

Manual No. 140  
61-00-40  
Revision 6  
August 2024



# 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 LLC**

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**COVER 61-00-40** Inside Cover  
Rev. 6 Aug/24

Fellow aviation enthusiasts, 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.



JJ Frigge  
President, Hartzell Propeller LLC

# WARNING (Rev. 5)

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.

**I** Hartzell Propeller LLC 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.

Inspect the propeller/blades in accordance with the applicable operation/maintenance documents.

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REVISION 6 HIGHLIGHTS

Revision 6, dated August 2024, incorporates the following:

Front matter (Cover, Revision Highlights, etc.), has been revised to match this revision.

Removed references to "Hartzell Propeller Inc.". Revised to "Hartzell Propeller LLC", where applicable.

Revised tool part numbers to match Hartzell Propeller part numbers.

Minor language/format changes and renumbering are marked with a revision bar but not listed in this section.

- INTRODUCTION

- Revised the section, "Reference Publications"
- Revised the section, "Personnel Requirements"

- INSTALLATION AND REMOVAL

- Revised the section, "Installing the HC-D2(MV,V)20-7( ) Propeller Assembly"
- Revised the section, "Installing the HC-D(2,3)(MV,V)20-8( ) Propeller Assemblies"

- TESTING AND TROUBLESHOOTING

- Revised the section, "Vibration"

- INSPECTION AND CHECK

- Revised the section, "Pre-Flight Checks"
- Revised the section, "Operational Checks"
- Revised the section, "Inspection Procedures"
- Revised Figure 5-3, "Blade Play"
- Revised the section, "Special Inspections"

- MAINTENANCE PRACTICES

- Revised the section, "Aluminum Blades"
- Revised Figure 6-5, "Repair Limitations"

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REVISION 6 HIGHLIGHTS1. Introduction

## A. General

- (1) This is a list of current revisions that have been issued against this manual. Please compare it to the RECORD OF REVISIONS page to make sure 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.

# HARTZELL PROPELLER OWNER'S MANUAL

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| <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  |
| Revision 4          | Mar/21            | Major Revision  |
| Revision 5          | Apr/23            | Major Revision  |
| Revision 6          | Aug/24            | Minor Revision  |

**RECORD OF REVISIONS**

This is a record of revisions inserted into this manual.  
Revision 5 includes all prior revisions.

| <b>Revision Number</b> | <b>Issue Date</b> | <b>Date Inserted</b> | <b>Inserted By</b> |
|------------------------|-------------------|----------------------|--------------------|
| 5                      | Apr/23            | Apr/23               | HPI                |
| 6                      | Aug/24            | Aug/24               | Hartzell           |
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### RECORD OF TEMPORARY REVISIONS

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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 A SERVICE DOCUMENT. INFORMATION CONTAINED IN A SERVICE DOCUMENT MAY BE SIGNIFICANTLY CHANGED FROM EARLIER REVISIONS. FAILURE TO COMPLY WITH INFORMATION CONTAINED IN A SERVICE DOCUMENT OR THE USE OF OBSOLETE INFORMATION MAY CREATE AN UNSAFE CONDITION THAT MAY RESULT IN DEATH, SERIOUS BODILY INJURY, AND/OR SUBSTANTIAL PROPERTY DAMAGE.

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         |
| HC-SL-61-185            | Rev. 4, Mar/21         |
| HC-SL-61-364            | Rev. 4, Mar/21         |
| HC-SL-61-366            | Rev. 4, Mar/21         |

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

| Rev.<br>No. | Description of Revision                                    |
|-------------|------------------------------------------------------------|
| 1           | Relocated Airworthiness Limitations pages from Manual 100E |
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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 D. Dwyer date: 5/19/11

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

LIST OF EFFECTIVE PAGES

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|-------------------------------|--------------------|----------|--------|
| Cover/Inside Cover            | Cover/Inside Cover | Rev. 6   | Aug/24 |
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| Revision Highlights           | 1 thru 4           | Rev. 6   | Aug/24 |
| Record of Revisions           | 1 and 2            | Rev. 5   | Apr/23 |
| Record of Temporary Revisions | 1 and 2            | Rev. 5   | Apr/23 |
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| Installation and Removal      | 3-1                | Rev. 6   | Aug/24 |
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| Inspection and Check        | 5-1 thru 5-5   | Rev. 6   | Aug/24 |
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| Inspection and Check        | 5-8 thru 5-18  | Rev. 6   | Aug/24 |
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| Inspection and Check        | 5-20 and 5-21  | Rev. 6   | Aug/24 |
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1. General (Rev. 2)

## A. Statement of Purpose

- (1) This manual has been reviewed and accepted by the FAA. Additionally, the Airworthiness Limitations section of this manual has been approved by the FAA.

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

- (2) The information in this manual can be used by qualified personnel to install, operate, and maintain the applicable Hartzell propeller assemblies.
- (a) Additional manuals are available that include overhaul procedures and specifications for the propeller.
- (3) This manual may include multiple design types.
- (a) Parentheses shown in the propeller model designations in this or other Hartzell Propeller 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.
- 1 Refer to the Description and Operation chapter of this manual for propeller and blade model designation information.
- (4) Where possible, this manual is written in the format specified by ATA iSpec 2200.

## B. Maintenance Practices

- (1) The propeller and its components are highly vulnerable to damage while 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 blade paddles must be used, use at least two paddles. Do not put the blade paddle in the area of the de-ice or anti-icing boot when applying torque to a blade assembly. Put the blade paddle in the thickest area of the blade, just outside of the de-ice or anti-icing boot. 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) Propellers must be statically balanced before installing on the engine.
  - (a) Hartzell Propeller statically balances all new propellers.
  - (b) Overhauled propellers must be statically balanced by a certified propeller repair station with the appropriate rating before return to service.
- (7) Dynamic balance is recommended, but may be accomplished at the discretion of the operator, unless specifically required by the airframe or engine manufacturer.
  - (a) Perform dynamic balancing in accordance with the Maintenance Practices chapter of this manual.
  - (b) Additional procedures may be found in the aircraft maintenance manual.
- (8) As necessary, use a soft, non-graphite pencil or crayon to make identifying marks on components.
- (9) As applicable, follow military standard NASM33540 for safety wire, safety cable, and cotter pin general practices. Use 0.032 inch (0.81 mm) diameter stainless steel safety wire unless otherwise indicated.

- (10)The information in this manual revision supersedes data in all previously published revisions of this manual.
- (11)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.
- (12)If the propeller is equipped with an ice protection system that uses components supplied by Hartzell Propeller, applicable instructions and technical information for the components can be found in Hartzell Propeller Ice Protection System Manual 180 (30-61-80).
- (13)Propeller ice protection system components not supplied by Hartzell Propeller are controlled by the applicable TC or STC holder's Instructions for Continued Airworthiness (ICA).
- (14)Approved corrosion protection followed by approved paint must be applied to all aluminum blades.
  - (a) For information about the application of corrosion protection and paint, refer to the Maintenance Practices chapter of this manual. Operation of blades without the specified coatings and finishes, i.e., "polished blades", is not permitted.

## 2. Airframe or Engine Modifications (Rev. 2)

### A. Propeller Stress Levels

- (1) Propellers are approved vibrationwise on airframe and engine combinations based on tests or analysis of similar installations. This data has demonstrated that propeller stress levels are affected by airframe configuration, airspeed, weight, power, engine configuration, and approved flight maneuvers. Aircraft modifications that can affect propeller stress include, but are not limited to: aerodynamic changes ahead of or behind the propeller, realignment of the thrust axis, increasing or decreasing airspeed limits, increasing or decreasing weight limits (less significant on piston engines), and the addition of approved flight maneuvers (utility and aerobatic).

### B. Engine Modifications

- (1) Engine modifications can affect the propeller. The two primary categories of engine modifications are those that affect structure and those that affect power. An example of a structural engine modification is the alteration of the crankshaft or damper of a piston engine. Any change to the weight, stiffness, or tuning of rotating components could result in a potentially dangerous resonant condition that is not detectable by the pilot. Most common engine modifications affect the power during some phase of operation. Some modifications increase the maximum power output, while others improve the power available during hot and high operation (flat rating) or at off-peak conditions.
  - (a) Examples of turbine engine modifications include, but are not limited to: changes to the compressor, power turbine or hot section of a turboprop engine.
  - (b) Examples of reciprocating engine modifications include, but are not limited to: the addition or alteration of a turbocharger or turbonormalizer, increased compression ratio, increased RPM, altered ignition timing, electronic ignition, full authority digital electronic controls (FADEC), or tuned induction or exhaust.
- (2) All such modifications must be reviewed and approved by the propeller manufacturer prior to obtaining approval on the aircraft.

3. Restrictions and Placards (Rev. 1)

## A. Important Information

- (1) The propellers covered by this manual may have a restricted operating range that requires a cockpit placard.
  - (a) The restrictions, if present, will vary depending on the propeller, blade, engine, and/or aircraft model.
  - (b) Review the propeller and aircraft type certificate data sheet (TCDS), Pilot Operating Handbook (POH), and any applicable Airworthiness Directives for specific information.

4. Reference Publications

## A. Hartzell Propeller Publications

- (1) Information published in Service Bulletins, Service Letters, Service Advisories, and Service Instructions may supersede information published in this manual. The reader must consult active Service Bulletins, Service Letters, Service Advisories, and Service Instructions for information that may have not yet been incorporated into the latest revision of this manual.
- (2) Some manuals are available on the Hartzell Propeller website at [www.hartzellprop.com](http://www.hartzellprop.com). The complete Hartzell Propeller Technical Library is available by subscription.
- (3) In addition to this manual, one or more of the following publications are required for information regarding specific recommendations and procedures to maintain propeller assemblies that are included in this manual.

**HARTZELL PROPELLER OWNER'S MANUAL**  
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| <b>Manual No.<br/>(ATA No.)</b> | <b>Hartzell Propeller LLC Manual Title</b>                                                                           |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------|
| n/a                             | Active Hartzell Propeller LLC<br>Service Bulletins, Service Letters, Service<br>Instructions, and Service Advisories |
| Manual 100E<br>(61-10-00)       | Hydro-Selective Propeller Overhaul Manual                                                                            |
| Manual 127<br>(61-16-27)        | Metal Spinner Maintenance Manual                                                                                     |
| Manual 130B<br>(61-23-30)       | Mechanically Actuated Governors and Accessories<br>Overhaul Manual                                                   |
| Manual 133C<br>(61-13-33)       | Aluminum Blade Overhaul Manual                                                                                       |
| Manual 159<br>(61-02-59)        | Application Guide                                                                                                    |
| Manual 165A<br>(61-00-65)       | Illustrated Tool and Equipment Manual                                                                                |
| Manual 180<br>(30-61-80)        | Ice Protection System Manual                                                                                         |
| Manual 202A<br>(61-01-02)       | Standard Practices Manual,<br>Volumes 1 through 11                                                                   |

B. Vendor Publications  
None.

**5. Personnel Requirements** (Rev. 3)**A. Service and Maintenance Procedures in this Manual**

- (1) Personnel performing the service and maintenance procedures in this manual are expected to have the required equipment/tooling, training, and certifications (when required by the applicable Aviation Authority) to accomplish the work in a safe and airworthy manner.
- (2) Compliance to the applicable regulatory requirements established by the Federal Aviation Administration (FAA) or international equivalent is mandatory for anyone performing or accepting responsibility for the inspection and/or repair of any Hartzell Propeller LLC product.
  - (a) Maintenance records must be kept in accordance with the requirements established by the Federal Aviation Administration (FAA) or international equivalent.
  - (b) Refer to Title 14 Code of Federal Regulations (CFR) Part 43 for additional information about general aviation maintenance requirements.

**6. Special Tooling and Consumable Materials** (Rev. 2)**A. Special Tooling**

(1) Special tooling may be required for procedures in this manual. For further tooling information, refer to Hartzell Propeller Illustrated Tool and Equipment Manual 165A (61-00-65).

(a) Tooling reference numbers appear with the prefix "TE" directly following the tool name to which they apply. For example, a template that is reference number 133 will appear as: template TE133.

**B. Consumable Materials**

(1) Consumable materials are referenced in certain sections throughout this manual. Specific approved materials are listed in the Consumable Materials chapter of Hartzell Propeller Standard Practices Manual 202A (61-01-02).

(a) Consumable material reference numbers appear with the prefix "CM" directly following the material to which they apply. For example, an adhesive that is reference number 16 will appear as: adhesive CM16. Only the material(s) specified can be used.

**7. Safe Handling of Paints and Chemicals** (Rev.1)**A. Instructions for Use**

(1) Always use caution when handling or being exposed to paints and/or chemicals during propeller overhaul and/or maintenance procedures.

(2) Before using paint or chemicals, always read the manufacturer's label on the container(s) and follow specified instructions and procedures for storage, preparation, mixing, and/or application.

(3) Refer to the product's Material Safety Data Sheet (MSDS) for detailed information about the physical properties, health, and physical hazards of any paint or chemical.

**8. Calendar Limits and Long Term Storage** (Rev. 3)**A. Calendar Limits**

- (1) The effects of exposure to the environment over a period of time create a need for propeller overhaul regardless of flight time.
- (2) A calendar limit between overhauls is specified in Hartzell Propeller Service Letter HC-SL-61-61Y.
- (3) Experience has shown that special care, such as keeping an aircraft in a hangar, is not sufficient to permit extension of the calendar limit.
- (4) The start date for the calendar limit is when the propeller is first installed on an engine.
- (5) The calendar limit is not interrupted by subsequent removal and/or storage.
- (6) The start date for the calendar limit must not be confused with the warranty start date, that is with certain exceptions, the date of installation by the first retail customer.

**B. Long Term Storage**

- (1) Propellers that have been in storage have additional inspection requirements before installation. Refer to the Packaging and Storage chapter of Hartzell Propeller Standard Practices Manual 202A (61-01-02).

**9. Component Life and Overhaul** (Rev. 3)

**WARNING:** CERTAIN PROPELLER COMPONENTS USED IN NON-AVIATION APPLICATIONS ARE MARKED WITH DIFFERENT PART NUMBERS TO DISTINGUISH THEM FROM COMPONENTS USED IN AVIATION APPLICATIONS. DO NOT ALTER THE PART NUMBERS SHOWN ON PARTS DESIGNATED FOR NON-AVIATION APPLICATIONS OR OTHERWISE APPLY THOSE PARTS FOR USE ON AVIATION APPLICATIONS.

**A. Component Life**

- (1) Component life is expressed in terms of hours of service (Time Since New, TSN) and in terms of hours of service since overhaul (Time Since Overhaul, TSO).

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

- (2) Time Since New (TSN) and Time Since Overhaul (TSO) records for the propeller hub and blades must be maintained in the propeller logbook.
- (3) Both TSN and TSO are necessary for defining the life of the component. Certain components, or in some cases an entire propeller, may be "life limited", which means that they must be replaced after a specified period of use (TSN).
- (a) It is a regulatory requirement that a record of the Time Since New (TSN) be maintained for all life limited parts.
- (b) Refer to the Airworthiness Limitations chapter in the applicable Hartzell Propeller Owner's Manual for a list of life limited components.
- (4) When a component or assembly undergoes an overhaul, the TSO is returned to zero hours.
- (a) Time Since New (TSN) can never be returned to zero.
- (b) Repair without overhaul does not affect TSO or TSN.

