttle maximum static rpm, with cockpit propeller control full forward, should be held to the limits listed in the Aircraft Specification.
  - (2) Reduce the propeller RPM with the propeller control until the correct RPM is obtained.
  - (3) Stop the engine.
  - (4) Adjust the propeller low pitch stop screw that limits valve lever travel and is attached to the hydraulic cylinder.  
**NOTE:** On -6 models the low pitch stop screw adjusts directly against the valve body.
- G. Static RPM too high - HC-D3(MV,V)20-6L Propeller Model
- (1) Start and warm up the engine and check propeller action. The full throttle maximum static rpm, with cockpit propeller control full forward, should be held to the limits listed in the Aircraft Specification.
  - (2) Reduce the propeller RPM with the propeller control until the correct RPM is obtained.
  - (3) Stop the engine.
  - (4) Adjust the propeller low pitch stop screw that limits valve lever travel and is attached to the hydraulic cylinder.



**H. Insufficient High-Low Pitch Control (Non-governing Reversing Propeller)****(1) Adjust the reversing control if it is not tight**

**NOTE:** If the reversing control does not pull the short end of the valve lever (pivot point) up tight against the bracket, it will be impossible to satisfactorily adjust the high-low pitch control. It may also be impossible to obtain full high pitch.

- (a) Loosen the clamp that holds the push-pull control housing.
- (b) Slide the housing away from the propeller.
- (c) Pull the lever pivot back against the bracket.
- (d) Tighten the clamp.
- (e) Position the cockpit reverse control line forward, just off the locked position.
- (f) Attach the control line at the propeller to the short end of the lever on the valve.
  - 1** Make sure the clamping bolt is tight against the bracket on the cylinder.
- (g) Move the cockpit reverse control lever into the locked position.

**NOTE:** There should be increased tension in the line due to the slack being taken up.

**I. Cruise RPM Too High (Non-governing Reversing Propeller)****(1) Improper piston travel**

- (a) Bottom the piston in the cylinder.

**NOTE:** Make sure the piston is actually bottoming in the cylinder. The piston should extend from the cylinder about 1/32 inch (0.794 mm). If the piston does not bottom, remove the piston and eliminate the cause.

- (b) Check the travel of the piston by measuring between the jack plate and the shoulder of the hub. Travel should be 1.062 to 1.094 inches (26.98 to 27.78 mm).
- (c) Shim behind the rear cone, if necessary, to provide correct travel.

**J. Hunting and Surging (Governing Propeller Only)**

Hunting is characterized by a cyclic variation in engine speed above and below desired speed. Surging is characterized by a large increase/decrease in engine speed, followed by a return to set speed after one or two occurrences.

(1) If propeller is hunting, a repair facility should check:

- (b) Fuel control
- (c) Check propeller rigging

(2) If propeller is surging:

Perform the steps under "Operational Tests," Steps 1.A. (1) through 1.A.(5). If surging reoccurs, it is most likely due to a faulty governor.

Hunting and/or surging may also be caused by friction or internal propeller corrosion that causes the propeller to react slower to governor commands. The propeller must be tested on a test bench at a propeller repair facility to isolate these faults.

**K. Engine Speed Varies with Flight Altitude (or Airspeed)**

Small variances in engine speed are normal and are no cause for concern.

**L. Vibration**

**CAUTION:** ANY VIBRATION THAT CAN BE DESCRIBED AS APPEARING SUDDENLY, OR IS ACCOMPANIED BY UNEXPLAINED GREASE LEAKAGE SHOULD BE INVESTIGATED IMMEDIATELY BEFORE FURTHER FLIGHT.

**NOTE:** Vibration problems caused by propeller system imbalance are normally felt throughout the RPM range, with the intensity of vibration increasing with RPM. Vibration is also a symptom of resonance and potentially harmful to the propeller. Avoid operation until the propeller can be checked by an authorized repair station.

(1) Check:

- (a) Control surfaces, cowl flaps, exhaust system, landing gear doors, etc. for excessive play, which may be causing vibration unrelated to the propeller
- (b) Secure attachment of engine mounted hardware
- (c) Engine mount wear
- (d) Proper engine/propeller flange mating
- (e) Spinner for cracks, improper installation, or "wobble" during operation
- (f) Uneven lubrication of propeller
- (g) Hub, blade or blade clamp for damage or cracking
- (h) Blade deformation
- (i) Blade track. (For procedure, refer to the Inspection and Check chapter of this manual.)
- (j) Airfoil profile identical between blades (after overhaul or rework for nicks - verify at propeller repair station)
- (k) Blade angles: Blade angle must be within 0.2 degree from blade to blade
- (l) Static balance

■ M. Propeller Overspeed (Non-governing)

(1) Check:

- (a) Tachometer error
- (b) Low pitch stop adjustment
- (c) Propeller rigging

■ N. Propeller Overspeed (Governing)

(1) Check:

- (a) Tachometer error
- (b) Low pitch stop adjustment
- (c) Governor Failure
- (d) Governor pilot valve is jammed, supplying high pressure

**O. Propeller Underspeed (Non-governing)**

(1) Check:

- (a) Tachometer error
- (b) Propeller rigging

**P. Propeller Underspeed (Governing)**

(1) Check:

- (a) Tachometer error
- (b) Excessive engine transfer bearing leakage
- (c) Governor oil pressure is low
- (d) Governor oil passage is clogged

**Q. Oil or Grease Leakage**

**CAUTION: GREASE LEAKAGE THAT CAN BE DESCRIBED AS EXCESSIVE AND APPEARING SUDDENLY, ESPECIALLY WHEN ACCOMPANIED BY VIBRATION, SHOULD BE INVESTIGATED IMMEDIATELY BEFORE FURTHER FLIGHT.**

(1) For grease leakage, check:

- (a) Damaged blade clamp O-ring seal
- (b) Damaged jack plate cover gasket

(2) For oil leakage, check:

- (a) Damaged diaphragm (-7 and -8 propellers)
- (b) Damaged gasket between the engine and cylinder (-7, -8, -3, and -6L propellers)
- (c) Damaged O-ring around the cylinder mounting stud (-8 propellers)
- (d) Loose guide pin in the cylinder (guides the piston) (-6L propellers)
- (e) Damaged O-rings in the cylinder (-3, -6L propellers)

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**1. Pre-Flight Checks**

**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.

Follow propeller preflight inspection procedures as specified in the aircraft maintenance manual or this manual. In addition, perform the following inspections:

**A. Blades**

**CAUTION:** BLADE DAMAGE THAT IS DEEPER OR WIDER THAN 0.031 INCH (0.79 MM) MUST BE REPAIRED BEFORE FURTHER FLIGHT. FOR BLADE REPAIR INFORMATION, REFER TO THE MAINTENANCE PRACTICES CHAPTER OF THIS MANUAL.

- (1) Visually inspect the entire blade for nicks, gouges, erosion, and cracks. Nicks, gouges, and scratches on blade surfaces or on the leading or trailing edges of the blade that are deeper or wider than 0.031 inch (0.79 mm) must be removed before flight. For blade repair information refer to the Maintenance Practices chapter of this manual.
  - (2) Visually inspect the blades for lightning strike. Refer to the Lightning Strikes section in this chapter for a description of damage.
- B.** Inspect the spinner and visible blade retention components for damage or cracks. Replace components as required before further flight.
- C.** Check for loose/missing hardware. Retighten or reinstall as necessary.