- (5) Blades and hubs are sometimes replaced while in service or at overhaul.
- (a) Maintaining separate TSN and TSO histories for a replacement hub or blade is required.
- (b) Hub replacement
- 1 If the hub is replaced, the replacement hub serial number must be recorded (the entry signed and dated) in the propeller logbook.
  - 2 The propeller will be identified with the serial number of the replacement hub.  
NOTE: Propeller assembly serial numbers are impression stamped on the hub. For stamping information, refer to the Parts Identification and Marking chapter of Hartzell Propeller Standard Practices Manual 202A (61-01-02).
  - 3 The TSN and TSO of the replacement hub must be recorded and maintained in the propeller logbook.
  - 4 If tracking any component(s) other than the hub/blades, maintain these TSN/TSO records separately in the propeller logbook.  
NOTE: Hub replacement does not affect the TSN/TSO of any other propeller components.

## B. Overhaul

- (1) Overhaul is the periodic disassembly, cleaning, inspecting, repairing as necessary, reassembling, and testing in accordance with approved standards and technical data approved by Hartzell Propeller LLC.
- (2) The overhaul interval is based on hours of service, i.e., flight time, or on calendar time.
  - (a) Overhaul intervals are specified in Hartzell Propeller Service Letter HC-SL-61-61Y.
  - (b) At such specified periods, the propeller hub assembly and the blade assemblies must be completely disassembled and inspected for cracks, wear, corrosion, and other unusual or abnormal conditions.
- (3) Overhaul must be completed in accordance with the latest revision of the applicable component maintenance manual and other publications applicable to, or referenced in, the component maintenance manual.
  - (a) Parts that are not replaced at overhaul must be inspected in accordance with the check criteria in the applicable Hartzell Propeller component maintenance manual.
  - (b) Parts that must be replaced at overhaul are identified by a "Y" in the O/H column of the Illustrated Parts List in the applicable Hartzell Propeller component maintenance manual.
- (4) The information in this manual supersedes data in all previously published revisions of this manual.

**10. Damage/Repair Types** (Rev. 2)**A. Airworthy/Unairworthy Damage**

- (1) Airworthy damage is a specific condition to a propeller component that is within the airworthy damage limits specified in the applicable Hartzell Propeller component maintenance manual.
  - (a) Airworthy damage does not affect the safety or flight characteristics of the propeller and conforms to its type design.
  - (b) Airworthy damage does not require repair before further flight, but should be repaired as soon as possible to prevent degradation of the damage.
- (2) Unairworthy damage is a specific condition to a propeller component that exceeds the airworthy damage limits specified in the applicable Hartzell Propeller component maintenance manual.
  - (a) Unairworthy damage can affect the safety or flight characteristics of the propeller and does not conform to its type design.
  - (b) Unairworthy damage must be repaired before the propeller is returned to service.

B. Minor/Major Repair

(1) Minor Repair

- (a) Minor repair is that which may be done safely in the field by a certified aircraft mechanic.

- 1 For serviceable limits and repair criteria for Hartzell propeller components, refer to the applicable Hartzell Propeller component maintenance manual.

(2) Major Repair

- (a) Major repair cannot be done by elementary operations.

- (b) Major repair work must be accepted by an individual that is certified by the Federal Aviation Administration (FAA) or international equivalent.

- 1 Hartzell recommends that individuals performing major repairs also have a Factory Training Certificate from Hartzell Propeller LLC.

- 2 The repair station must meet facility, tooling, and personnel requirements and is required to participate in Hartzell Propeller Sample Programs as defined in the Approved Facilities chapter of Hartzell Propeller Standard Practices Manual 202A (61-01-02).

## 11. Propeller Critical Parts (Rev. 2)

### A. Propeller Critical Parts

- (1) Procedures in this manual may involve Propeller Critical Parts (PCP).
  - (a) 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 Instructions for Continued Airworthiness (ICA) for this product.
  - (b) Refer to the Illustrated Parts List chapter in the applicable Hartzell Propeller maintenance manual to identify the Propeller Critical Parts.
- (2) Numerous propeller system parts can produce a propeller Major or Hazardous effect, even though those parts may not be considered as Propeller Critical Parts.
  - (a) 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.

## 12. Warranty Service (Rev. 2)

### A. Warranty Claims

- (1) If you believe you have a warranty claim, contact the Hartzell Propeller Product Support Department to request a *Warranty Application* form. Complete this form and return it to Hartzell Propeller Product Support for evaluation **before proceeding with repair or inspection work**. Upon receipt of this form, the Product Support Department will provide instructions on how to proceed.
  - (a) For Hartzell Propeller Product Support Department contact information, refer to the "Hartzell Propeller Contact Information" section in this chapter.

**13. Hartzell Propeller Contact Information** (Rev. 3)**A. Product Support Department**

- (1) Contact the Hartzell Propeller Product Support Department of Hartzell Propeller about any maintenance problems or to request information not included in this publication.

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

- (a) The Product Support Department 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.
- (b) The Product Support Department can also be reached by fax at (937) 778-4215, and by e-mail at [techsupport@hartzellprop.com](mailto:techsupport@hartzellprop.com).
- (c) 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.
- 1 A technical representative will contact you during normal business hours.
- 2 Urgent AOG support is also available 24 hours per day, seven days per week via this message service.
- (d) Additional information is available on the Hartzell Propeller website at [www.hartzellprop.com](http://www.hartzellprop.com).

**B. Technical Publications Department**

- (1) For Hartzell Propeller service literature and revisions, contact:

Hartzell Propeller LLC

Telephone: 937.778.4200

Attn: Technical Publications Department

Fax: 937.778.4215

One Propeller Place

E-mail: [manuals@hartzellprop.com](mailto:manuals@hartzellprop.com)

Piqua, Ohio 45356-2634 U.S.A.

**C. Recommended Facilities**

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

#### 14. Definitions (Rev. 5)

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

| <b>Term</b>           | <b>Definition</b>                                                                                                                                                                                                                                                                                   |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Annealed              | Softening of material due to overexposure to heat                                                                                                                                                                                                                                                   |
| Aviation Certified    | Intended for FAA or international equivalent type certificated aircraft applications. A TC and PC number must be stamped on the hub, and a PC number must be stamped on blades.                                                                                                                     |
| Aviation Experimental | Intended for aircraft/propeller applications not certified by the FAA or international equivalent. Products marked with an "X" at or near the end of the model number or part number are not certified by the FAA or international equivalent and are not intended to use on certificated aircraft. |
| Beta Operation        | A mode of pitch control that is directed by the pilot rather than by the propeller governor                                                                                                                                                                                                         |
| Beta Range            | Blade angles between low pitch and maximum reverse blade angle                                                                                                                                                                                                                                      |
| Beta System           | Parts and/or equipment related to operation (manual control) of propeller blade angle between low pitch blade angle and full reverse blade angle                                                                                                                                                    |
| Blade Angle           | Measurement of blade airfoil location described as the angle between the blade airfoil and the surface described by propeller rotation                                                                                                                                                              |

| Term             | Definition                                                                                                                                                                                                                                                                                                                                                               |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Blade Centerline | An imaginary reference line through the length of a blade around which the blade rotates                                                                                                                                                                                                                                                                                 |
| Blade Station    | <p>Refers to a location on an individual blade for blade inspection purposes. It is a measurement from the blade “zero” station to a location on a blade, used to apply blade specification data in blade overhaul manuals.</p> <p><u>Note:</u> Do not confuse <i>blade station</i> with <i>reference blade radius</i>; they may not originate at the same location.</p> |
| Blemish          | An imperfection with visible attributes, but having no impact on safety or utility                                                                                                                                                                                                                                                                                       |
| Brinelling       | A depression caused by failure of the material in compression                                                                                                                                                                                                                                                                                                            |
| Bulge            | An outward curve or bend                                                                                                                                                                                                                                                                                                                                                 |
| Camber           | The surface of the blade that is directed toward the front of the aircraft. It is the low pressure, or suction, side of the blade. The camber side is convex in shape over the entire length of the blade.                                                                                                                                                               |
| Chord            | A straight line distance between the leading and trailing edges of an airfoil                                                                                                                                                                                                                                                                                            |
| Chordwise        | A direction that is generally from the leading edge to the trailing edge of an airfoil                                                                                                                                                                                                                                                                                   |
| Co-bonded        | The act of bonding a composite laminate and simultaneously curing it to some other prepared surface                                                                                                                                                                                                                                                                      |

| Term                 | Definition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Composite Material   | Kevlar®, carbon, or fiberglass fibers bound together with, or encapsulated within an epoxy resin                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Compression Rolling  | A process that provides improved strength and resistance to fatigue                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Constant Force       | A force that is always present in some degree when the propeller is operating                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Constant Speed       | A propeller system that employs a governing device to maintain a selected engine RPM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Corrosion (Aluminum) | The chemical or electrochemical attack by an acid or alkaline that reacts with the protective oxide layer and results in damage of the base aluminum. Part failure can occur from corrosion due to loss of structural aluminum converted to corrosion product, pitting, a rough etched surface finish, and other strength reduction damage caused by corrosion.                                                                                                                                                                                                                                                                     |
| Corrosion (Steel)    | Typically, an electrochemical process that requires the simultaneous presence of iron (component of steel), moisture and oxygen. The iron is the reducing agent (gives up electrons) while the oxygen is the oxidizing agent (gains electrons). Iron or an iron alloy such as steel is oxidized in the presence of moisture and oxygen to produce rust. Corrosion is accelerated in the presence of salty water or acid rain. Part failure can occur from corrosion due to loss of structural steel converted to corrosion product, pitting, a rough etched surface finish and other strength reduction damage caused by corrosion. |

| Term                         | Definition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Corrosion Product (Aluminum) | A white or dull gray powdery material that has an increased volume appearance (compared to non-corroded aluminum). Corrosion product is not to be confused with damage left in the base aluminum such as pits, worm holes, and etched surface finish.                                                                                                                                                                                                                                                                                     |
| Corrosion Product (Steel)    | When iron or an iron alloy such as steel corrodes, a corrosion product known as rust is formed. Rust is an iron oxide which is reddish in appearance and occupies approximately six times the volume of the original material. Rust is flakey and crumbly and has no structural integrity. Rust is permeable to air and water, therefore the interior metallic iron (steel) beneath a rust layer continues to corrode. Corrosion product is not to be confused with damage left in the base steel such as pits and etched surface finish. |
| Crack                        | Irregularly shaped separation within a material, sometimes visible as a narrow opening at the surface                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Debond                       | Separation of two materials that were originally bonded together in a separate operation                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Defect                       | An imperfection that affects safety or utility                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Delamination                 | Internal separation of the layers of composite material                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Dent                         | The permanent deflection of the cross section that is visible on both sides with no visible change in cross sectional thickness                                                                                                                                                                                                                                                                                                                                                                                                           |

| Term           | Definition                                                                                                                                                                                                                                                                                                  |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Depression     | Surface area where the material has been compressed but not removed                                                                                                                                                                                                                                         |
| Distortion     | Alteration of the original shape or size of a component                                                                                                                                                                                                                                                     |
| Edge Alignment | Distance from the blade centerline to the leading edge of the blade                                                                                                                                                                                                                                         |
| Erosion        | Gradual wearing away or deterioration due to action of the elements                                                                                                                                                                                                                                         |
| Exposure       | Leaving material open to action of the elements                                                                                                                                                                                                                                                             |
| Face           | The surface of the blade that is directed toward the rear of the aircraft. The face side is the high pressure, or thrusting, side of the blade. The blade airfoil sections are normally cambered or curved such that the face side of the blade may be flat or even concave in the midblade and tip region. |
| Face Alignment | Distance from the blade centerline to the highest point on the face side perpendicular to the chord line                                                                                                                                                                                                    |
| Feathering     | The capability of blades to be rotated parallel to the relative wind, thus reducing aerodynamic drag                                                                                                                                                                                                        |
| Fraying        | A raveling or shredding of material                                                                                                                                                                                                                                                                         |
| Fretting       | Damage that develops when relative motion of small displacement takes place between contacting parts, wearing away the surface                                                                                                                                                                              |
| Galling        | To fret or wear away by friction                                                                                                                                                                                                                                                                            |

| <b>Term</b>                | <b>Definition</b>                                                                                                                |
|----------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| Gouge                      | Surface area where material has been removed                                                                                     |
| Hazardous Propeller 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 |
| Inboard                    | Toward the butt of the blade                                                                                                     |
| Intergranular Corrosion    | Corrosion that attacks along the grain boundaries of metal alloys                                                                |
| Jog                        | A term used to describe movement up/down, left/right, or on/off in short incremental motions                                     |
| Laminate                   | To unite composite material by using a bonding material, usually with pressure and heat                                          |
| Lengthwise                 | A direction that is generally parallel to the pitch axis                                                                         |
| Loose Material             | Material that is no longer fixed or fully attached                                                                               |
| Low Pitch                  | The lowest blade angle attainable by the governor for constant speed operation                                                   |
| Major Propeller Effect     | The major propeller effects are defined in Title 14 CFR section 35.15(g)(2)                                                      |
| Minor Deformation          | Deformed material not associated with a crack or missing material                                                                |

| Term                      | Definition                                                                                                                                                                                                                                                                            |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Monocoque                 | A type of construction in which the outer skin carries all or a major part of the load                                                                                                                                                                                                |
| Nick                      | Removal of paint and possibly a small amount of material                                                                                                                                                                                                                              |
| Non-Aviation Certified    | Intended for non-aircraft application, such as Hovercraft or Wing in Ground Effect (WIG) applications. These products are certificated by an authority other than FAA. The hub and blades will be stamped with an identification that is different from, but comparable to TC and PC. |
| Non-Aviation Experimental | Intended for non-aircraft application, such as Hovercraft or Wing-In-Ground effect (WIG) applications. Products marked with an "X" at or near the end of the model number or part number are not certified by any authority and are not intended for use on certificated craft.       |
| Onspeed                   | Condition in which the RPM selected by the pilot through the propeller control/condition lever and the actual engine (propeller) RPM are equal                                                                                                                                        |
| Open Circuit              | Connection of high or infinite resistance between points in a circuit which are normally lower                                                                                                                                                                                        |
| Outboard                  | Toward the tip of the blade                                                                                                                                                                                                                                                           |
| Overhaul                  | The periodic disassembly, inspection, repair, refinish, and reassembly of a propeller assembly to maintain airworthiness                                                                                                                                                              |

| Term                     | Definition                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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/condition lever                                                                                                                                                                                                                                               |
| Pitch                    | Same as “Blade Angle”                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Pitting                  | Formation of a number of small, irregularly shaped cavities in surface material caused by corrosion or wear                                                                                                                                                                                                                                                                                                                                                                            |
| Pitting (Linear)         | The configuration of the majority of pits forming a pattern in the shape of a line                                                                                                                                                                                                                                                                                                                                                                                                     |
| Porosity                 | An aggregation of microvoids. See “voids”.                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Propeller Critical Parts | 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                                                                                                                                                                                                                                                                                                                  |
| Reference Blade Radius   | Refers to the propeller reference blade radius in an assembled propeller, e.g., 30-inch radius. A measurement from the propeller hub centerline to a point on a blade, used for blade angle measurement in an assembled propeller. An adhesive stripe (blade angle reference tape CM160) is usually located at the reference blade radius location.<br><u>Note:</u> Do not confuse <i>reference blade radius</i> with <i>blade station</i> ; they may not originate at the same point. |
| Reversing                | The capability of rotating blades to a position to generate reverse thrust to slow the aircraft or back up                                                                                                                                                                                                                                                                                                                                                                             |

| Term           | Definition                                                                                                                                                                                                                                         |
|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Scratch        | Same as "Nick"                                                                                                                                                                                                                                     |
| Short Circuit  | Connection of low resistance between points on a circuit between which the resistance is normally much greater                                                                                                                                     |
| Shot Peening   | Process where steel shot is impinged on a surface to create compressive surface stress, that provides improved strength and resistance to fatigue                                                                                                  |
| Single Acting  | Hydraulically actuated propeller that utilizes a single oil supply for pitch control                                                                                                                                                               |
| Split          | Delamination of blade extending to the blade surface, normally found near the trailing edge or tip                                                                                                                                                 |
| Station Line   | See "Blade Station"                                                                                                                                                                                                                                |
| 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                                                                     |
| Ticking        | A series of parallel marks or scratches running circumferentially around the diameter of the blade                                                                                                                                                 |
| 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 |

| <b>Term</b>               | <b>Definition</b>                                                                                                                                  |
|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| Trailing Edge             | The aft edge of an airfoil over which the air passes last                                                                                          |
| Trimline                  | Factory terminology referring to where the part was trimmed to length                                                                              |
| Underspeed                | The condition in which the actual engine (propeller) RPM is lower than the RPM selected by the pilot through the propeller control/condition lever |
| Unidirectional Material   | A composite material in which the fibers are substantially oriented in the same direction                                                          |
| Variable Force            | A force that may be applied or removed during propeller operation                                                                                  |
| Vertical Balance          | Balance between the leading and trailing edges of a two-blade propeller with the blades positioned vertically                                      |
| Voids                     | Air or gas that has been trapped and cured into a laminate                                                                                         |
| Windmilling               | The rotation of an aircraft propeller caused by air flowing through it while the engine is not producing power                                     |
| Woven Fabric              | A material constructed by interlacing fiber to form a fabric pattern                                                                               |
| Wrinkle (aluminum blade)  | A wavy appearance caused by high and low material displacement                                                                                     |
| Wrinkle (composite blade) | Overlap or fold within the material                                                                                                                |

15. Abbreviations (Rev. 2)

| <b>Abbreviation</b> | <b>Term</b>                              |
|---------------------|------------------------------------------|
| AD                  | Airworthiness Directives                 |
| AMM                 | Aircraft Maintenance Manual              |
| AOG                 | Aircraft on Ground                       |
| AR                  | As Required                              |
| ATA                 | Air Transport Association                |
| CSU                 | Constant Speed Unit                      |
| FAA                 | Federal Aviation Administration          |
| FH                  | Flight Hour                              |
| FM                  | Flight Manual                            |
| FMS                 | Flight Manual Supplement                 |
| Ft-Lb               | Foot-Pound                               |
| HMI                 | Human Machine Interface                  |
| ICA                 | Instructions for Continued Airworthiness |
| ID                  | Inside Diameter                          |
| In-Lb               | Inch-Pound                               |
| IPL                 | Illustrated Parts List                   |
| IPS                 | Inches Per Second                        |
| kPa                 | Kilopascals                              |
| Lb(s)               | Pound(s)                                 |
| Max.                | Maximum                                  |
| Min.                | Minimum                                  |

| <b>Abbreviation</b> | <b>Term</b>                                    |
|---------------------|------------------------------------------------|
| MIL-X-XXX           | Military Specification                         |
| MPI                 | Major Periodic Inspection (Overhaul)           |
| MS                  | Military Standard                              |
| MSDS                | Material Safety Data Sheet                     |
| N                   | Newtons                                        |
| N/A                 | Not Applicable                                 |
| NAS                 | National Aerospace Standards                   |
| NASM                | National Aerospace Standards, Military         |
| NDT                 | Nondestructive Testing                         |
| NIST                | National Institute of Standards and Technology |
| N•m                 | Newton-Meters                                  |
| OD                  | Outside Diameter                               |
| OPT                 | Optional                                       |
| PC                  | Production Certificate                         |
| PCP                 | Propeller Critical Part                        |
| PLC                 | Programmable Logic Controller                  |
| PMB                 | Plastic Media Blasting (Cleaning)              |
| POH                 | Pilot's Operating Handbook                     |
| PSI                 | Pounds per Square Inch                         |
| RF                  | Reference                                      |
| RPM                 | Revolutions per Minute                         |

| <b>Abbreviation</b> | <b>Term</b>                     |
|---------------------|---------------------------------|
| SAE                 | Society of Automotive Engineers |
| STC                 | Supplemental Type Certificate   |
| TBO                 | Time Between Overhaul           |
| TC                  | Type Certificate                |
| TSI                 | Time Since Inspection           |
| TSN                 | Time Since New                  |
| TSO                 | Time Since Overhaul             |
| UID                 | Unique Identification           |
| WIG                 | Wing-In-Ground-Effect           |

DESCRIPTION and OPERATION - CONTENTS

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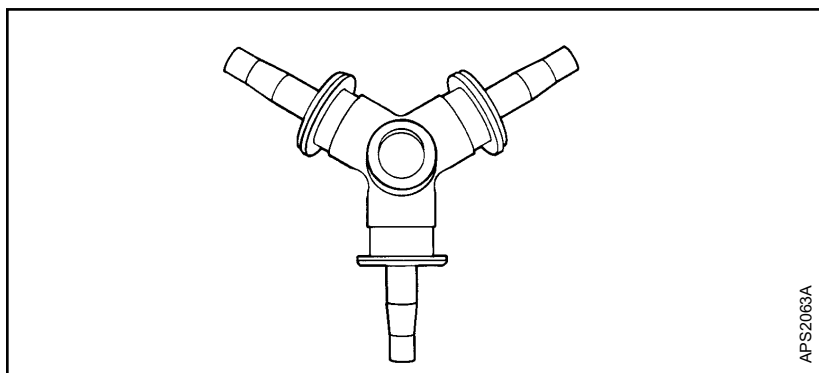
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# 1. Description of Propeller and Systems

## A. 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.



**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.

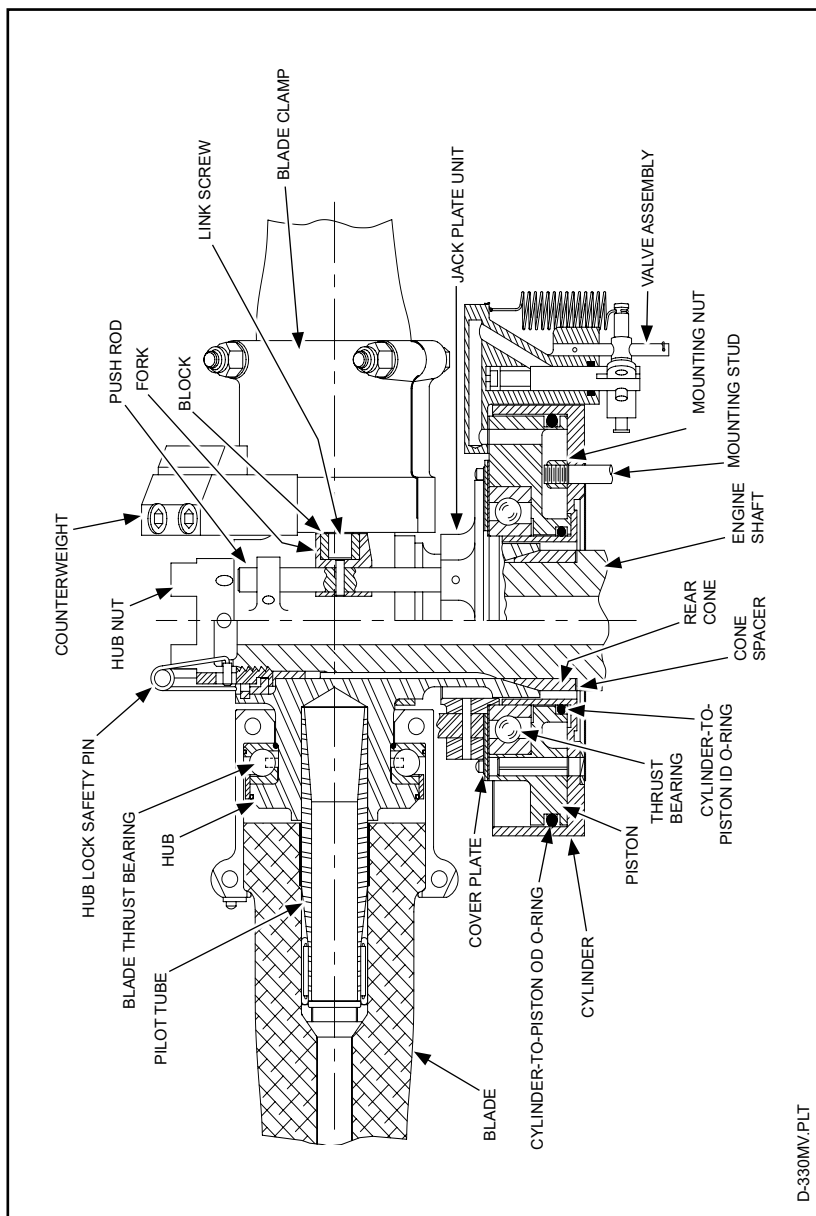
#### B. Forces

- (1) 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. Control

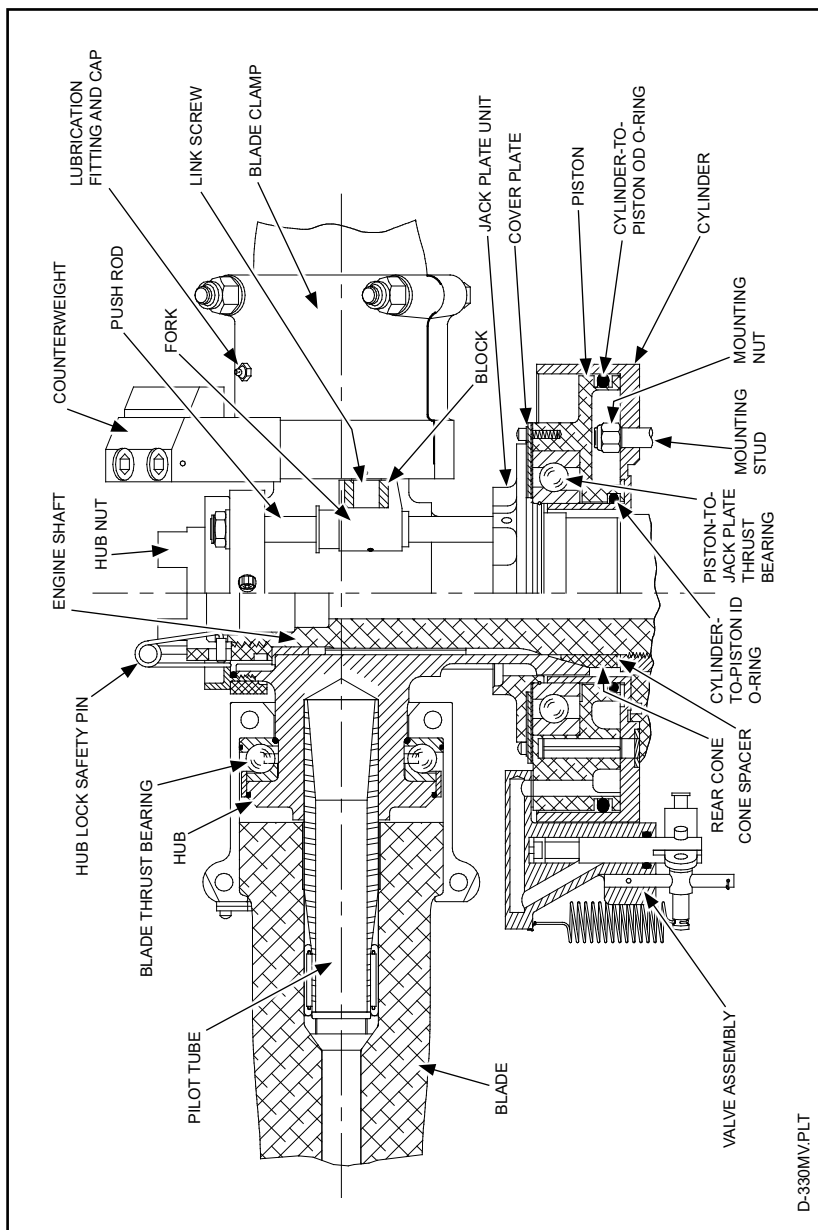
- (1) The summation of the propeller forces is toward higher pitch (low RPM) and is opposed by a variable force toward lower pitch (high RPM). The variable force is oil controlled from a governor or is engine oil that is pilot controlled through a valve. The variable oil force (oil supply) is supplied 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**

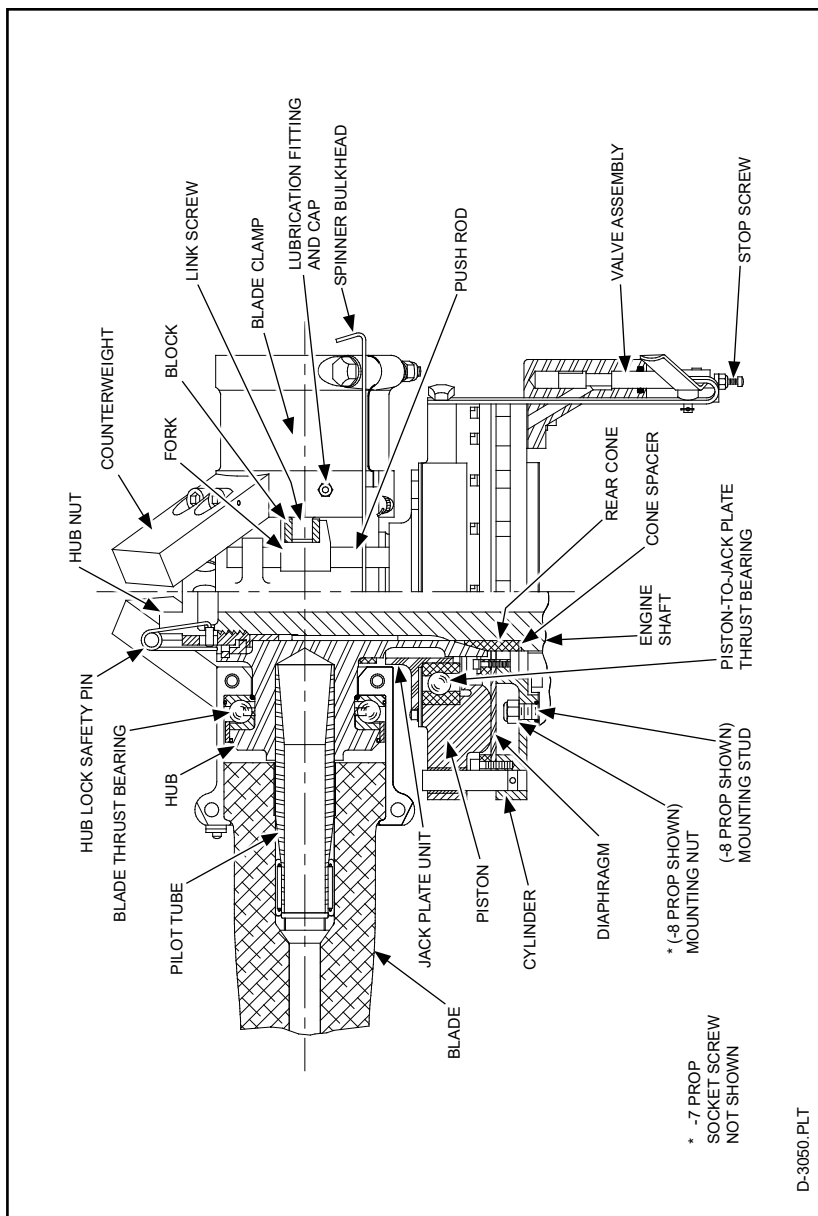
- D. Propeller Model HC-D2(MV,V)20-3( ). Refer to Figure 2-2.
- (1) This propeller model uses manual control and is reversing. The basic components of this propeller assembly consist of a propeller, a hydraulic unit, and a valve assembly.
  - (2) A blade angle range up to 33 degrees enables reverse thrust 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