**WARNING:** ABNORMAL GREASE LEAKAGE CAN BE AN INDICATION OF A FAILING PROPELLER BLADE OR BLADE RETENTION COMPONENT. AN IN-FLIGHT BLADE SEPARATION CAN RESULT IN A CATASTROPHIC AIRCRAFT ACCIDENT.

- D. Inspect for grease and oil leakage and determine its source.
- E. Check the blades for radial play or movement of the blade tip (in and out or back and forth). Refer to Loose Blades, in the Periodic Inspections section of this chapter, for blade play limits.
- F. Refer to the Periodic Inspections section in this chapter for additional inspection information and possible corrections to any discrepancies discovered as a result of preflight checks.

## 2. Operational Checks

**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.

- A. Following propeller installation or as required, perform initial run-up as outlined in Operational Tests in the Testing and Troubleshooting chapter of this manual.
- B. Check the propeller speed control and operation from reverse or low pitch to high pitch, using the procedure specified in the Pilot Operating Handbook (POH) for the aircraft.



WARNING: ABNORMAL VIBRATION CAN BE AN INDICATION OF A FAILING PROPELLER BLADE OR BLADE RETENTION COMPONENT. AN IN-FLIGHT BLADE SEPARATION CAN RESULT IN A CATASTROPHIC AIRCRAFT ACCIDENT.

- C. Check for any abnormal vibration during this run-up. If vibration occurs, shut the engine down, determine the cause, and correct it before further flight. Refer to the Vibration section in the Testing and Troubleshooting chapter of this manual.
- D. Refer to Periodic Inspections in this chapter for additional inspection information and possible corrections to any discrepancies discovered as a result of Pre-Flight Checks.
- E. Refer to the airframe manufacturer's manual for additional operational checks.

**3. Required Periodic Inspections and Maintenance**

**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.

A detailed inspection must be made during the annual inspection or after 100 hours of operation, whichever occurs first, as required by the Federal Aviation Regulations. Procedures involved in these inspections are detailed below.

**A. Periodic Inspections**

Accomplish a detailed inspection at 100 hour intervals not to exceed twelve (12) calendar months. Procedures involved in these inspections are detailed below.

**NOTE 1:** Inspection and maintenance specified by an airframe manufacturer's maintenance program and approved by the applicable airworthiness agency may not coincide with the inspection time intervals specified. In this situation, the airframe manufacturer's schedule may be applied with the exception that the calendar limit for the inspection interval may not exceed twelve (12) months.

**NOTE 2:** Refer to Inspection Procedures, in this chapter, for additional inspection information and possible corrections to any discrepancies discovered as a result of the Periodic Inspection.

**CAUTION:** TO PREVENT DAMAGE TO THE BLADE AND BLADE PAINT, WRAP THE BLADE SHANKS IN SEVERAL LAYERS OF MASKING OR DUCT TAPE BEFORE REMOVING THE SPINNER DOME (IF INSTALLED).

- (1) Spinner dome removal (if installed)
  - (a) Remove the screws and washers that secure the spinner to the spinner bulkhead.
  - (b) Remove the spinner dome.
- (2) Visually inspect the blades for nicks, gouges, and cracks. If any damage is discovered, refer to the Blade Repairs section in the Maintenance Practices chapter of this manual for additional information. A cracked blade must be referred to an appropriately licensed propeller repair station. Do not attempt repair.
- (3) Visually inspect the hub parts for cracks, or wear. Refer to Grease and Oil Leaks in the Inspection Procedures section of this chapter for procedure. A cracked hub must be referred to an authorized propeller repair station. Do not attempt repair.
- (4) Inspect all visible propeller parts for cracks, wear or unsafe conditions.
- (5) Check for oil and grease leaks. Refer to Oil and Grease Leakage in the Inspection Procedures section of this chapter.
- (6) Check the blade track. Refer to Blade Track in the Inspection Procedures section of this chapter.
- (7) Lubricate the propeller assembly. Refer to the Maintenance Practices chapter of this manual.
- (8) Check the accuracy of the tachometer. Refer to Tachometer Inspection in the Inspection Procedures section of this chapter.
- (9) Make an entry in the log book verifying this inspection.

**B. Periodic Maintenance**

- (1) Lubricate the propeller assembly. Refer to Lubrication in the Maintenance Practices chapter of this manual for intervals and procedures.
- (2) Rubber Diaphragm - HC-D2-(MV,V)-(7,8) propellers
  - (a) An inspection of the rubber diaphragm (P/N B-119-2) is required every 6 months. Refer to FAA Airworthiness Directive AD 65-21-04, Service Letter HC-SL-61-48A, and Service Letter HC-SL-61-61Y. These inspections must be performed by an appropriately licensed propeller repair facility in accordance with the applicable propeller maintenance manual.
  - (b) Replacement of the rubber diaphragm (P/N B-119-2) is required at intervals not to exceed 24 months or 250 hours of operation, whichever occurs first. Refer to FAA Airworthiness Directive AD 65-21-04, Service Letter HC-SL-61-48A, and Service Letter HC-SL-61-61Y.

**C. Airworthiness Limitations**

- (1) Certain components, as well as the entire propeller, may have specific life limits established as part of the certification by the FAA. Such limits require mandatory replacement of specified parts after a defined number of hours and/or cycles of use.
- (2) Life limited component times may exist for the propeller models covered in this manual. Refer to the Airworthiness Limitations Section of this manual.
- (3) Refer to the latest revision of Hartzell Propeller Inc. Service Letter HC-SL-61-61Y for life limit data that has not yet been incorporated into this manual. The service letter is available on the Hartzell Propeller Inc. website at [www.hartzellprop.com](http://www.hartzellprop.com).

**D. Overhaul Periods**

In flight, the propeller is constantly subjected to vibration from the engine and the airstream, as well as high centrifugal forces. The propeller is also subject to corrosion, wear, and general deterioration because of aging. Under these conditions, metal fatigue or mechanical failures can occur. To protect your safety and your investment, and to maximize the safe operating lifetime of your propeller, it is essential that a propeller be properly maintained and overhauled according to the recommended service procedures.

**CAUTION 1:** OVERHAUL PERIODS LISTED BELOW, ALTHOUGH CURRENT AT THE TIME OF PUBLICATION, ARE FOR REFERENCE PURPOSES ONLY. OVERHAUL PERIODS MAY BE INCREASED OR DECREASED AS A RESULT OF CONTINUING EVALUATION.

**CAUTION 2:** REFER TO THE LATEST REVISION OF HARTZELL PROPELLER INC. SERVICE LETTER 61( ) FOR THE MOST CURRENT INFORMATION. THIS DOCUMENT IS AVAILABLE ON HARTZELL PROPELLER'S WEBSITE AT WWW.HARTZELLPROP.COM.

- (1) Hartzell Propeller Inc. HC-D( )V( )-( ) ( ) propellers must be overhauled at 1000 hours or 60 calendar months (whichever occurs first).
- (2) Hartzell Propeller Inc. HC-D( )MV( )-( ) ( ) propellers must be overhauled at 2000 hours or 60 calendar months (whichever occurs first).

**4. Inspection Procedures**

**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.

The following inspections are made on a regular basis, either before flight, during the 100 hour inspection, or if a problem is noted. Possible corrections to problems discovered during inspections, additional inspections, and limits are detailed in the following inspection procedures.

**A. Blade Damage**

Refer to Blade Repairs section in the Maintenance Practices chapter of this manual for information regarding blade damage.

**B. Grease or Oil Leakage**

**NOTE:** A new or newly overhauled propeller may leak slightly during the first several hours of operation. This leakage may be caused by the seating of seals and O-rings, and the slinging of lubricants used during assembly. Such leakage should cease within the first ten hours of operation.

- (1) Leakage that persists beyond the first ten hours of operation on a new or newly overhauled propeller, or occurs on a propeller that has been in service for some time will require repair. A determination should be made as to the source of the leak.
- (2) The only leakage that is field repairable is the replacement of the O-rings in the cylinder for -3 and -6 propellers, the diaphragm on -7 and -8 propellers, and the gasket between the cylinder and engine. For additional information, refer to the Oil or Grease Leakage section in the Testing and Troubleshooting chapter of this manual.

**CAUTION:** TO PREVENT DAMAGE TO THE BLADE AND BLADE PAINT, WRAP THE BLADE SHANKS IN SEVERAL LAYERS OF MASKING OR DUCT TAPE BEFORE REMOVING THE SPINNER DOME (IF INSTALLED).

- (3) Spinner dome removal (if installed)
  - (a) Remove the screws and washers that secure the spinner to the spinner bulkhead.
  - (b) Remove the spinner dome.

**CAUTION:** PERFORM A VISUAL INSPECTION WITHOUT CLEANING THE PARTS. A TIGHT CRACK IS OFTEN EVIDENT BECAUSE OF TRACES OF GREASE EMANATING FROM THE CRACK. CLEANING CAN REMOVE SUCH EVIDENCE AND MAKE A CRACK VIRTUALLY IMPOSSIBLE TO SEE.

- (4) Perform a visual inspection of the hub, blade clamps and blades to locate the origin of leakage. If the origin of the grease leakage is determined to be a noncritical part, such as an O-ring, gasket or sealant, repairs can be accomplished during scheduled maintenance as long as flight safety is not compromised.
- (5) If cracks are suspected, perform additional inspections before further flight (by qualified personnel at an appropriately licensed propeller repair station) to verify the condition. Such inspections typically include disassembly of the propeller followed by inspection of parts, using nondestructive methods in accordance with published procedures.
- (6) If cracks or failing components are found, these parts must be replaced before further flight. Report such occurrences to airworthiness authorities and to Hartzell Propeller Inc. Product Support.

**C. Vibration**

Instances of abnormal vibration should be investigated immediately. If the cause of the vibration is not readily apparent, the propeller may be inspected following the procedure below:

**NOTE:** It may sometimes be difficult to readily identify the cause of abnormal vibration. Vibration may originate in the engine, propeller, or airframe. Troubleshooting procedures typically begin with an investigation of the engine. Airframe components, such as engine mounts or loose landing gear doors, can also be the source of vibration. When investigating an abnormal vibration, the possibility of a failing blade or blade retention component should be considered as a potential source of the problem.

- (1) Perform troubleshooting and evaluation of possible sources of vibration in accordance with engine or airframe manufacturer's instructions.
- (2) Refer to the Vibration section in the Testing and Troubleshooting chapter of this manual. Perform the checks to determine possible cause of the vibration. If no cause is found, then consider that the origin of the problem could be the propeller and proceed with steps 4.C.(3) through 4.C.(7).
- (3) Perform a visual inspection for cracks in the hub, blade clamps and blades.

**NOTE:** A crack may be readily visible or may be indicated by grease leaking from a seemingly solid surface.

- (4) If cracks are suspected, additional inspections must be performed before further flight. These inspections must be performed by qualified personnel at an appropriately licensed propeller repair station to verify the condition. Such inspections typically include disassembly of the propeller followed by inspection of parts, using nondestructive methods in accordance with published procedures.



- (5) Check the blades and compare blade-to-blade differences:
  - (a) Inspect the propeller blades for unusual looseness or movement. Refer to Loose Blades section of this chapter.
  - (b) Check blade track. Refer to Blade Track section of this chapter.

**CAUTION:** DO NOT USE BLADE PADDLES TO TURN THE BLADES.

- (c) Manually (by hand) attempt to turn the blades (change pitch).
  - (d) Visually check for damaged blades.
- (6) If abnormal blade conditions or damage are found, perform additional inspections (by qualified personnel at an appropriately licensed propeller repair station) to evaluate the condition. Refer to Blade Repairs section in Maintenance Practices chapter of this manual.
- (7) If cracks or failing components are found, these parts must be replaced before further flight. Report such occurrences to airworthiness authorities and Hartzell Propeller Inc. Product Support.

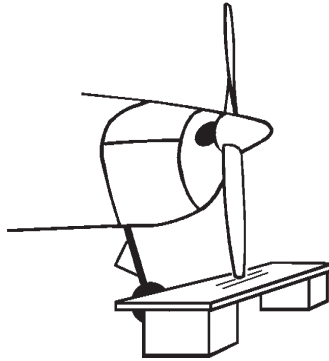
#### D. Tachometer Inspection

**WARNING:** OPERATION WITH AN INACCURATE TACHOMETER MAY RESULT IN RESTRICTED RPM OPERATION AND DAMAGING HIGH STRESSES. BLADE LIFE WILL BE SHORTENED AND COULD RESULT IN CATASTROPHIC FAILURE.

**NOTE:** An appropriately licensed propeller repair station may also be able to perform a tachometer inspection.

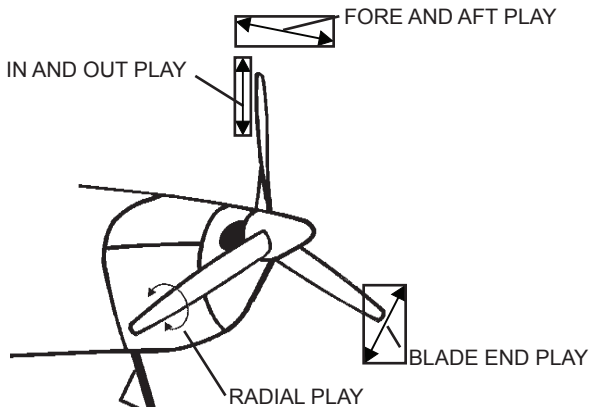
- (1) For installations that use a mechanical tachometer, perform the following tachometer inspection.
  - (a) Use a hand held tachometer to verify the accuracy of the engine tachometer at 100 hour intervals or at annual inspection, whichever occurs first.
  - (b) Hartzell Propeller Inc. recommends using a tachometer that is accurate within +/- 10 RPM, has NIST calibration (traceable), and has an appropriate calibration schedule.

APS6155



**Checking Blade Track**  
**Figure 5-1**

APS6163



**Blade Play**  
**Figure 5-2**

**E. Blade Track**

(1) Check the blade track as follows:

- (a) Chock the aircraft wheels securely.
- (b) Refer to Figure 5-1. Place a fixed reference point beneath the propeller, within 0.25 inch (6 mm) of the lowest point of the propeller arc.

**NOTE:** This reference point may be a flat board with a sheet of paper attached to it. The board may then be blocked up to within 0.25 inch (6.0 mm) of the propeller arc.

**WARNING:** MAKE SURE THE ENGINE MAGNETO IS GROUNDED (OFF) BEFORE ROTATING THE PROPELLER.

- (c) Rotate the propeller by hand (the opposite direction of normal rotation) until a blade points directly at the paper. Mark the position of the blade tip in relation to the paper.
- (d) Repeat this procedure with the remaining blades.
- (e) Tracking tolerance is  $\pm 0.062$  inch (1.57 mm) or 0.125 inch (3.17 mm) total.