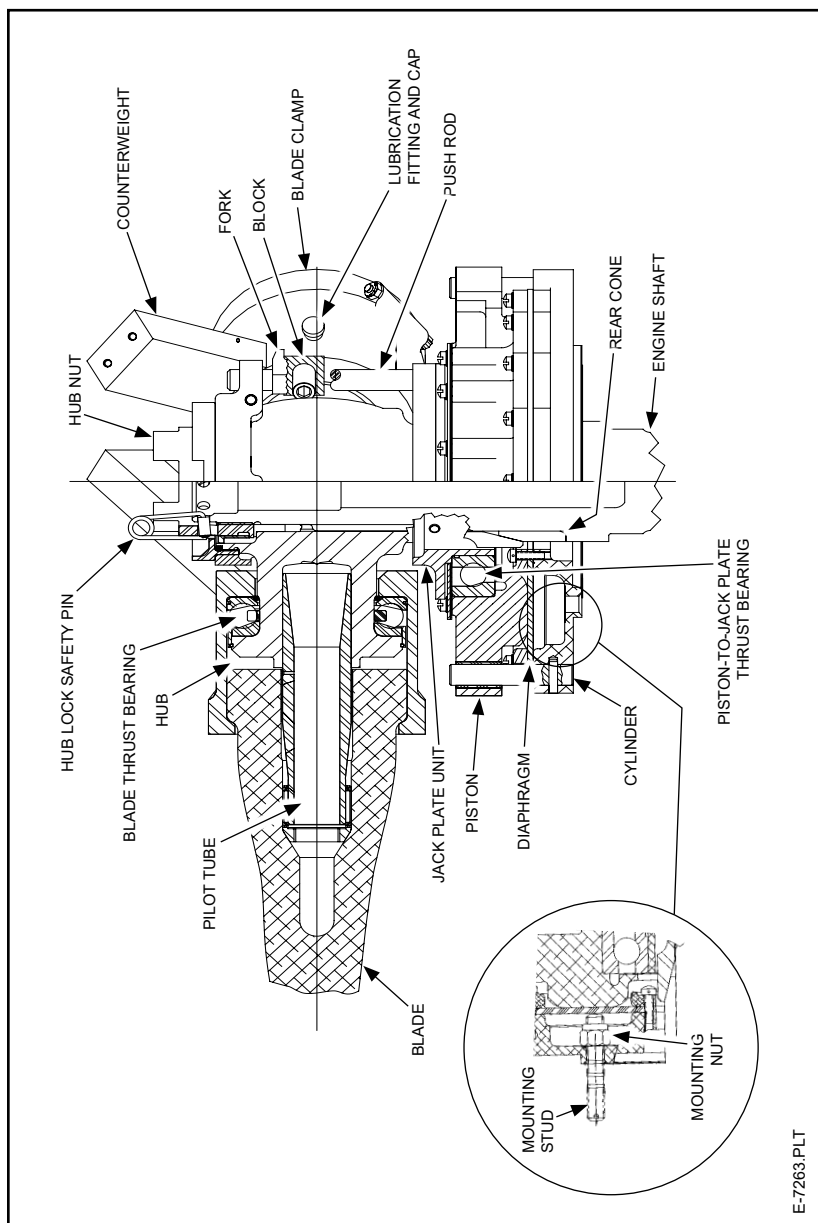
Figure 2-3

- E. 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.



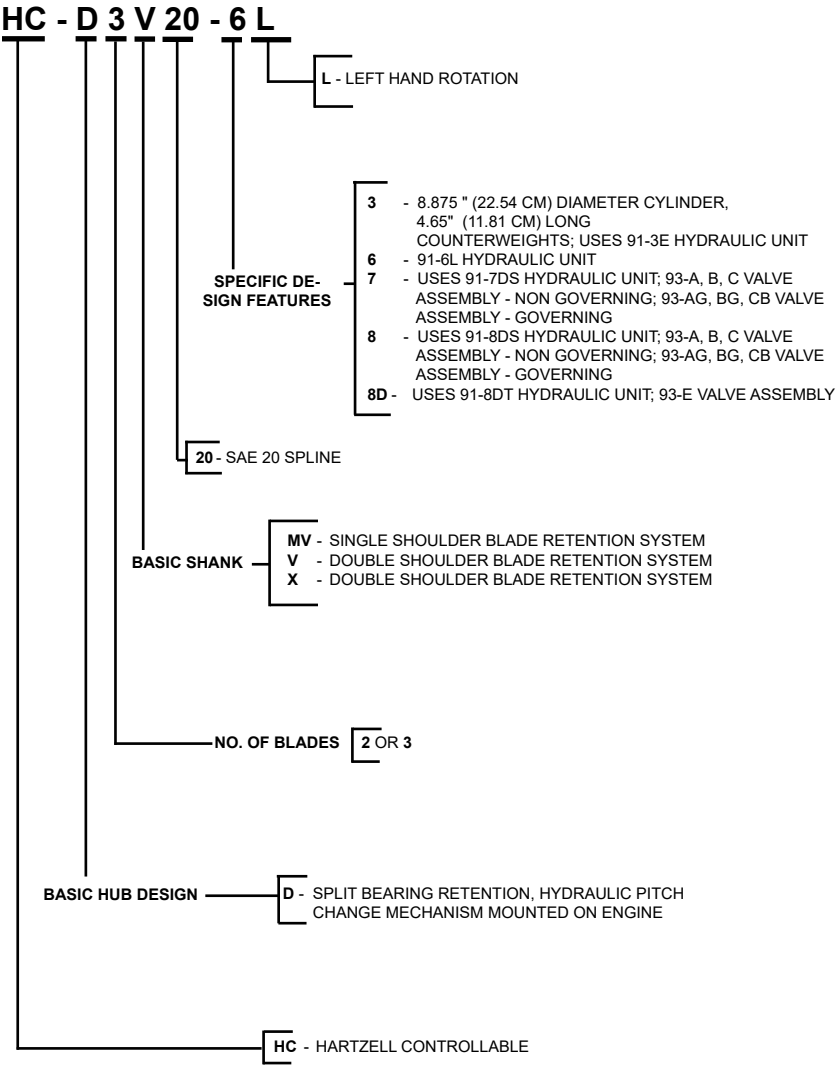
HC-D2(MV,V)20-(7,8)( ) Propeller Assembly  
Figure 2-4

- F. 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**

- G. 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.



**Propeller Model Designations**  
**Table 2-1**

## H. Propeller Model Designation

- (1) Hartzell Propeller LLC uses a model number designation system to identify specific propeller and blade assemblies. The propeller model number and blade model number are separated by a slash ( / ).
  - (a) Example: *propeller model number / blade model number*
- (2) The propeller model number is impression stamped on the propeller hub.
- (3) Refer to Table 2-1 for a description of the characters used in the propeller model number.

## prop model/MV8433N-6

**Dash Number (or + number)**, diameter reduction (or increase) from basic design.

In this example, the nominal 84 inch diameter has been reduced 6 inches = 78 inch dia. (with some exceptions)

there may be a letter following the dash number:

**R** - specifically rounded tip

**S** - square tip (Exception: blade model 8433NS was manufactured with a square tip; however, the "S" square tip designator in the model number did not follow a dash.)

**T** - specifically rounded tip

**Q** - Q-tip, factory 90 degree bent tip

**A** - slightly thinner & narrower tip fairing

**E** - elliptical tip

**Suffix letters:**

**A** - blade cuff modification or; 0 degree sweepback or; for 8433 blades a 1 degree sweepback; or Y shank pitch knob

**C** - modified blade, dimensional or blade twist modification from initial blade design

**D** - modified blade, blade twist, or thickness change

**F** - modified blade, dimensional modification (width/thickness)

**H** - hard alloy (7076)

**N** - shank modification (pilot tube hole), thickness added

**S** - Shot peen (Exception: Blade model M10474 was manufactured with a shot peened surface; however, the "S" shot peen designator was not included in the model number. The "S" designator must be added to M10476 blades at overhaul.)

**blank** - original design, no changes

The first 2 or 3 numbers indicate initial design diameter (in inches), the last 2 numbers indicate basic model or template (there are some exceptions to this definition)

**Prefix of up to 3 letters:**

**J** - left hand rotation, tractor

**L** - left hand rotation, pusher

**V, MV** - shank design

**Aluminum Blade Model Designation  
Table 2-2**

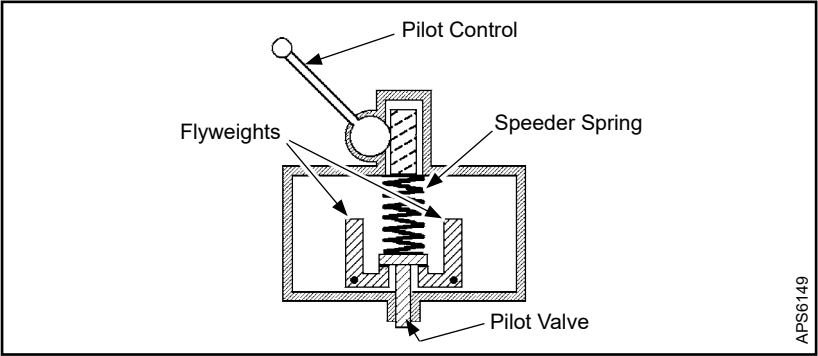
## 2. Propeller Blades

### A. Description of Aluminum Blades

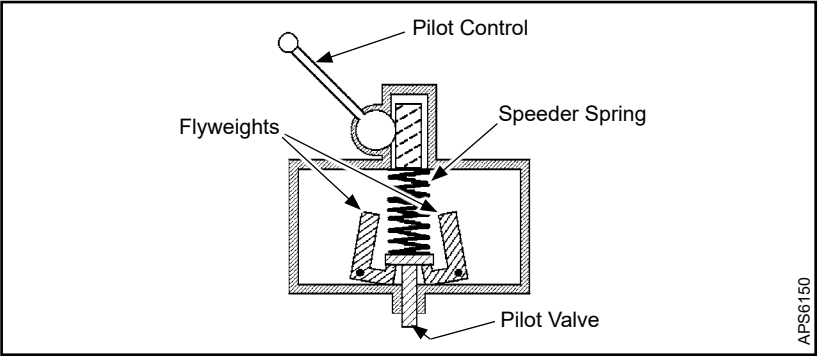
- (1) Aluminum propeller blades are manufactured from one solid piece of aluminum that has been forged and heat-treated prior to manufacture.
- (2) Aluminum blades are identified by shank design, propeller diameter, tip configurations, and other blade characteristics.
  - (a) Refer to the section, "Blade Model Designation" in this chapter.

### B. Blade Model Designation

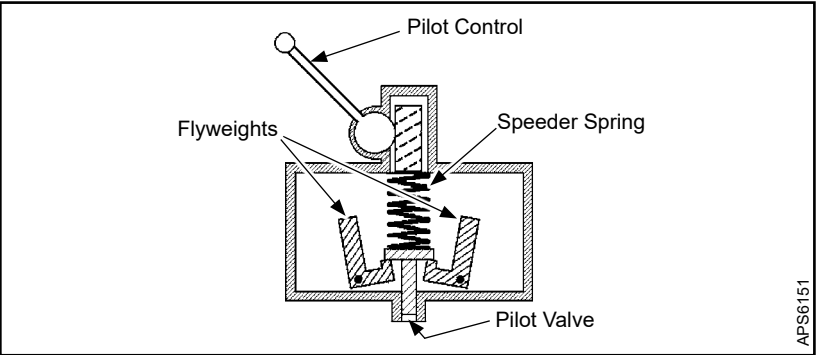
- (1) Hartzell Propeller LLC uses a model number designation system to identify specific propeller and blade assemblies. The propeller model number and blade model number are separated by a slash ( / ).
  - (a) Example: *propeller model number / blade model number*
- (2) The blade model number is impression stamped on the butt end of the blade, and also identified by a label on the cylinder.
- (3) Refer to Table 2-2 for a description of the characters used in the blade model number:



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



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



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

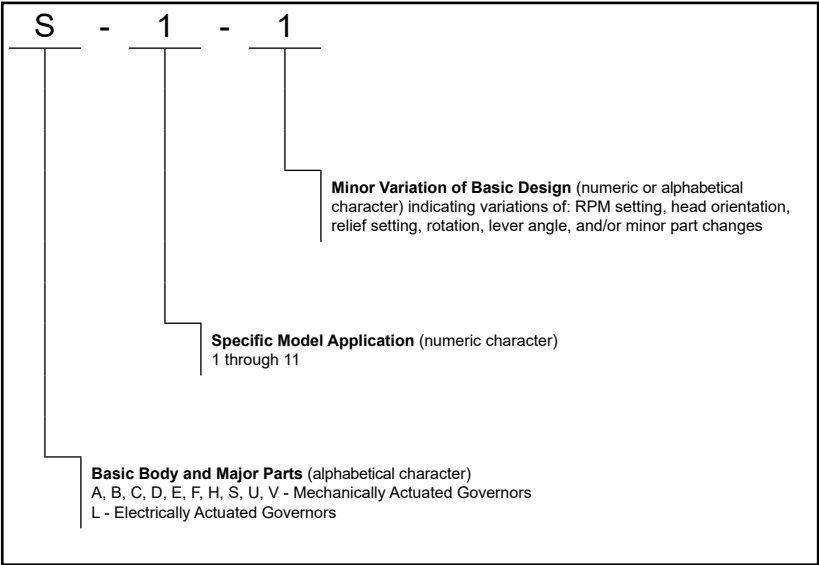
### 3. Governors (Rev. 3)

#### 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 maintains 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 Model Designation

- (1) Hartzell Propeller LLC uses a model number designation system to identify specific governor models.
- (2) The governor model number is stamped on the base and/or body of the governor assembly.
- (3) Refer to Table 2-3 for a description of the characters used in the governor model number.



**Governor Model Designations**  
**Table 2-3**

#### 4. 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.
  - (a) 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
  - (a) Perform engine start and warm-up per the Pilot's Operating Handbook (POH).
  - (b) During this process the pitch control should be forward (low pitch position).
- (5) Take-Off
  - (a) No pitch control is necessary.
  - (b) 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
  - (a) 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
  - (a) Pull the pitch control out to select RPM for cruise.
  - (b) Select RPM for best fuel consumption in accordance with Pilot's Operating Handbook (POH).

- (8) Long Range Cruise
  - (a) Maximum cruise economy dictates low airspeed, low RPM and fairly high manifold pressure.
  - (b) 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
  - (a) Push the pitch control forward before landing to enable an emergency takeoff again if necessary.
- (10) Taxi
  - (a) 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.
    - 1 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.
  - 1 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.

CAUTION: NEVER LET THE ENGINE  
OVERSPEED IN REVERSE.  
ALWAYS MAINTAIN AN RPM  
BELOW THE MAXIMUM ENGINE  
RPM.