**F. Loose Blades**

Refer to Figure 5-2. Limits for blade looseness are as follows:

End Play	$\pm 0.100$ inch (2.54 mm)
Fore & Aft Movement	$\pm 0.100$ inch (2.54 mm)
In and Out Movement	0.032 inch (0.81 mm)
Radial Play (pitch change)	$\pm 0.5$ degree (1 degree total)

Blade movement beyond these limits should be referred to an appropriately licensed propeller repair station.

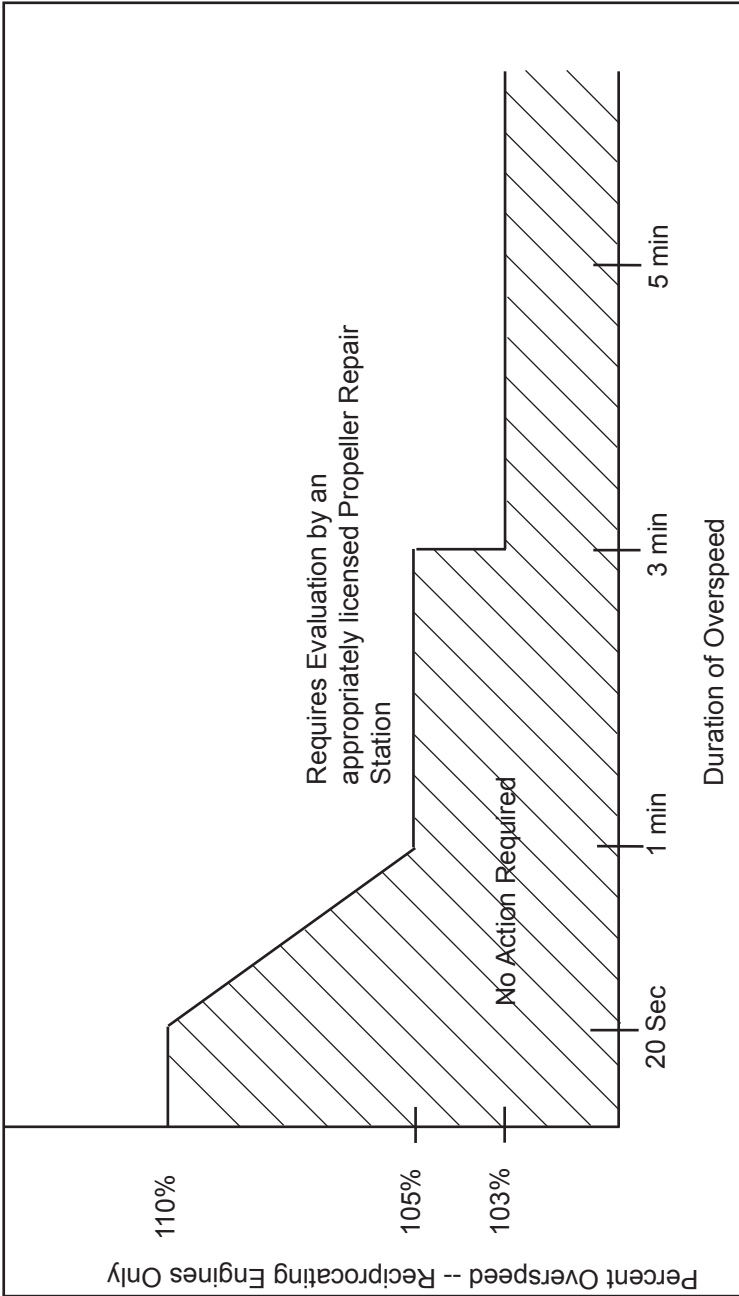
**G. Corrosion**

**WARNING:** REWORK THAT INVOLVES COLD WORKING THE METAL, RESULTING IN CONCEALMENT OF A DAMAGED AREA IS NOT PERMITTED.

- (1) Light corrosion on blades may be removed by qualified personnel in accordance with the Blade Repairs section in the Maintenance Practices chapter of this manual.
- (2) Heavy corrosion that results in severe pitting must be referred to an appropriately licensed propeller repair station.

**H. Spinner Damage (if installed)**

Inspect the spinner for cracks, missing hardware, or other damage. Refer to a certificated propeller repair station for spinner damage acceptance and repair information.



**Reciprocating Engine Overspeed Limits**  
Figure 5-3



**5. Special Inspections**

**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.

**A. Overspeed**

An overspeed has occurred when the propeller RPM has exceeded the maximum RPM stated in the applicable Aircraft Type Certificate Data Sheet. The duration of time at overspeed for a single event determines the corrective action that must be taken to ensure no damage to the propeller has occurred.

The criteria for determining the required action after an overspeed are based on many factors. The additional centrifugal forces that occur during overspeed are not the only concern. Some applications have sharp increases in vibratory stresses at RPMs above the maximum rated for the airframe/engine/propeller combination

- (1) When a propeller installed on a reciprocating engine has an overspeed event, refer to the Reciprocating Engine Overspeed Limits (Figure 5-3) to determine the corrective action to be taken.
- (2) Make a log book entry to document the overspeed event.

**B. Lightning Strike**

**CAUTION:** ALSO CONSULT ENGINE AND AIRFRAME MANUFACTURER'S MANUALS. THERE MAY BE ADDITIONAL REQUIREMENTS SUCH AS ENGINE SYSTEM CHECKS TO PERFORM AFTER A PROPELLER LIGHTNING STRIKE.

**(1) General**

In the event of a propeller lightning strike, an inspection is required before further flight. It may be permissible to operate a propeller for an additional ten (10) hours of operation if the propeller is not severely damaged and meets the requirements in paragraph 5.B.(2).

Regardless of the outcome of the initial inspection, the propeller must eventually be removed from the aircraft, disassembled, evaluated, and/or repaired by an authorized propeller repair station.

**(2) Procedure for Temporary Operation**

If temporary additional operation is desired before propeller removal and disassembly:

**CAUTION:** IF THE PROPELLER EXPERIENCES LIGHTNING STRIKE, THE ALUMINUM BLADES MUST BE WITHIN AIRWORTHY LIMITS FOR ANY ADDITIONAL FLIGHT.

- (a) If the only evident damage is minor arcing burns to the blades, then operation for ten (10) hours is acceptable before disassembly and inspection.
- (b) Regardless of the degree of damage, make a log book entry to document the lightning strike.
- (c) The propeller must be removed from the aircraft, disassembled, evaluated, and/or repaired by an appropriately licensed propeller repair station for flight beyond the temporary operation limits granted above.

**C. Foreign Object Strike/Ground Strike****(1) General**

(a) A foreign object strike can include a broad spectrum of damage, from a minor stone nick to severe ground impact damage. A conservative approach in evaluating the damage is required because there may be hidden damage that is not readily apparent during an on-wing, visual inspection.

(b) A foreign object strike is defined as:

- 1 Any incident, whether or not the engine is operating, that requires repair to the propeller other than minor dressing of the blades. Examples of foreign object strike include situations where an aircraft is stationary and the landing gear collapses causing one or more blades to be significantly damaged, or where a hangar door (or other object) strikes the propeller blade. These cases should be handled as foreign object strikes because of potentially severe side loading on the propeller hub, blades and retention bearings.
- 2 Any incident during engine operation in which the propeller impacts a solid object that causes a drop in revolutions per minute (RPM) and also requires structural repair of the propeller (incidents requiring only paint touch-up are not included). This is not restricted to propeller strikes against the ground.
- 3 A sudden RPM drop while impacting water, tall grass, or similar yielding medium, where propeller blade damage is not normally incurred.



**(2) Procedure**

- (a) In the event of a foreign object strike, an inspection is required before further flight. If the inspection reveals one or more of the following indications, the propeller must be removed from the aircraft, disassembled and repaired or overhauled in accordance with the applicable propeller and blade maintenance manuals.
  - 1 A blade rotated in the clamp.
  - 2 Any noticeable or **suspected** damage to the pitch change mechanism.
  - 3 A bent blade (out of track or angle).
  - 4 Any diameter reduction.
  - 5 Blade damage.
  - 6 A bent, cracked, or failed engine shaft.
  - 7 Vibration during operation.
- (b) Nicks, gouges, and scratches on blade surfaces or the leading and trailing edges must be removed before flight. Refer to the Blade Repairs section in the Maintenance Practices chapter of this manual.
- (c) Engine mounted components - such as governors, pumps, etc., may be damaged by a foreign object strike, especially if the strike resulted in a sudden stoppage of the engine. These components should be inspected, repaired, or overhauled as recommended by the applicable component maintenance manual.
- (d) Make a log book entry to document the foreign object strike/ground strike incident and any corrective action(s) taken.

**D. Fire Damage or Heat Damage**

**WARNING:** HUBS AND CLAMPS ARE MANUFACTURED FROM HEAT TREATED FORGINGS AND ARE SHOT PEENED. BLADES ARE MANUFACTURED FROM HEAT TREATED FORGINGS AND ARE COMPRESSIVELY ROLLED AND SOMETIMES SHOT PEENED. EXPOSURE TO HIGH TEMPERATURES CAN DESTROY THE FATIGUE BENEFITS OBTAINED FROM THESE PROCESSES.

On rare occasions propellers may be exposed to fire or heat damage, such as an engine or hanger fire. In the event of such an incident, an inspection by an appropriately licensed propeller repair station is required before further flight.

**6. Long Term Storage**

- A. Parts shipped from the Hartzell Propeller Inc. factory are not shipped or packaged in a container that is designed for long term storage.
- B. Long term storage procedures may be obtained by contacting a Hartzell Propeller Inc. distributor, or the Hartzell Propeller Inc. factory via the product support number listed in the Introduction chapter of this manual. Storage information is also detailed in Hartzell Propeller Inc. Manual 202A (61-01-02).
- C. Information regarding the return of a propeller assembly to service after long term storage may be obtained by contacting a Hartzell Propeller Inc. distributor, or the Hartzell Propeller Inc. factory via the product support number listed in the Introduction chapter of this manual. This information is also detailed in Hartzell Propeller Inc. Manual 202A (61-01-02).

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## 1. Cleaning

CAUTION 1: 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.

CAUTION 2: DO NOT USE PRESSURE WASHING EQUIPMENT TO CLEAN THE PROPELLER OR CONTROL COMPONENTS. PRESSURE WASHING CAN FORCE WATER AND/OR CLEANING SOLVENTS PAST SEALS, AND LEAD TO INTERNAL CORROSION OF PROPELLER COMPONENTS.

### A. General Cleaning

CAUTION 1: WHEN CLEANING THE PROPELLER, DO NOT ALLOW SOAP OR SOLVENT SOLUTIONS TO RUN OR SPLASH INTO THE HUB AREA.

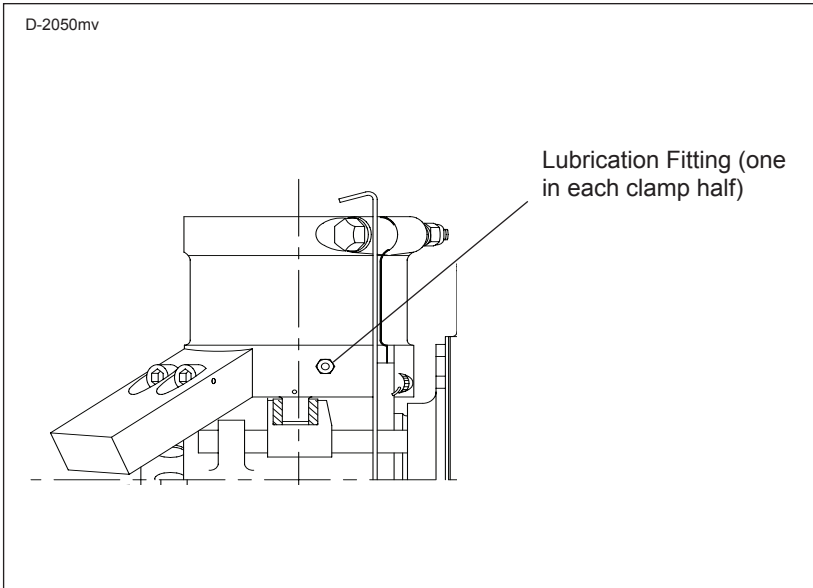
CAUTION 2: DO NOT CLEAN THE PROPELLER WITH CAUSTIC OR ACIDIC SOAP SOLUTIONS. IRREPARABLE CORROSION OF PROPELLER COMPONENTS MAY OCCUR.

(1) Wash propeller with a noncorrosive soap solution.

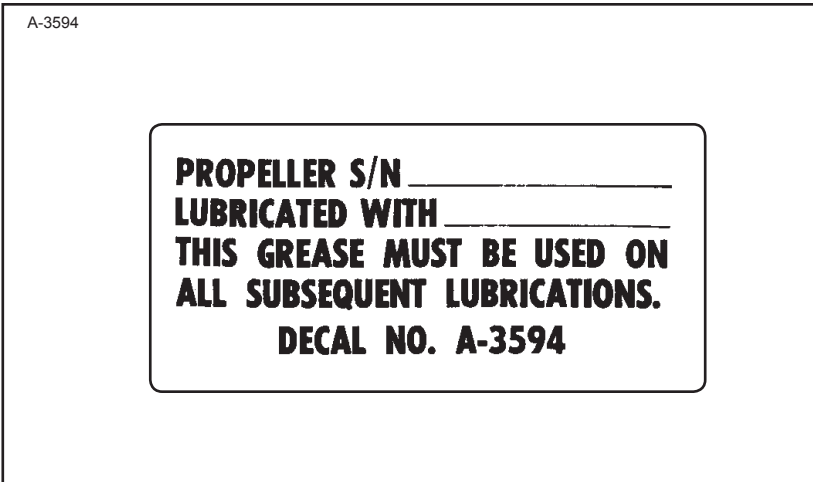
CAUTION: DO NOT USE ANY SOLVENT DURING CLEANING THAT COULD SOFTEN OR DESTROY THE BOND BETWEEN CHEMICALLY ATTACHED PARTS.

(2) To remove grease or oil from propeller surfaces, apply Stoddard Solvent or equivalent to a clean cloth and wipe the part clean.

(3) Thoroughly rinse with water and allow to dry.



Lubrication Fitting  
Figure 6-1



Lubrication Label  
Figure 6-2

**B. Spinner Cleaning and Polishing**

- (1) Clean the spinner using the General Cleaning procedures in this Cleaning section.
- (2) Polish the dome (if required) with an automotive-type aluminum polish.

**2. Lubrication**

**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.

**A. Lubrication Intervals**

- (1) The propeller must be lubricated at (12) calendar months or at 100 hour intervals, whichever occurs first.

**NOTE 1:** If annual operation is significantly less than 100 hours, calendar lubrication intervals should be reduced to six months.

**NOTE 2:** If the aircraft is operated or stored under adverse atmospheric conditions, e.g., high humidity, salt air, calendar lubrication intervals should be reduced to six months.