- 2 When the control is completely back, the blade pitch is in full reverse and the pilot can apply throttle for reverse thrust.
  - a 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.

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.
  - (a) 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

- (a) Perform engine start and warm-up per the Pilot's Operating Handbook (POH).
- (b) 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

- (a) Set the governor RPM control to maximum RPM.
- (b) RPM will remain constant during the takeoff roll and rotation.

## (5) Climb

- (a) Adjust the governor RPM control per the Pilot's Operating Handbook (POH).

## (6) Cruise

- (a) Select RPM for best fuel consumption in accordance with Pilot's Operating Handbook (POH).

## (7) Landing

- (a) Push the governor RPM control forward for maximum RPM before landing to enable an emergency takeoff again if necessary.

## (8) Taxi

- (a) Taxi with the governor RPM control fully forward for lowest blade angle when throttle is reduced.

INSTALLATION AND REMOVAL - CONTENTS

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1. Tools, Consumables, and Expendables

**CAUTION:** INSTRUCTIONS AND PROCEDURES IN THIS CHAPTER MAY INVOLVE CRITICAL PARTS. REFER TO THE INTRODUCTION CHAPTER OF THIS MANUAL FOR INFORMATION ABOUT PROPELLER CRITICAL PARTS. CONTACT HARTZELL PROPELLER LLC FOR THE IDENTIFICATION OF SPECIFIC PROPELLER CRITICAL PARTS.

## A. General

- (1) 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.

## B. Tooling

**20 Spline**

- Safety wire pliers (Alternate: Safety cable tool)
- Torque wrench
- Torque wrench adapter TE146

## C. Consumables

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

## D. Expendables

- 0.032 inch (0.813 mm) Stainless Steel Aircraft Safety Wire (Alternate: 0.032 inch [0.81 mm] aircraft safety cable, and associated hardware)
- O-ring, cylinder-to-stud seal - Refer to Table 3-1.

## 2. Pre-Installation

### A. Inspection of Shipping Package

- (1) Examine the exterior of the shipping container, especially the box ends around each blade, for signs of shipping damage.
  - (a) If the box is damaged, contact the freight company for a freight claim.
  - (b) A hole, or 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.
- 1 If the propeller is damaged, contact Hartzell Propeller LLC Refer to the section, "Hartzell Propeller Contact Information" in the Introduction chapter of this manual.

### B. Uncrating

- (1) Put the propeller on a firm support.
- (2) Remove the banding and any external wood bracing from the cardboard shipping container.
- (3) Remove the cardboard from the hub and blades.

**CAUTION:** DO NOT STAND THE PROPELLER ON A BLADE TIP.

- (4) Put the propeller on a padded surface that supports the entire length of the propeller.
- (5) Remove the plastic dust cover cup from the propeller mounting flange, if installed.

### C. Inspection after Shipment

- (1) After removing the propeller from the shipping container, examine the propeller components for shipping damage.

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

- (1) If a propeller was received disassembled for shipment, it must be reassembled by trained personnel in accordance with the applicable propeller maintenance manual.

**3. Propeller Mounting Hardware and Torque Information (Rev. 1)**
**A. Propeller Mounting Hardware**

- (1) Refer to Table 3-1 for part numbers of the propeller mounting hardware and O-rings.

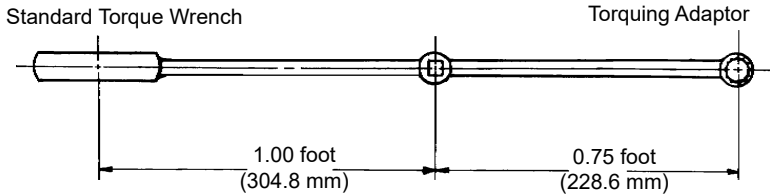
| <b>Part</b>           | <b>Part No.</b> | <b>Usage</b>                 |
|-----------------------|-----------------|------------------------------|
| Hydraulic Unit Gasket | A-181           | HC-D(2,3)(MV,V)20-(3,6,8)( ) |
|                       | A-135           | HC-D2(MV,V)20-7( )           |
| 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             |
|                       | A-2038-10       | All except 93C and CG Valve  |
| Mounting O-ring       | C-3317-341      | HC-D(2,3)(MV,V)20-(3,6)( )   |
|                       | C-3317-012      | 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**

- CAUTION 1:** FOR A PROPELLER THAT DOES NOT USE A LUBRICATED (WET) TORQUE, THE MOUNTING HARDWARE MUST BE CLEAN AND DRY TO PREVENT EXCESSIVE PRELOAD OF THE MOUNTING FLANGE.
- CAUTION 2:** TORQUE VALUES WITH "WET" NOTED AFTER THEM ARE BASED ON LUBRICATED THREADS WITH APPROVED ANTI-SEIZE COMPOUND MIL-PRF-83483( ).
- CAUTION 3:** REFER TO FIGURE 3-1 FOR TORQUE READING WHEN USING A TORQUE WRENCH ADAPTER.

| Part                           | Part No.  | Torque                      |
|--------------------------------|-----------|-----------------------------|
| Hub Nut                        | A-63B     | 440-460 Ft-Lb (597-623 N•m) |
| Piston Rod Nut                 | A-848-2   | 20-22 Ft-Lb (27-29 N•m)     |
| Mounting Nut                   | A-2043-1  | 27-33 Ft-Lb (37-44 N•m)     |
| Socket Head Cap Screw          | A-2037-2C | 27-30 Ft.Lb (37-40 N•m)     |
| Nut<br>(Governor-to-"T" drive) | B-3808-5  | 18-20 Ft-Lb (25-27 N•m)     |

**Torque Values**  
**Table 3-2**



$$\frac{(\text{actual torque required}) \times (\text{torque wrench length})}{(\text{torque wrench length}) + (\text{length of adaptor})} = \text{Torque wrench reading to achieve required actual torque}$$

EXAMPLE:

$$\frac{100 \text{ Ft-Lb (136 N}\cdot\text{m)} \times 1 \text{ ft (308.4 mm)}}{1 \text{ ft (308.4 mm)} + 0.75 \text{ ft (228.6 mm)}} = 57.1 \text{ Ft-Lb (77.4 N}\cdot\text{m)} < \begin{array}{l} \text{reading on torque} \\ \text{wrench with 9-inch} \\ \text{(228.6 mm) adaptor} \\ \text{for actual torque of} \\ \text{100 Ft-Lb (136 N}\cdot\text{m)} \end{array}$$

The correction shown is for an adapter that is aligned with the centerline of the torque wrench. If the adapter is angled 90 degrees relative to the torque wrench centerline, the torque wrench reading and actual torque applied will be equal.

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**Calculating Torque When Using a Torque Wrench Adapter**  
**Figure 3-1**

## B. Torque Information

- (1) The structural integrity of joints in the propeller that are held together with threaded fasteners is dependent upon proper torque application.
  - (a) Vibration can cause an incorrectly tightened fastener to fail in a matter of minutes.
  - (b) Correct tension in a fastener depends on a variety of known load factors and can influence fastener service life.
  - (c) Correct tension is achieved by application of measured torque.
- (2) Use accurate wrenches and professional procedures to make sure of correct tensioning.
- (3) Refer to Table 3-2 for the torque values to use when installing a Hartzell propeller.
- (4) When an adapter is used with a torque wrench, use the equation in Figure 3-1 to determine the correct torque value.

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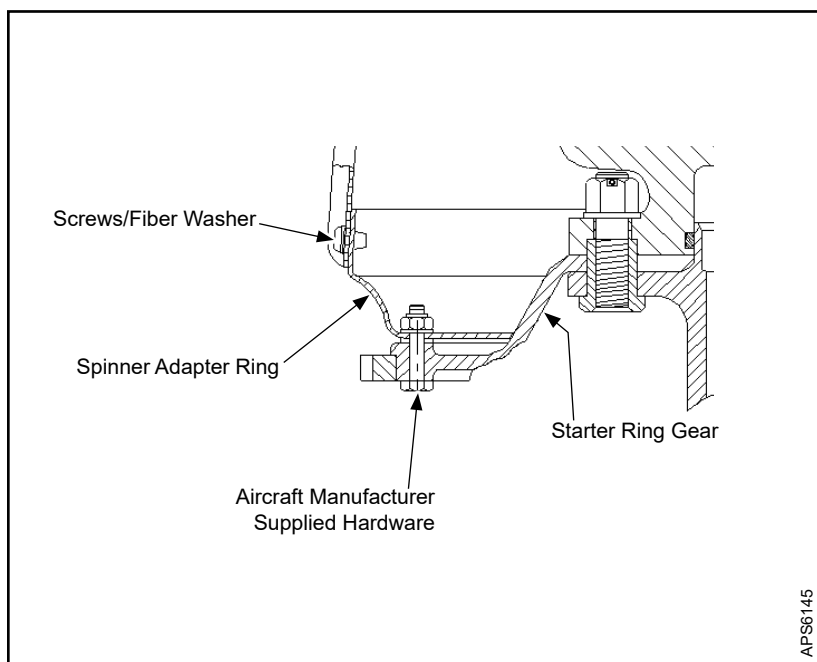
4. Spinner Adapter Ring Installation (if applicable)

## A. Installation

- (1) Install the spinner adapter ring to the starter ring gear using hardware supplied by the airframe manufacturer. Refer to Figure 3-2.

**CAUTION:** BOLTS INSTALLED INCORRECTLY  
CAN DAMAGE ENGINE  
COMPONENTS.

- (a) Install spinner adapter bolts so that the bolt heads are at the rear of the starter ring gear. Refer to Figure 3-2.
- (2) Torque the bolts as specified by the airframe manufacturer.



**Spinner Adapter Ring**  
**Figure 3-2**

## 5. Propeller Assembly Installation

### A. Precautions

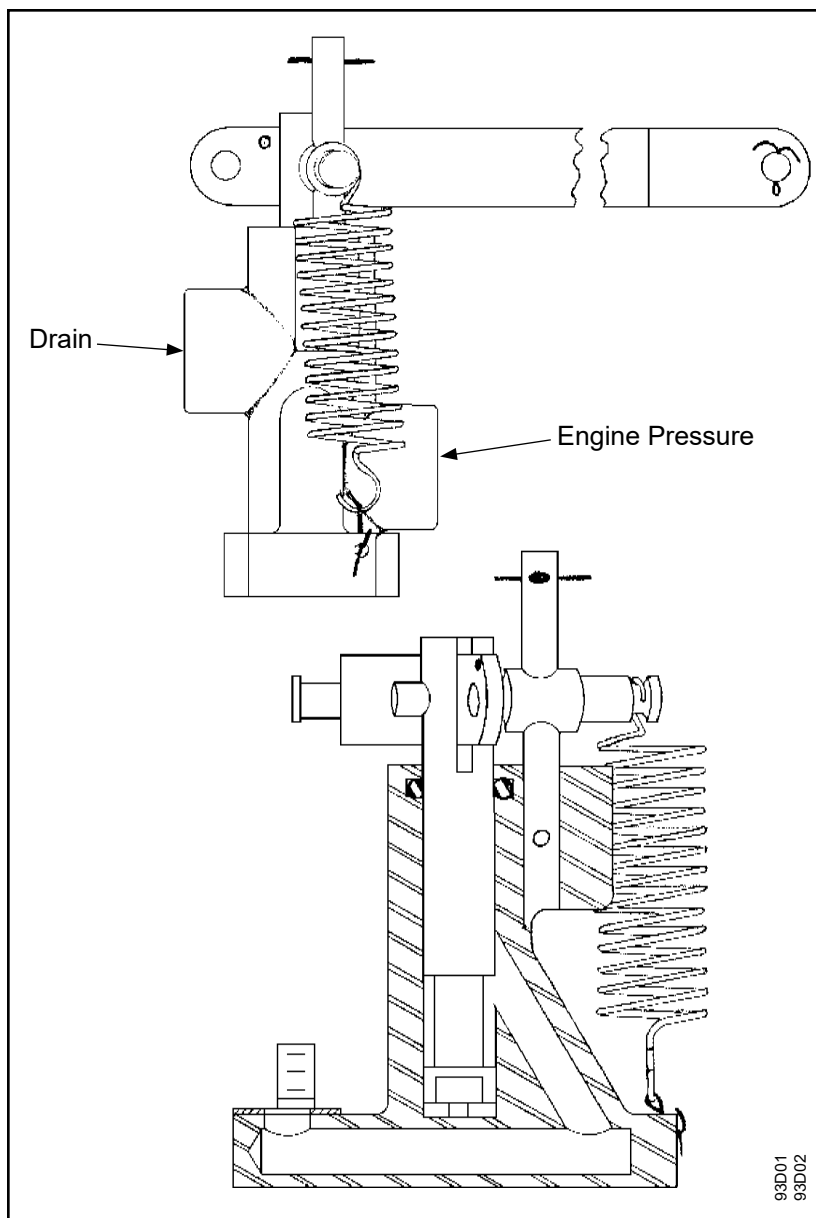
WARNING 1: DURING ENGINE INSTALLATION OR REMOVAL, USING THE PROPELLER TO SUPPORT THE WEIGHT OF THE ENGINE IS NOT AUTHORIZED. UNAPPROVED INSTALLATION AND REMOVAL TECHNIQUES MAY CAUSE DAMAGE TO THE PROPELLER THAT MAY LEAD TO FAILURE RESULTING IN AN AIRCRAFT ACCIDENT.

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. Propeller Mounting Hardware/O-rings

- (1) Refer to Table 3-1 for part numbers of the applicable propeller mounting hardware.



Valve Assembly: For HC-D2(MV,V)20-3  
Figure 3-3

## 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.

- (1) Refer to Figure 2-2 for location of the parts specified in this procedure.
- (2) Hydraulic Valve Installation - Refer to Figure 3-3.
  - (a) If not previously installed, install the hydraulic valve assembly on the piston with a gasket and two screws. Refer to 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.

1 Safety with 0.032 inch (0.81 mm) safety wire.

**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.
- (3) 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 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 gasket A-181 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 on each of the six studs to secure the hydraulic cylinder to the engine. Refer to Table 3-1.
- (g) Torque each nut in accordance with Table 3-2.
- (h) Verify the installation of both cylinder-to-piston O-rings in the piston.
  - 1 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. Refer to 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. Refer to Table 3-1.
  - 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. Refer to 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) Using the shaft nut wrench TE146 or equivalent, torque the hub nut on the engine shaft in accordance with Table 3-2.

- (aa) Check the available piston travel by measuring between the jack plate and the hub shoulder.
- 1 Travel should be 1.062 inch to 1.094 inch (26.97 to 27.79 mm).
  - 2 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.

- 1 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.

(4) 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.

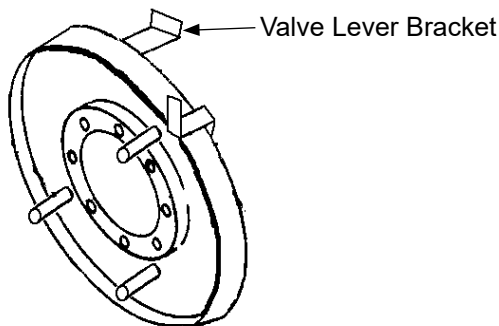
## (5) Reverse Pitch Hardware Adjustment

**CAUTION:** REVERSING CONTROL MUST PULL THE SHORT END OF THE VALVE LEVER TIGHT AGAINST THE BRACKET. REFER TO FIGURE 3-4.