- (2) Owners of high use aircraft may wish to extend their lubrication intervals. Lubrication interval may be gradually extended after evaluation of previous propeller overhauls, with regard to bearing wear and internal corrosion.
- (3) New or newly overhauled propellers should be lubricated after the first one or two hours of operation, because centrifugal loads will pack and redistribute grease.

**NOTE:** The purchaser of a new aircraft should check the propeller logbook to verify whether the propeller was lubricated by the manufacturer during flight testing. If it was not, the propeller should be serviced at earliest convenience.

**B. Lubrication Procedure**

**CAUTION:** FOLLOW LUBRICATION PROCEDURES CORRECTLY TO MAINTAIN AN ACCURATE BALANCE OF THE PROPELLER ASSEMBLY.

- (1) Refer to Figure 6-1. Each blade clamp has two lubrication fittings. Remove both lubrication fitting caps and one of the lubrication fittings from each blade clamp.
- (2) Use a piece of safety wire to loosen any blockage or hardened grease at the threaded holes where the lubrication fitting was removed.

**WARNING:** WHEN MIXING AEROSHELL GREASES 5 AND 6, AEROSHELL GREASE 5 MUST BE INDICATED ON THE LABEL (HARTZELL PROPELLER INC. P/N A-3594) AND THE AIRCRAFT MUST BE PLACARDED TO INDICATE THAT FLIGHT IS PROHIBITED IF THE OUTSIDE AIR TEMPERATURE IS LESS THAN -40°F (-40°C).

**CAUTION:** USE HARTZELL PROPELLER INC. APPROVED GREASE ONLY. EXCEPT IN THE CASE OF AEROSHELL GREASES 5 AND 6, DO NOT MIX DIFFERENT SPECIFICATIONS AND/OR BRANDS OF GREASE.

- (4) Aeroshell greases 5 and 6 both have a mineral oil base and have the same thickening agent; therefore, mixing of these two greases is acceptable in Hartzell propellers.
- (5) A label (Hartzell Propeller Inc. P/N A-3494 is normally applied to the propeller to indicate the type of grease previously used (Figure 6-2).
  - (a) This grease type should be used during relubrication unless the propeller has been disassembled and the old grease removed.
  - (b) Purging of old grease through lubrication fittings is only about 30 percent effective.
  - (c) To completely replace one grease with another, the propeller must be disassembled in accordance with the applicable overhaul manual.



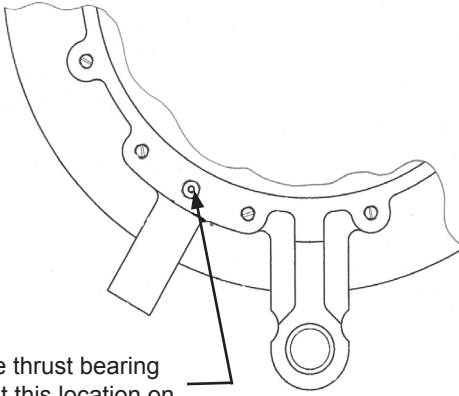
**CAUTION:** DO NOT USE AN AIR ASSISTED GREASE GUN TO LUBRICATE THE PROPELLER.

- (3) Pump grease into each blade clamp lubrication fitting until grease emerges from the hole of the removed lubrication fitting.

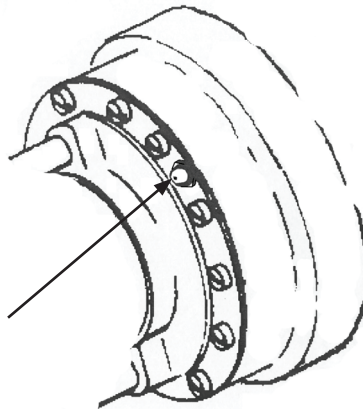
**NOTE:** Lubrication is complete when grease emerges in a steady flow with no air pockets or moisture, and has the color and texture of the new grease.

- (4) Reinstall the removed lubrication fitting on each clamp.
- (5) Tighten the lubrication fittings until snug.
  - (a) Make sure the ball of each lubrication fitting is properly seated.
- (6) Install new lubrication fitting caps on each lubrication fitting.

D-78  
C-112-2D



Lubricate thrust bearing  
A-38( ) at this location on  
the C-112-2 Piston



Lubricate thrust bearing  
A-38( ) at this location on  
the D-78 Piston

**Thrust Bearing Lubrication**  
**Figure 6-3**

**C. Approved Lubricants**

- (1) The following lubricants are approved for use in Hartzell propellers:

Aeroshell 6 -	Recommended "all purpose" grease. Used in most new production propellers since 1989. Higher leakage/oil separation than Aeroshell 5 at higher temperatures (approximately 100°F [38°C]).
Aeroshell 5 -	Good high temperature qualities, very little oil separation or leakage. Cannot be used in temperatures colder than -40°F (-40°C). Aircraft serviced with this grease must be placarded to indicate that flight is prohibited if the outside air temperature is less than -40°F (-40°C).
Aeroshell 7 -	Good low temperature grease, but high leakage/oil separation at higher temperatures. This grease has been associated with sporadic problems involving seal swelling.
Aeroshell 22 -	Qualities similar to Aeroshell 7.
Roycol 22CF -	Not widely used. Qualities similar to Aeroshell 22.

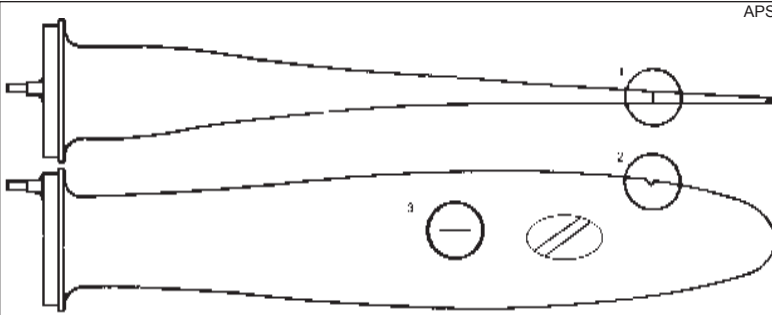
**D. A-38( )Thrust Bearing Lubrication**

- (1) The A-38( ) thrust bearing must be lubricated every 100 hours.
- (2) Propeller Models HC-D2(V,MV)20-3 and HC-D3(V,MV)20-6L contain piston P/N D-78.
- (3) Propeller Models HC-D2(V,MV)20-(7,8) and HC-D3MV20-8D contain piston P/N C-112-2.

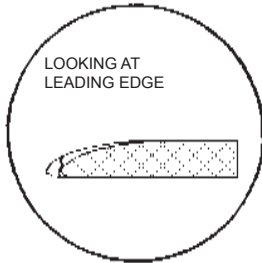
**CAUTION:** DO NOT OVER LUBRICATE THE A-38( ) THRUST BEARING.

- (4) Using approximately one tablespoon full of high speed bearing grease Hartzell Propeller Inc. P/N A-6741-139-1, lubricate the A-38( ) thrust bearing in accordance with Figure 6-3.

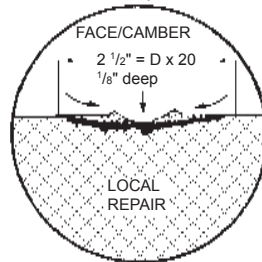
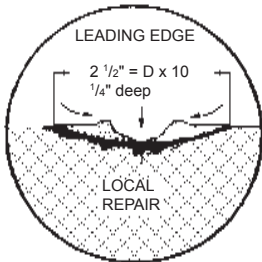
APS6157



Example 1



Example 3



On the leading and trailing edge on the face and camber

Repair Limitations  
Figure 6-4

**3. Blade Repairs**

**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.

Nicks, gouges, and scratches on blade surfaces or on the leading or trailing edges of the blade that are greater than 0.31 inch (0.79 mm) wide or deep must be removed before flight. Field repair of small nicks and scratches may be performed by qualified personnel in accordance with FAA Advisory Circular 43.13-1B, as well as the procedures specified below. Normal blade lead edge erosion (sand-blasted appearance) is acceptable, and does not require removal before further flight.