## (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.



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**Reverse Pitch Hardware Adjustment**  
**Figure 3-4**

- (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.
- (6) Slowly turn the propeller on the engine shaft to identify if there is clearance between the blade clamp assemblies and the valve assembly.
- (7) 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.

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

**Spacer Selection**  
**Table 3-3**

- (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 in accordance with 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.
- (8) Repeat steps (6) through (7)(o) of this procedure until clearance between the blade clamp assemblies and the valve assembly is achieved.

## (9) Model HC-D2MV20-3 only:

- (a) Rotate the blades by hand toward low pitch until the jack plate contacts the spacer ring.
  - 1 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.

**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 to provide 0.025 inch (0.63 mm) minimum clearance between each clamp and the valve. Refer to Table 3-3.
  - 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 (9)(f)1 through (9)(f)4, 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.

(1) Refer to Figure 2-3 for part identification and location.

(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.

(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 on each of the six studs to secure the hydraulic cylinder to the engine. Refer to Table 3-1.
- (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 on each push rod, with the shoulder against the fork. Refer to Table 3-1.
- (m) Install one reverse stop on each sleeve and push rod against the sleeve shoulder. Refer to Table 3-1.
- (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. Refer to 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) Using the shaft nut wrench TE146 or equivalent, torque the hub nut on the engine shaft in accordance with Table 3-2.

(af) Check the available piston travel by measuring between the jack plate and the hub shoulder.

- 1 Travel should be 1.032 inch (26.21 mm) minimum.
- 2 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 3-1.

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

(3) 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. Refer to 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.

- 1 Safety with 0.032 inch (0.81 mm) safety wire.

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.

- 1 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.

(4) 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.

## (5) Reverse Pitch Hardware Adjustment

**CAUTION:** REVERSING CONTROL MUST PULL THE SHORT END OF THE VALVE LEVER TIGHT AGAINST THE BRACKET. REFER TO FIGURE 3-4.

## (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.
- (6) Slowly turn the propeller on the engine shaft to identify if there is clearance between the blade clamp assemblies and the valve assembly.
- (7) 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 3-4 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 in accordance with 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 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.
- (8) Repeat steps (6) through (7)(o) of this procedure until clearance between the blade clamp assemblies and the valve assembly is achieved.

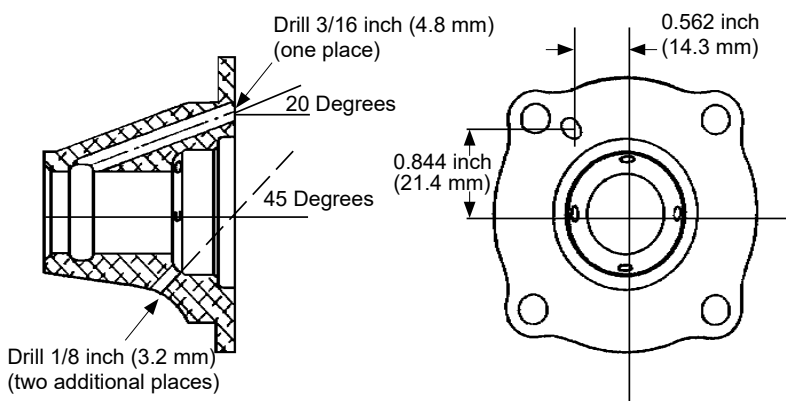
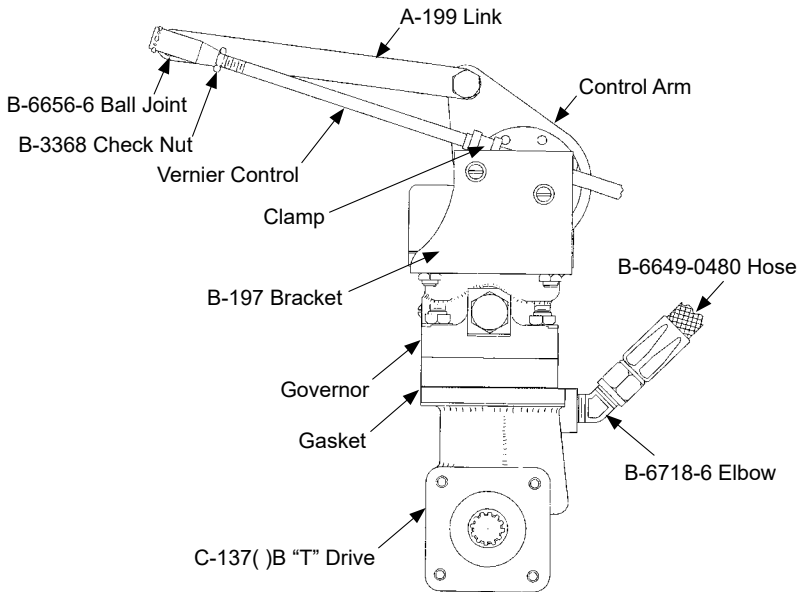


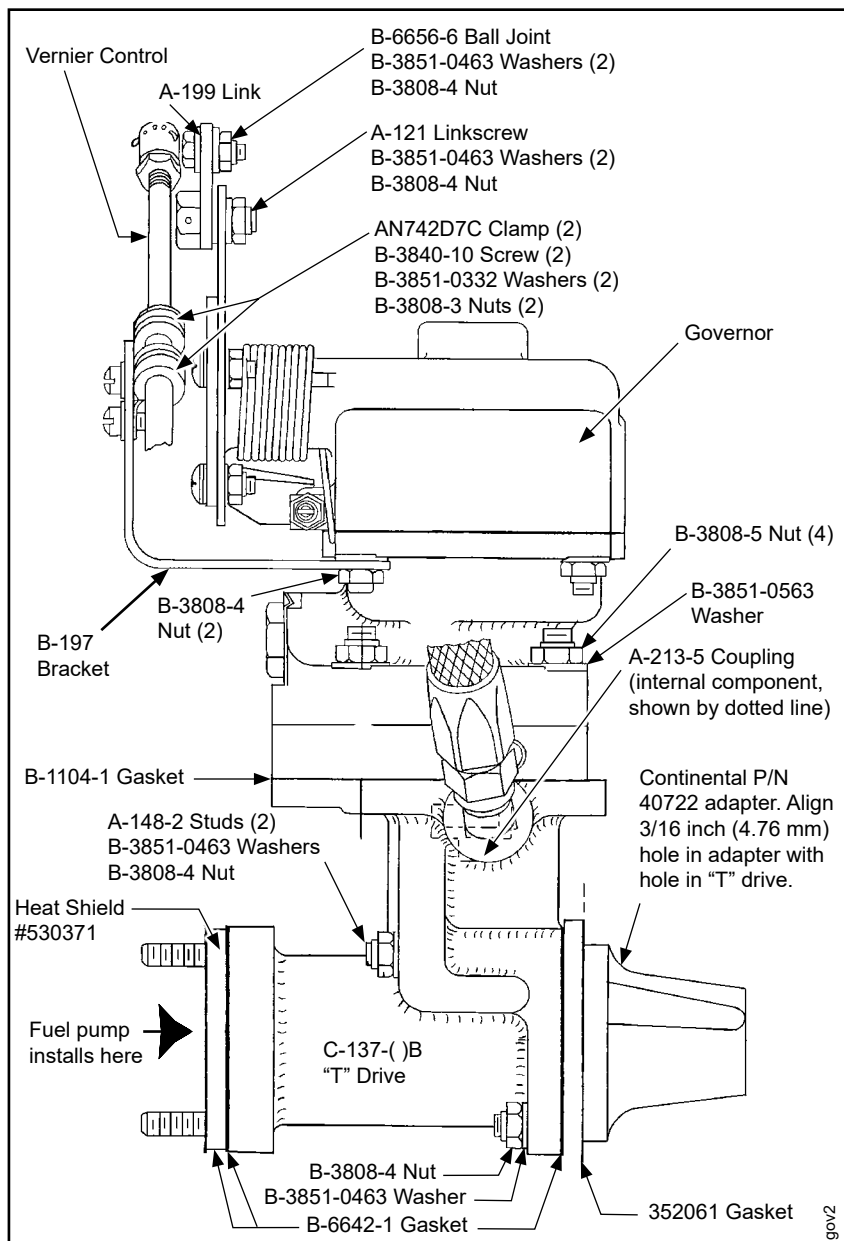
Fig301

**Modification of Shaft Gear Adapter (Continental P/N 40722)****Figure 3-5**



gov1

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



Installation of Governor and "T"-Drive

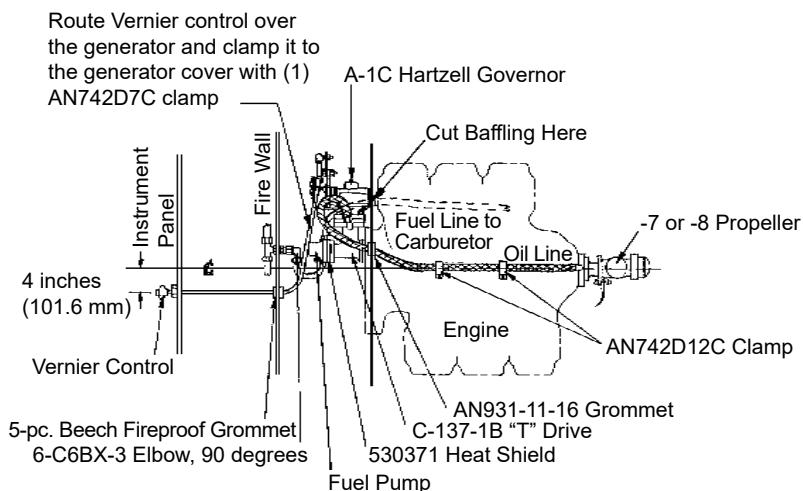
Figure 3-7

- E. Installation of Governor and "T" Drive (on -7 and -8 Series Propellers Only). Refer to Figures 3-5 through 3-7.

**CAUTION 1:** MAKE SURE THE A-213-5 COUPLING IS IN PLACE BEFORE INSTALLING THE GOVERNOR ON THE "T" DRIVE. REFER TO FIGURE 3-7.

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



B2055

Installation of Oil Line and Vernier Control

Figure 3-8

(8) Remove the fuel pump from the pad on the engine.

(a) 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 3-5.

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 two 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 3-7.
- (22) Reinstall the gasket 352061 on the pad of the engine, as shown in Figure 3-7.
- (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 3-7.
- (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 four B-3808-4 nuts and four 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 3-6.
- (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 3-7.
- (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 3-8.

**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 one 112436-6 retainer, two 112413-4 ball halves, and two 112412 split grommets.
  - (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 3-7 and 3-8.
- (34) Install the B-3368 check nut and the AN276-6 ball joint on the vernier control. Refer to Figure 3-7.

**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 two B-3851-0463 washers and one B-3308-4 nut, as shown in Figure 3-7.
- (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.

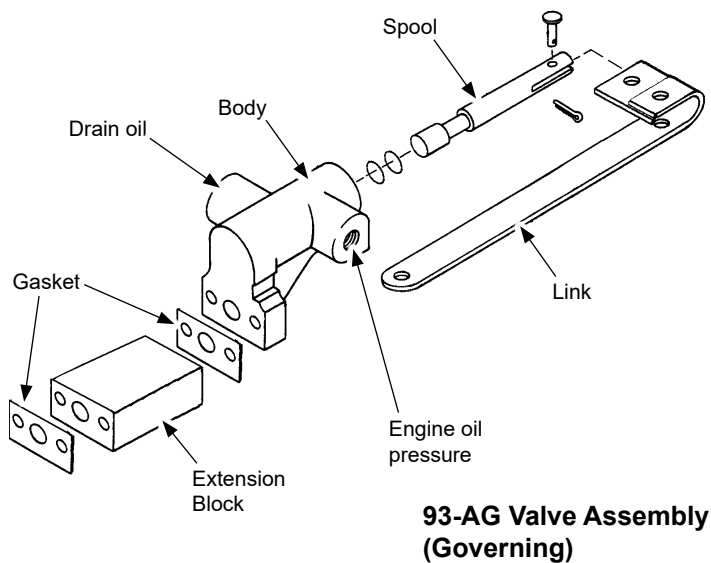
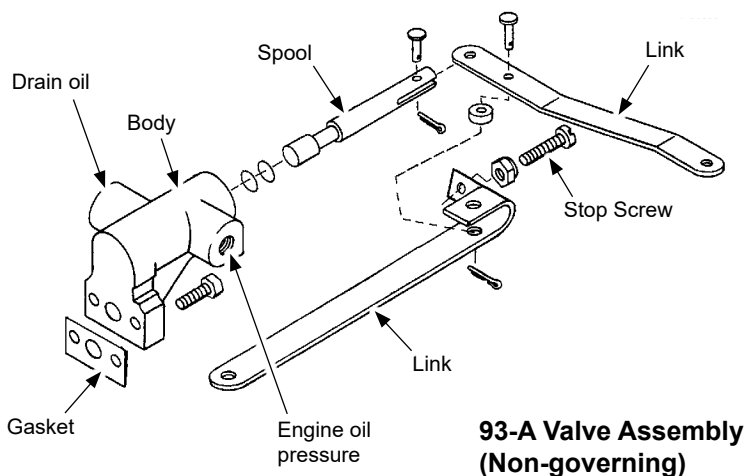
Refer to Figure 2-4 for parts identification and location.

## (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 HC-D2(MV,V)20-(7,8)**  
**Figure 3-9**

- (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 on the piston with a gasket and two screws. Refer to Figure 3-9 and 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.
    - 1 Safety with 0.032 inch (0.81 mm) safety wire.
  - (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 or equivalent aircraft safety cable and associated hardware.
  - (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

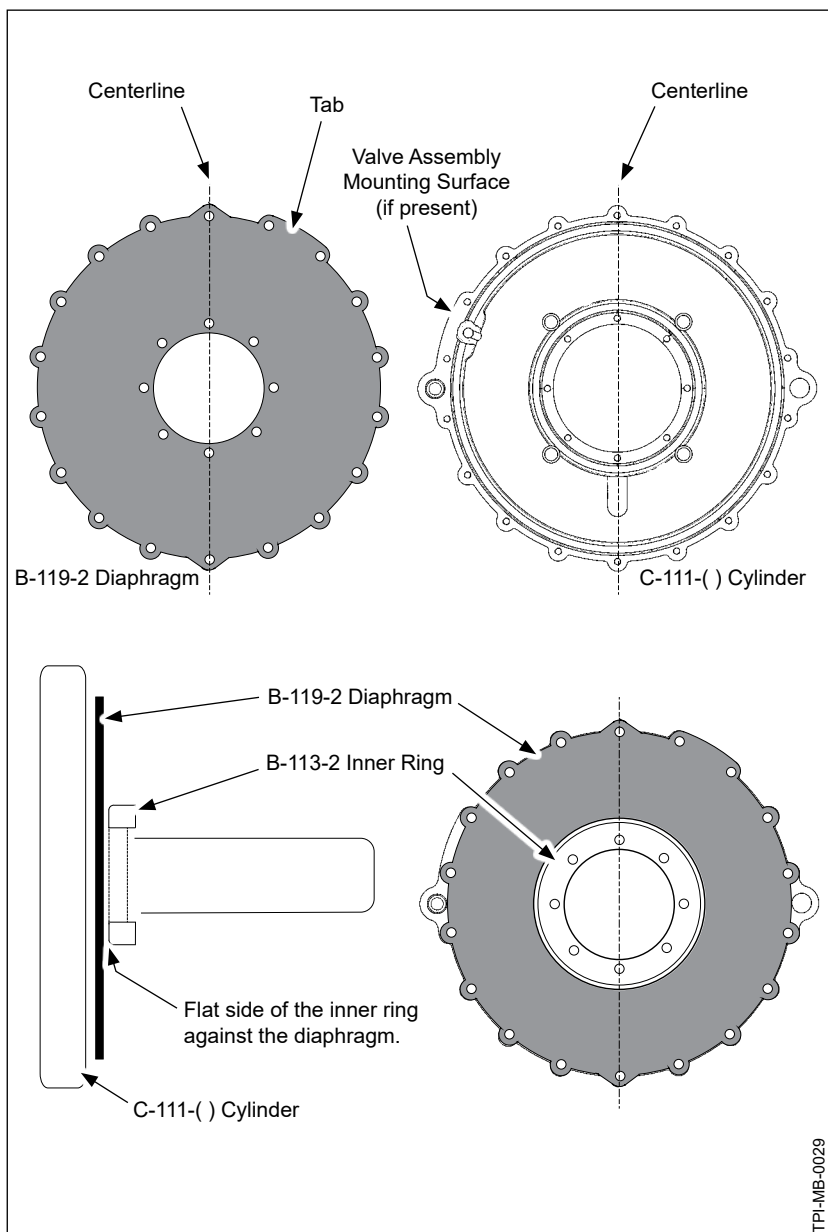
- 1 Install one socket head cap screw in each of four cylinder mounting holes. Position the head of each screw on the piston side of the cylinder.
- 2 Install one metal washer on each socket head cap screw that protrudes through the cylinder on the engine side of the cylinder.
- 3 Align the four cylinder 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 or equivalent aircraft safety cable and associated hardware.

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.



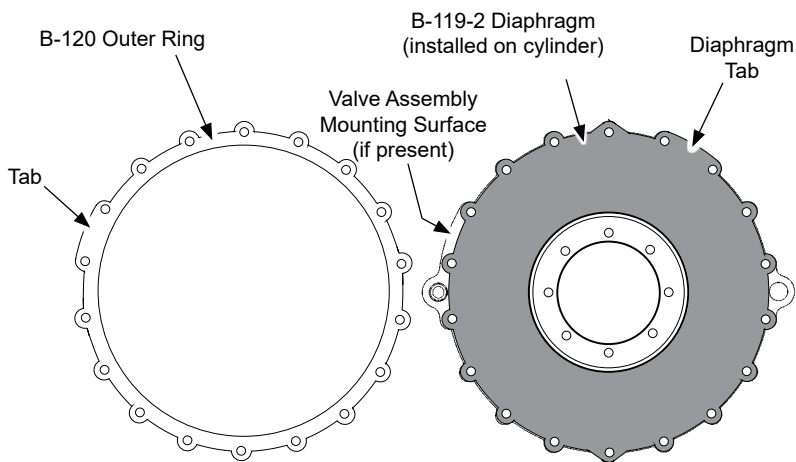
**Installation of the Diaphragm and the Inner Ring**  
**Figure 3-10**

- (j) Install the diaphragm and the inner ring.  
Refer to Figure 3-10.

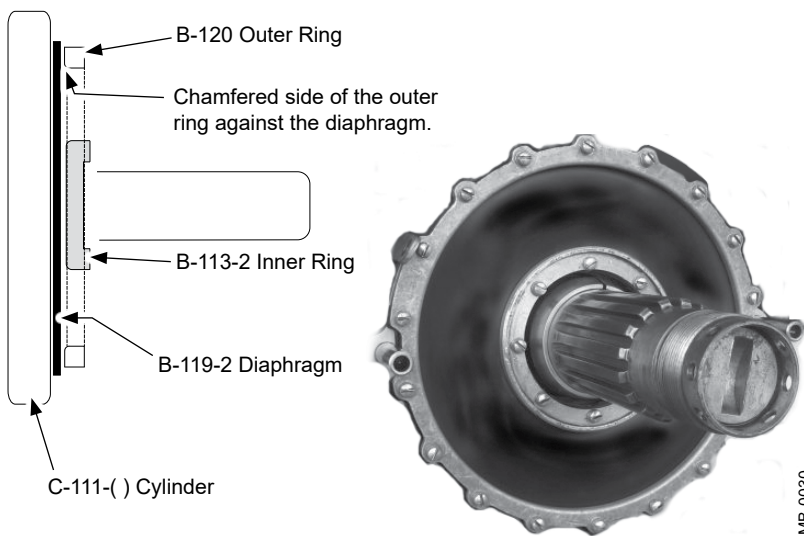
**WARNING:** DO **NOT** ALIGN THE TAB ON THE DIAPHRAGM WITH THE VALVE ASSEMBLY MOUNTING SURFACE ON THE CYLINDER. THIS WILL PREVENT THE DIAPHRAGM FROM SEATING PROPERLY AND MAY CAUSE THE DIAPHRAGM TO FAIL. FAILURE OF THE DIAPHRAGM CAN QUICKLY RESULT IN COMPLETE LOSS OF ENGINE OIL AND RAPID ENGINE SHUTDOWN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

**CAUTION:** MAKE SURE THE DIAPHRAGM MATING SURFACES ON THE CYLINDER AND INNER RING ARE CLEAN AND DRY BEFORE INSTALLING THE DIAPHRAGM. ANY OIL OR OTHER CONTAMINANTS ON THE MATING SURFACES COULD COMPROMISE THE SEAL AND CAUSE AN OIL LEAK.

- 1 Clean the diaphragm mating surfaces on the cylinder and inner ring with MEK or acetone.
- 2 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 3-10.
- 3 Position the flat side of the inner ring flush against the diaphragm.



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).



TPI-MB-0030

**Installation of the Outer Ring**  
**Figure 3-11**

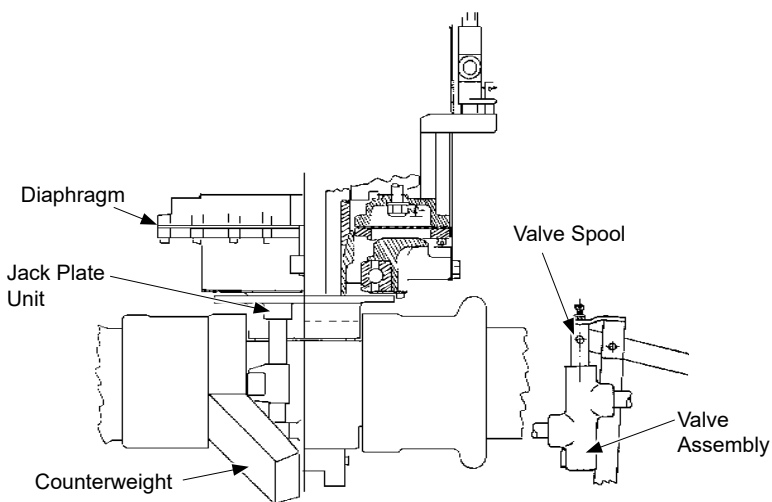
- 4 Align the mounting holes in the inner ring with the holes in the diaphragm and cylinder.
- 5 Install the screws through the inner ring and diaphragm and thread into cylinder. Refer to Table 3-1.

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

- 6 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).
- (k) Install the outer ring. Refer to Figure 3-11

CAUTION: MAKE SURE THE DIAPHRAGM MATING SURFACES ON THE CYLINDER AND OUTER RING ARE CLEAN AND DRY BEFORE INSTALLING THE DIAPHRAGM. ANY OIL OR OTHER CONTAMINANTS ON THE MATING SURFACES COULD COMPROMISE THE SEAL AND CAUSE AN OIL LEAK.

- 1 Clean the diaphragm mating surfaces on the cylinder and outer ring with MEK or acetone.
- 2 Position the chamfered side of the outer ring flush against the diaphragm.
- 3 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 3-11, align the tab with the valve assembly mounting surface (if present), not the diaphragm tab.
- 4 Install the lock washers onto the screws, then install the screws through the outer ring and diaphragm into the cylinder. Refer to Table 3-1.



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**Hydraulic Unit Travel Adjustment**  
**Figure 3-12**

**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 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.
- 6** 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 3-9.
  - 1** Connect the link with the tab and screw attached to the hydraulic piston.
  - 2** Insert the screw in the large hole in the link at the end farthest away from the valve and tab. Refer to Table 3-1.
  - 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).

**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 3-12.
- (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. Refer to 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) Using shaft nut wrench TE146, torque the hub nut on the engine shaft in accordance with Table 3-2.
- (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 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. Refer to 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 3-9.
- (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 around each mounting stud, flush against the gasket. Refer to Table 3-1.
- (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 on each of the six studs to secure the hydraulic cylinder to the engine. Refer to Table 3-1.
  - 3 Torque each nut in accordance with Table 3-2.
- (h) Install the diaphragm and the inner ring. Refer to Figure 3-10.

CAUTION 1: 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.

CAUTION 2: MAKE SURE THE DIAPHRAGM MATING SURFACES ON THE CYLINDER AND INNER RING ARE CLEAN AND DRY BEFORE INSTALLING THE DIAPHRAGM. ANY OIL OR OTHER CONTAMINANTS ON THE MATING SURFACES COULD COMPROMISE THE SEAL AND CAUSE AN OIL LEAK.

- 1 Clean the diaphragm mating surfaces on the cylinder and inner ring with MEK or acetone
- 2 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 3-10.

- 3 Position the flat side of the inner ring flush against the diaphragm.
- 4 Align the mounting holes in the inner ring with the holes in the diaphragm and cylinder.
- 5 Install the screws through the inner ring and diaphragm and thread into cylinder. Refer to Table 3-1.

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

- 6 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 3-11.

**CAUTION:** MAKE SURE THE DIAPHRAGM MATING SURFACES ON THE CYLINDER AND OUTER RING ARE CLEAN AND DRY BEFORE INSTALLING THE DIAPHRAGM. ANY OIL OR OTHER CONTAMINANTS ON THE MATING SURFACES COULD COMPROMISE THE SEAL AND CAUSE AN OIL LEAK.

- 1 Clean the diaphragm mating surfaces on the cylinder and outer ring with MEK or acetone
- 2 Position the chamfered side of the outer ring flush against the diaphragm.
- 3 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 3-11, align the tab with the valve assembly mounting surface (if present), not the diaphragm tab.
- 4 Install the lock washers onto the screws, then install the screws through the outer ring and diaphragm into the cylinder. Refer to Table 3-1.

**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 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.
- 6 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 3-12.
- (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.
  - (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. Refer to 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 TE146. Refer to Table 3-2 and Figure 3-3 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 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.

6. **Spinner Dome Installation** (Rev. 3)

**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. THIS MAY AFFECT THE DYNAMIC BALANCE OF THE PROPELLER.

**NOTE 1:** The following instructions relate to Hartzell Propeller LLC spinners only. In some cases, the airframe manufacturer produced the spinner assembly. If so, refer to the airframe manufacturer's manual for spinner installation instructions.

**NOTE 2:** The B-3845-8 screws supplied with metal spinner assemblies are 0.500 inch (12.70 mm) in length. If correct thread engagement cannot be achieved when installing the spinner dome, B-3845-9 screws may be used. The B-3845-9 screws are 0.562 inch (14.27 mm) in length.

**A. Installation Procedure**

**(1) Install the spinner dome.**

**(a) If anti-ice travel tubes are installed:**

**CAUTION: THE TRAVEL TUBES MUST NOT TOUCH THE SPINNER DOME BLADE CUTOUT.**

- 1** Make sure there is clearance between the travel tubes and the spinner dome blade cutouts.
- 2** Make adjustments to the position of the travel tubes in accordance to Hartzell Propeller Ice Protection System Manual 180 (30-61-80).

**CAUTION: MAKE SURE OF PROPER THREAD ENGAGEMENT FOR THE SCREWS IN THE NUTPLATES. APPROXIMATELY 1 TO 1 1/2 THREADS MUST EXTEND PAST THE BULKHEAD NUTPLATES. TO AVOID DAMAGING THE AIRCRAFT COWLING, THE SCREWS MUST NOT EXTEND MORE THAN THREE THREADS PAST THE BULKHEAD NUTPLATES.**

**(2) Attach the spinner dome to the spinner bulkhead with the supplied screws and washers. Refer to Table 3-4.**

**(a) Install a screw in the hole(s) centered between each two adjacent blade cutouts.**

| <b>Spinner Dome/Cap</b> | <b>Washer</b>        | <b>Screw</b>               |
|-------------------------|----------------------|----------------------------|
| Metal Dome              | A-1020 Washer, Fiber | B-3845-8 10-32, Truss Head |

**Spinner Dome and Spinner Cap Mounting Hardware**  
**Table 3-4**

- 1 If the centerline between the adjacent blade cutouts does not align with a mounting hole, install screws in the two holes closest to the centerline.

**CAUTION:** BE SURE THE SCREWS DRAW THE SPINNER DOME TIGHT TO THE BULKHEAD.

- (b) Tighten the screws until snug, then turn an additional 1/8 rotation.

**CAUTION:** IN THE FOLLOWING STEP, TIGHTEN EACH SCREW BEFORE INSTALLING THE NEXT SCREW.

- (c) Working from the screw(s) previously installed at the centerline toward the blade cutouts, install the remaining screws one at a time.

- 1 Tighten each screw until snug, then turn an additional 1/8 rotation before installing the next screw.

## 7. 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

(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 Checks (Rev. 1)

## A. Operational Checks

- (1) Refer to the Inspection and Check chapter of this manual for operational checks including pre-flight, initial run-up, and post-run checks.

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) (Rev. 2)

## (1) General

- (a) 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.
- (b) If the propeller is hunting, a certified airframe and powerplant mechanic with the appropriate rating or a certified propeller repair station with the appropriate rating should check:
  - 1 Governor
  - 2 Fuel control
  - 3 Synchrophaser, or synchronizer (if applicable)

## (2) If propeller is surging:

- (a) Perform the "Initial Run-Up" in accordance with the Inspection and Check chapter of this manual to release trapped air from the propeller.
  - 1 If surging reoccurs it is most likely due to a faulty governor.
    - a Have the governor tested by a certified propeller repair station with the appropriate rating.
- (b) Hunting and/or surging may also be caused by friction or binding within the governor control, or internal propeller corrosion, which causes the propeller to react slower to governor commands.
  - 1 To isolate these faults, the propeller must be tested on a test bench at a certified propeller repair station with the appropriate rating.

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

## (1) General

- (a) Small variances in engine speed are normal and are no cause for concern.

## L. Vibration (Rev. 1)

CAUTION 1: ANY VIBRATION THAT OCCURS SUDDENLY, OR IS ACCOMPANIED BY UNEXPLAINED OIL LEAKAGE SHOULD BE INVESTIGATED IMMEDIATELY BEFORE FURTHER FLIGHT.

CAUTION 2: VIBRATION PROBLEMS BECAUSE OF PROPELLER SYSTEM IMBALANCE ARE NORMALLY FELT THROUGHOUT THE RPM RANGE, WITH THE INTENSITY OF VIBRATION INCREASING WITH RPM. VIBRATION PROBLEMS THAT OCCUR IN A NARROW RPM RANGE ARE A SYMPTOM OF RESONANCE THAT IS POTENTIALLY HARMFUL TO THE PROPELLER. AVOID OPERATION UNTIL THE PROPELLER CAN BE CHECKED BY A CERTIFIED PROPELLER REPAIR STATION WITH THE APPROPRIATE RATING.