**A. Repair of Nicks or Gouges**

- (1) Make local repairs using files, electrical or air powered equipment. Use emery cloth, scotch brite, and crocus cloth for final finishing. Refer to Figure 6-4.

**CAUTION 1:** REWORK THAT INVOLVES COLD WORKING THE METAL, RESULTING IN CONCEALMENT OF A DAMAGED AREA, IS NOT ACCEPTABLE. A STRESS CONCENTRATION MAY EXIST, WHICH CAN RESULT IN A BLADE FAILURE.

CAUTION 2: BLADES THAT HAVE BEEN SHOT PEENED (AS INDICATED BY A "PEBBLE GRAIN" SURFACE) THAT HAVE DAMAGE IN THE SHOT PEENED AREAS IN EXCESS OF 0.015 INCH (0.38 MM) DEEP ON THE FACE OR CAMBER OR 0.250 INCH (6.35 MM) ON THE LEADING OR TRAILING EDGES MUST BE REMOVED FROM SERVICE, AND THE REWORKED AREA SHOT PEENED BEFORE FURTHER FLIGHT. SHOT PEENING OF AN ALUMINUM BLADE MUST BE ACCOMPLISHED BY AN APPROPRIATELY LICENSED AND APPROVED REPAIR FACILITY IN ACCORDANCE WITH HARTZELL PROPELLER INC. ALUMINUM BLADE MANUAL 133C (61-13-33).

- (2) Make repairs to the leading or trailing edge by removing material from the bottom of the damaged area. Remove material from this point out to both sides of the damage, providing a smooth, blended depression that maintains the original airfoil general shape.
- (3) Make repairs to the blade face or camber in the same manner as above. Repairs that form a continuous line across the blade section (chordwise) are unacceptable.
- (4) Determine the area of repair as follows:  
Leading and trailing edge damage: Depth of nick x 10.  
Face and camber: Depth of nick x 20. Refer to Figure 6-4.

NOTE: Leading edge includes the first 10 percent of chord from the leading edge. The trailing edge consists of the last 20 percent of chord adjacent to the trailing edge.

- (5) After filing or sanding of the damaged area, the area must then be polished, with emery cloth and finally with crocus cloth to remove any traces of filing.
- (6) Inspect the repaired area with a 10X magnifying glass. Make sure that no indication of the damage, file marks, or coarse surface finish remain.

- (7) If inspections shows any remaining blade damage, repeat steps 3.A.(5) and 3.A.(6) until no damage remains. Dye penetrant inspection is recommended in accordance with Hartzell Propeller Inc. Manual 202A (61-01-02).
- (8) Treat the repaired area to prevent corrosion. Properly apply chemical conversion coating and approved paint to the repaired area before returning the blade to service. Refer to Painting After Repair in this chapter.

#### B. Repair of Bent Blades

**CAUTION:** DO NOT ATTEMPT TO "PRE-STRAIGHTEN" A BLADE BEFORE DELIVERY TO AN APPROPRIATELY LICENSED PROPELLER REPAIR STATION. THIS WILL CAUSE THE BLADE TO BE SCRAPPED BY THE REPAIR STATION.

- (1) Repair of a bent blade or blades is considered a major repair. This type of repair must be accomplished by an appropriately licensed propeller repair station, and only within approved guidelines.

#### 4. Painting After Repair

**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.

- A. Propeller blades are painted with a durable specialized coating that is resistant to abrasion. If this coating becomes eroded, it is necessary to repaint the blades to provide proper corrosion and erosion protection. Painting should be performed by an appropriately licensed propeller repair station in accordance with Hartzell Propeller Inc. Standard Practices Manual 202A (61-01-02).

- B. It is permissible to perform a blade touch-up with aerosol paint in accordance with the procedures in Painting of Aluminum Blades, below.
- C. The following paints (Table 6-1) are approved for blade touch-up:

Vendor	Color/Type	Vendor P/N	Hartzell Propeller Inc. P/N
Tempo	Epoxy Black	A-150	n/a
Tempo	Epoxy Gray	A-151	n/a
Tempo	Epoxy White (tip stripe)	A-152	n/a
Tempo	Epoxy Red (tip stripe)	A-153	n/a
Tempo	Epoxy Yellow (tip stripe)	A-154	n/a
Sherwin-Williams	Black	F75KXB9958-4311	A-6741-145-1
Sherwin-Williams	Gray	F75KXA10445-4311	A-6741-146-1
Sherwin-Williams	White (tip stripe)	F75KXW10309-4311	A-6741-147-1
Sherwin-Williams	Red (tip stripe)	F75KXR12320-4311	A-6741-149-1
Sherwin-Williams	Yellow (tip stripe)	F75KXY11841-4311	A-6741-150-1
Sherwin-Williams	Silver	F75KXS13564-4311	A-6741-190-1

**Approved Paints**  
**Table 6-1**

- D. The paint manufacturers may be contacted as listed below:

**Tempo Products Co.**

A plasti-kote Company  
1000 Lake Road  
Medina, OH 44256  
Tel: 800.321.6300  
Fax: 216.349.4241  
Cage Code: 07708

**Sherwin Williams Co.**

2390 Arbor Boulevard  
Dayton, Ohio  
Tel: 937.298.8691  
Fax: 937.298.3820  
Cage Code: 0W199



**E. Painting of Aluminum Blades**

**WARNING:** CLEANING AGENTS (ACETONE, #700 LACQUER THINNER, AND MEK), ARE FLAMMABLE AND TOXIC TO THE SKIN, EYES AND RESPIRATORY TRACT. SKIN AND EYE PROTECTION ARE REQUIRED. AVOID PROLONGED CONTACT. USE IN WELL VENTILATED AREA.

**CAUTION:** ANY REFINISHING PROCEDURE CAN ALTER PROPELLER BALANCE. PROPELLERS THAT ARE OUT OF BALANCE MAY EXPERIENCE EXCESSIVE VIBRATIONS WHILE IN OPERATION.

- (1) Using acetone, #700 lacquer thinner, or MEK, wipe the surface of the blade to remove any contaminants.
- (2) Feather the existing coatings away from the eroded or repaired area with 120 to 180 grit sandpaper.

**NOTE:** Paint erosion is typically very similar on all blades in a propeller assembly. If one blade has more extensive damage, e.g., in the tip area, all the blades should be sanded in the tip area to replicate the repair of the most severely damaged blade tip. This practice is essential in maintaining balance after refinishing.

- (3) Use acetone, #700 lacquer thinner, or MEK to wipe the surface of the blade. Allow solvent to evaporate.
- (4) Before refinishing the blades, apply a corrosion preventive coating to the bare aluminum surface. Oakite 31, Chromicote L-25, or Alodine 1201 are approved chemical conversion coatings. Apply these coatings in accordance with the directions provided by the product manufacturer.
- (5) Mask the tip stripes, as applicable.

WARNING: FINISH COATINGS ARE FLAMMABLE AND TOXIC TO THE SKIN. EYES AND RESPIRATORY TRACT. SKIN AND EYE PROTECTION ARE REQUIRED. AVOID PROLONGED CONTACT. USE IN WELL VENTILATED AREA.

CAUTION: APPLY FINISH COATING ONLY TO THE DEGREE REQUIRED TO UNIFORMLY COVER THE REPAIR/EROSION. AVOID EXCESSIVE PAINT BUILDUP ALONG THE TRAILING EDGE TO AVOID CHANGING BLADE PROFILE.

- (6) Apply sufficient finish coating to achieve 2 to 4 mils thickness when dry. Re-coat before 30 minutes, or after 48 hours. If the paint is allowed to dry longer than four (4) hours, it must be lightly sanded before another coat is applied.
- (7) Remove the masking from the tip stripes and re-mask to allow for the tip stripe refinishing, if required.
- (8) Apply sufficient tip stripe coating to achieve 2 to 4 mils thickness when dry. Re-coat before 30 minutes, or after 48 hours. If the paint is allowed to dry longer than four (4) hours, it must be lightly sanded before another coat is applied.
- (9) Remove the masking immediately from the de-ice boot and tip stripes, if required.
- (10) Optionally, perform dynamic balancing in accordance with the procedures and limitations specified in Dynamic Balance section of this chapter.

**5. Dynamic Balance**

**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.

**A. Overview**

**WARNING:** WHEN USING REFLECTIVE TAPE FOR DYNAMIC BALANCING, DO NOT APPLY THE TAPE ON EXPOSED BARE METAL OF A BLADE. THIS WILL ALLOW MOISTURE TO COLLECT UNDER THE TAPE AND CAUSE CORROSION THAT CAN PERMANENTLY DAMAGE THE BLADE. REFLECTIVE TAPE MUST BE REMOVED AFTER DYNAMIC BALANCING IS COMPLETED.

**NOTE:** Dynamic balance is recommended to reduce vibrations that may be caused by a rotating system (propeller and engine) imbalance. Dynamic balancing can help prolong the life of the propeller, engine, airframe, and avionics.

- (1) Dynamic balance is accomplished by using an accurate means of measuring the amount and location of the dynamic imbalance.
- (2) The number of balance weights installed must not exceed the limits specified in this chapter.
- (3) Follow the dynamic balance equipment manufacturer's instructions for dynamic balance in addition to the specifications of this section.

**NOTE:** Hartzell Propeller Inc. Standard Practices Manual 202A (61-01-02), Chapter 600, also contains information on weight placement and balancing.

**B. Inspection Procedures Before Balancing**

- (1) Visually inspect the propeller assembly before dynamic balancing.

**NOTE:** The first run-up of a new or overhauled propeller assembly may leave a small amount of grease on the blades.

- (a) Use Stoddard solvent (or equivalent) to completely remove any grease on the blades or inner surface of the spinner dome.
- (b) Visually check each propeller blade assembly for evidence of grease leakage.
- (c) Visually inspect the inner surface of the spinner dome for evidence of grease leakage.
- (2) If there is no evidence of grease leakage, lubricate the propeller in accordance with the Maintenance Practices chapter in this manual. If grease leakage is evident, determine the location of the leak and correct before relubricating the propeller and dynamic balancing.
- (3) Before dynamic balance record the number and location of all balance weights.
- (4) Static balance is required when an overhaul or major repair is performed at a propeller overhaul facility.

**NOTE:** If static balancing is not accomplished before dynamic balancing, the propeller may be so severely unbalanced that dynamic balance may not be achievable due to limitations of measurement equipment.



**Dynamic Balance Label  
Figure 6-5**

**C. Placement of Balance Weights for Dynamic Balance**

The preferred method of attachment of dynamic balance weights is to add the weights to the spinner bulkhead; however, some propeller models covered in this manual do not have a spinner. Dynamic balance must then be accomplished through the removal or addition and/or the relocation of the static balance weights located on the blade clamps.

**NOTE:** Chadwick-Helmuth Manual AW-9511-2, "The Smooth Propeller", specifies several generic bulkhead rework procedures. These are acceptable, providing they comply with the conditions specified herein.

- (1) Each blade clamp has four balance weight locations on the outboard circular surface of the clamp (Figure 6-5).
- (2) The maximum number of balance weights per location is four (4).

**CAUTION 1:** BEFORE DYNAMIC BALANCE, RECORD THE NUMBER AND LOCATION OF ALL STATIC BALANCE WEIGHTS.

**CAUTION 2:** USE ONLY STEEL BALANCE WEIGHTS A-48.

**CAUTION 3:** DO NOT EXCEED THE MAXIMUM NUMBER OF BALANCE WEIGHTS PER LOCATION.

- (3) Alter the number and/or location of static balance weights as necessary to achieve dynamic balance.
- (4) Install weights using aircraft quality #10-32 or AN-3( ) type screws or bolts.
- (5) When dynamic balancing is accomplished, it is recommended that Warning Decal Part No. A-2803 (Figure 6-5) be installed on the propeller.

**NOTE:** This will alert repair station personnel that the existing balance weight configuration may not be correct for static balance.

- (6) Record the number and location of dynamic balance weights and static balance weights, if they have been reconfigured, in the logbook.

**6. Maximum RPM Check (On Ground)**

**WARNING 1:** RPM ADJUSTMENTS MUST BE MADE WITH REFERENCE TO A CALIBRATED TACHOMETER. AIRCRAFT MECHANICAL TACHOMETERS DEVELOP ERRORS OVER TIME AND SHOULD BE PERIODICALLY RECALIBRATED TO MAKE SURE THE PROPER RPM IS DISPLAYED.

**WARNING 2:** LOW PITCH BLADE ANGLE ADJUSTMENTS MUST BE MADE IN CONSULTATION WITH THE APPLICABLE TYPE CERTIFICATE HOLDER'S APPROVED MAINTENANCE DATA.

**WARNING 3:** SIGNIFICANT ADJUSTMENT OF THE LOW PITCH STOP TO ACHIEVE THE SPECIFIED STATIC RPM MAY MASK AN ENGINE POWER PROBLEM.

- A. The propeller low pitch stop is set to the aircraft TC or STC holder's requirements. The TC or STC holder provides the required low pitch stop blade angle and may also provide the acceptable RPM range for a maximum power static condition. Be aware that the aircraft TC or STC holder may specify the static RPM to be less than the RPM to which the engine is rated.
- B. An overspeed at the maximum power static condition indicates that the propeller low-pitch blade angle is set too low or that the governor is improperly adjusted.
- C. An underspeed during the maximum power static condition may be caused by any one or a combination of the following:
  - (1) The propeller low pitch blade angle is too high
  - (2) The governor is improperly adjusted
  - (3) The engine is not producing rated power

NOTE: None of the propellers covered in this manual use anti-ice or de-ice systems.

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3. Propeller Logbook

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**1. Introduction**

Federal Aviation Regulations require that a record be kept of any repairs, adjustments, maintenance, or required inspections performed on a propeller or propeller system.

This chapter provides a method for maintaining these records. It also provides a location for recording information which can aid the service technician in maintaining the propeller system.

**2. Record Keeping****A. Information to be Recorded**

- (1) Information which is required to be recorded is listed in Part 43 of the U.S. Federal Aviation Regulations.
- (2) The log book may also be used to record:
  - (a) Propeller position (on aircraft), if applicable
  - (b) Propeller model.
  - (c) Propeller serial number
  - (d) Blade design number
  - (e) Blade serial numbers
  - (f) Spinner assembly part number, if applicable
  - (g) Propeller pitch range
  - (h) Aircraft information (aircraft type, model, serial number and registration number).

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