## (1) Check:

- (a) Control surfaces, cowl flaps, exhaust system, landing gear doors, etc. for excessive play that may be causing vibration unrelated to the propeller
- (b) Isolation of engine controls and lines
- (c) Engine mount wear
- (d) Uneven or over lubrication of propeller
- (e) Proper engine/propeller flange mating
- (f) Blade track:
  - 1 Refer to the section, "Blade Track" in the Inspection and Check chapter of this manual.
- (g) Blade angles:
  - 1 Blade angles must be within specified tolerance between blades.
    - a Refer to a certified propeller repair station with the appropriate rating to check/adjust blade angles.

- (h) Spinner for cracks, improper installation, or "wobble" during operation
- (i) Static balance
- (j) Hub damage or cracking
- (k) Grease or oil leakage
- (l) Blade deformation

(2) Dynamic Balance

- (a) Dynamic balancing is recommended after installing or performing maintenance on a propeller. While this is normally an optional task, it may be required by the engine or airframe manufacturer to make certain the propeller/engine combination is balanced properly before operation.

1 Refer to the engine or airframe manuals, and the Maintenance Practices chapter of this manual.

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)

INSPECTION AND CHECK - CONTENTS

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**1. Pre-Flight Checks** (Rev. 5)

**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. Important Information**

- (1) Follow propeller pre-flight inspection procedures specified in the Pilot Operating Handbook (POH) in addition to the inspections specified in this section.
- (2) Defects or damage found during the pre-flight inspection must be evaluated in accordance with the applicable section in the Testing and Troubleshooting chapter and/or the Maintenance Practices chapter of this manual.

**B. Propeller Blades**

- (1) Visually examine the entire blade (leading edge, trailing edge, face, and camber sides) for nicks, gouges, erosion, and cracks.
  - (a) Normal erosion (sand-blasted appearance) on the leading edge of the blade is permitted and does not require removal before further flight.
- (2) Visually examine the blades for lightning strike indications in accordance with the section, "Lightning Strike" in this chapter.
- (3) Check the blades for radial play or movement of the blade tip (in-and-out, fore-and-aft, and end play).
  - (a) Refer to the section, "Blade Tolerances" in this chapter for blade play limits.
- (4) If an ice protection system is installed, visually examine the anti-icing or de-ice boot for damage.
  - (a) Refer to the Anti-ice and De-ice Systems chapter in this manual for operational checks and troubleshooting information for Hartzell Propeller ice protection systems.

- C. Spinner Assembly and Blade Retention Components
  - (1) Inspect the spinner and the visible blade retention components for damage and/or cracks.
    - (a) Repair or replace components as required before further flight.
- D. Hardware
  - (1) Check for loose or missing hardware.
    - (a) Retighten or reinstall as necessary.

**WARNING:** ABNORMAL GREASE/OIL 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.

- E. Grease/Oil Leakage
  - (1) Examine the face and camber-sides of the blades for evidence of grease/oil leakage.
  - (2) Using an appropriate light source, examine the propeller through the blade cut-outs in the spinner for signs of grease/oil leakage.
    - (a) Spinner removal is not required for this inspection.
    - (b) If grease/oil leakage is found, refer to the section, "Inspection Procedures" in this chapter.
- F. Initial Run-Up
  - (1) Perform the Initial Run-Up procedure in accordance with the section, "Operational Checks" in this chapter.
- G. Additional Information
  - (1) Refer to the airframe manufacturer's manual for additional pre-flight checks.
  - (2) Refer to the section, "Inspection Procedures" in this chapter for additional inspection/repair information.

**2. Operational Checks** (Rev. 4)

**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) Following propeller installation and before flight, perform the Initial Run-Up procedure in accordance with the instructions in this section.

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

- (2) Perform engine start and warm-up in accordance with the Pilot's Operating Handbook (POH).

**CAUTION:** AIR TRAPPED IN THE PROPELLER HYDRAULIC CYLINDER WILL CAUSE PITCH CONTROL TO BE IMPRECISE AND CAN CAUSE PROPELLER SURGING.

- (3) Cycle the propeller control through the operating blade range from low pitch to high pitch (or as specified in the POH).

- (a) Repeat this step at least three times.

**NOTE:** Cycling the propeller control purges air from the propeller hydraulic system and introduces warm oil to the cylinder.

- (4) Check the propeller speed control and operation from low pitch to high pitch using the procedure specified in the POH.
  - (a) Perform all ground functional, feathering, and cycling checks with the minimum propeller RPM drop required to demonstrate the function.

**WARNING:** ABNORMAL VIBRATION CAN BE AN INDICATION OF A FAILING PROPELLER BLADE OR BLADE RETENTION COMPONENT. AN IN-FLIGHT BLADE SEPARATION CAN RESULT IN DEATH, SERIOUS BODILY INJURY, AND/OR SUBSTANTIAL PROPERTY DAMAGE.

- (5) Check for any abnormal vibration during this run-up.
  - (a) If vibration occurs, shut the engine down, determine the cause, and correct it before further flight.
    - 1 Refer to the section, "Vibration" in the Testing and Troubleshooting chapter of this manual to determine the cause/correction for the vibration.
- (6) Shut down the engine in accordance with the POH.
- (7) For additional inspection information (including possible corrections), refer to the section, "Inspection Procedures" in this chapter, and/or the Testing and Troubleshooting chapter of this manual.
- (8) Refer to the POH and the airframe manufacturer's manual for additional operational checks.

## B. Static RPM Check (Governing Propeller)

**NOTE:** This operational check should be performed after installation, maintenance, or propeller adjustment.

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

- (1) Set the brakes and chock the aircraft or tie aircraft down.
- (2) Back the Maximum RPM Stop on the governor out one turn.
- (3) Start the engine.
- (4) Advance the propeller control lever to MAX (max RPM), then retard the control lever one inch (25.4 mm).
- (5) SLOWLY advance the throttle to the maximum manifold pressure.
- (6) Slowly advance the propeller control lever until the engine speed stabilizes.
  - (a) If engine speed stabilizes at the maximum power static RPM specified by the TC or STC holder, then the low pitch stop is set correctly.
  - (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.
- (7) Stop the engine.
- (8) Return the Maximum RPM Stop on the governor to the original position.
- (9) Test fly the aircraft to confirm the maximum rated RPM specified in the aircraft TC or STC is achieved.
  - (a) Adjust the governor to the rated RPM with the Maximum RPM Stop screw.
    - 1 If the governor is adjusted to the rated RPM with the maximum RPM stop screw, hold the maximum RPM stop screw in place and torque the maximum RPM stop locking nut in accordance with Table 3-2, Torque Table.
- (10) Refer to the Aircraft Maintenance Manual for additional procedures that may be required after propeller installation.

- C. Static RPM Check (Non-Governing Propellers)
  - (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.
    - (a) Refer to the airframe manufacturer's manual or the STC paperwork for the applicable static RPM.
- D. Post-Run Check
  - (1) After engine shutdown, check propeller for signs of grease/oil leakage.
- E. Propeller Ice Protection System
  - (1) Refer to the Anti-ice and De-ice Systems chapter in this manual for operational checks and troubleshooting information for Hartzell Propeller ice protection systems.

3. Required Periodic Inspections and Maintenance (Rev. 3)

**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. Periodic Inspection
  - (1) Perform the following inspection procedures at 100 hour intervals, not to exceed twelve (12) calendar months. Procedures involved in these inspections are detailed below.
    - (a) 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.

- 1 In this situation, the airframe manufacturer's schedule may be applied as long as the calendar limit for the inspection interval does not exceed twelve (12) months.
  - (b) For additional inspection information (including possible corrections), refer to the section, "Inspection Procedures" in this chapter, and/or the Testing and Troubleshooting chapter of this manual.
  - (2) Remove the spinner dome.
  - (3) Visually examine the propeller blades (lead edge, trail edge, face, and camber sides) for nicks, gouges, erosion, cracks, etc.
    - (a) Refer to the section, "Aluminum Blades" in the Maintenance Practices chapter of this manual for damage evaluation and repair information.
  - (4) Make an entry in the propeller logbook about completion of these inspections.
- B. Periodic Maintenance
- (1) Lubricate the propeller assembly.
    - (a) Refer to the section, "Lubrication" in the Maintenance Practices chapter of this manual for intervals and procedures.
- 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 call for 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 chapter of this manual.
  - (3) Operators are urged to keep informed of airworthiness information via Hartzell Propeller Service Bulletins and Service Letters, which are available from Hartzell distributors or from Hartzell by subscription. Selected information is also available on Hartzell Propeller's website at [www.hartzellprop.com](http://www.hartzellprop.com).

## D. Overhaul Periods

- (1) In flight, the propeller is constantly subjected to vibration from the engine and the airstream, as well as high centrifugal forces.
- (2) The propeller is also subject to corrosion, wear, and general deterioration due to aging. Under these conditions, metal fatigue or mechanical failures can occur.
- (3) To protect your safety, 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.
  - (a) For propeller overhaul periods, refer to Hartzell Propeller Service Letter HC-SL-61-61Y.

4. Inspection Procedures

## A. Blade Damage (Rev. 1)

- (1) Refer to the section, "Aluminum Blades" in the Maintenance Practices chapter of this manual for damage evaluation and repair information.

## B. Grease/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 Product Support.

## C. Vibration (Rev. 3)

**NOTE:** 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 blades and the blade retention components should be considered as potential sources of the vibration.

## (1) Important Information

- (a) Instances of abnormal vibration should be investigated immediately. If the cause of the vibration is not readily apparent, examine the propeller in accordance with the instructions in this section.
- (b) Perform troubleshooting and evaluation of possible sources of vibration in accordance with engine or airframe manufacturer's instructions.
- (c) Refer to the section, "Vibration" in the Testing and Troubleshooting chapter of this manual.
  - 1 Perform the checks to determine possible cause of the vibration.
    - a If no cause is found, the propeller could be the source of the vibration. Examine the propeller in accordance with the Inspection steps in this section.

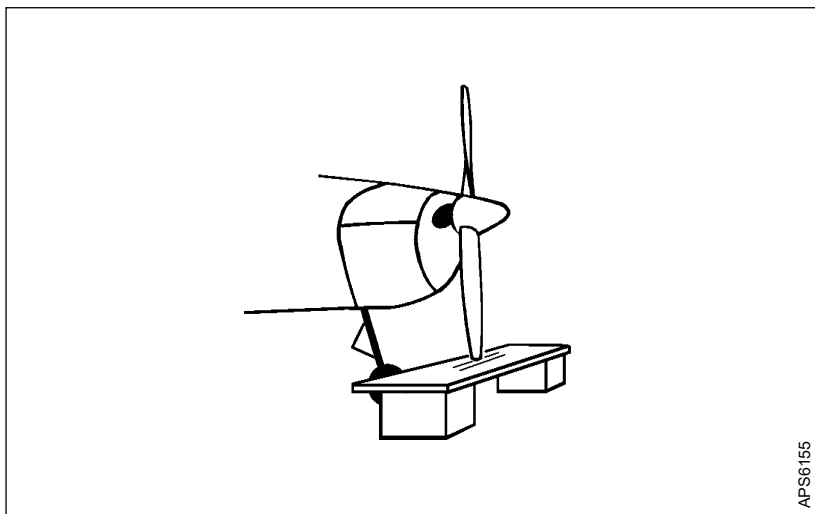
## (2) Inspection

- (a) Remove the spinner dome.
- (b) Visually examine the hub, blades, and blade clamps (if applicable) for cracks.
  - 1 Pay particular attention to the blade clamps on steel hub propellers.
  - 2 A crack may be readily visible, or may be indicated by grease leaking from a seemingly solid surface.

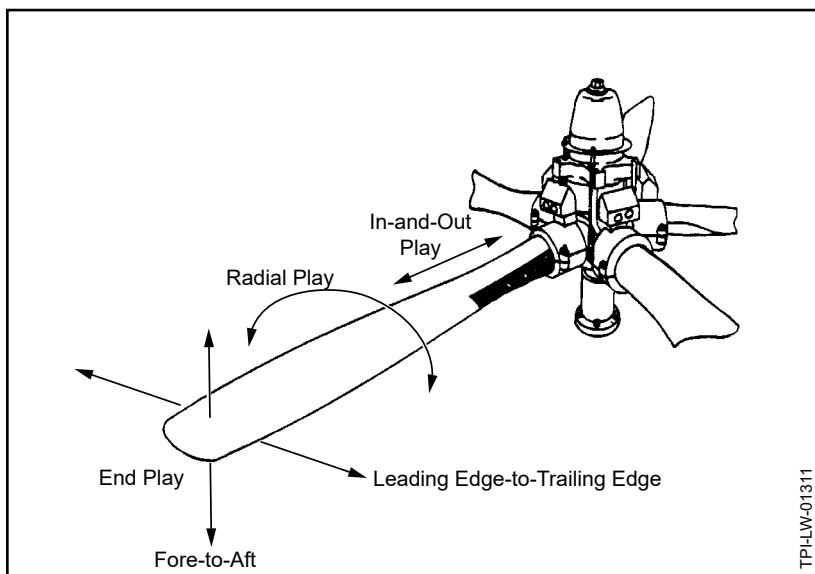
- (c) If cracks are suspected, additional inspections must be performed to evaluate the condition before further flight.
  - 1 These inspections typically include disassembly of the propeller, followed by inspection of parts, using nondestructive methods in accordance with published procedures.
  - 2 These inspections must be performed at a certified propeller repair station with the appropriate rating.
- (d) Inspect the play of the propeller blades in accordance with the section, "Blade Tolerances" in this chapter.
- (e) Inspect blade track in accordance with the section, "Blade Track" in this chapter.

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

- 1 Manually (by hand) attempt to turn the blades (change pitch).
  - 2 Visually check for damaged blades.
- (f) If abnormal blade conditions or damage are found, additional inspections must be performed to evaluate the condition before further flight.
  - 1 These inspections must be performed at a certified propeller repair station with the appropriate rating.
- (g) If cracks or failing components are found, these parts must be replaced before further flight.
  - 1 Report such occurrences to airworthiness authorities and Hartzell Propeller Product Support.



**Checking Blade Track**  
**Figure 5-2**



**Blade Play**  
**Figure 5-3**

## D. Blade Track

(1) Check the blade track as follows:

- (a) Chock the aircraft wheels securely.
- (b) Refer to Figure 5-2. 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  $\pm 0.0625$  inch (1.58 mm) or 0.125 inch (3.17 mm) total.

## E. Blade Tolerances (Rev. 4)

(1) Limits for blade play are specified below.  
Refer to Figure 5-3.

(a) End Play:

|                  |                             |
|------------------|-----------------------------|
| 1 Leading        | $\pm 0.0625$ inch (1.58 mm) |
| Edge-to-Trailing | Total: 0.125 inch (3.17 mm) |
| Edge             |                             |

|                  |                             |
|------------------|-----------------------------|
| 2 Fore-to-Aft    | $\pm 0.0625$ inch (1.58 mm) |
| (face to camber) | Total: 0.125 inch (3.17 mm) |

(b) In-and-Out Play      0.032 inch (0.81 mm)

(c) Radial Play       $\pm 0.5$  degree (Total: 1 degree)  
pitch change      measured at reference station

(2) Blades should be tight in the propeller; however, play that is within the allowable limits is acceptable if the blade returns to its original position when released.

## F. Corrosion (Rev. 1)

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

- (1) Corrosion of any type on the hub or heavy corrosion on other parts that results in severe pitting must be referred to a certified propeller repair station with the appropriate rating.

## G. Spinner Damage (Rev. 3)

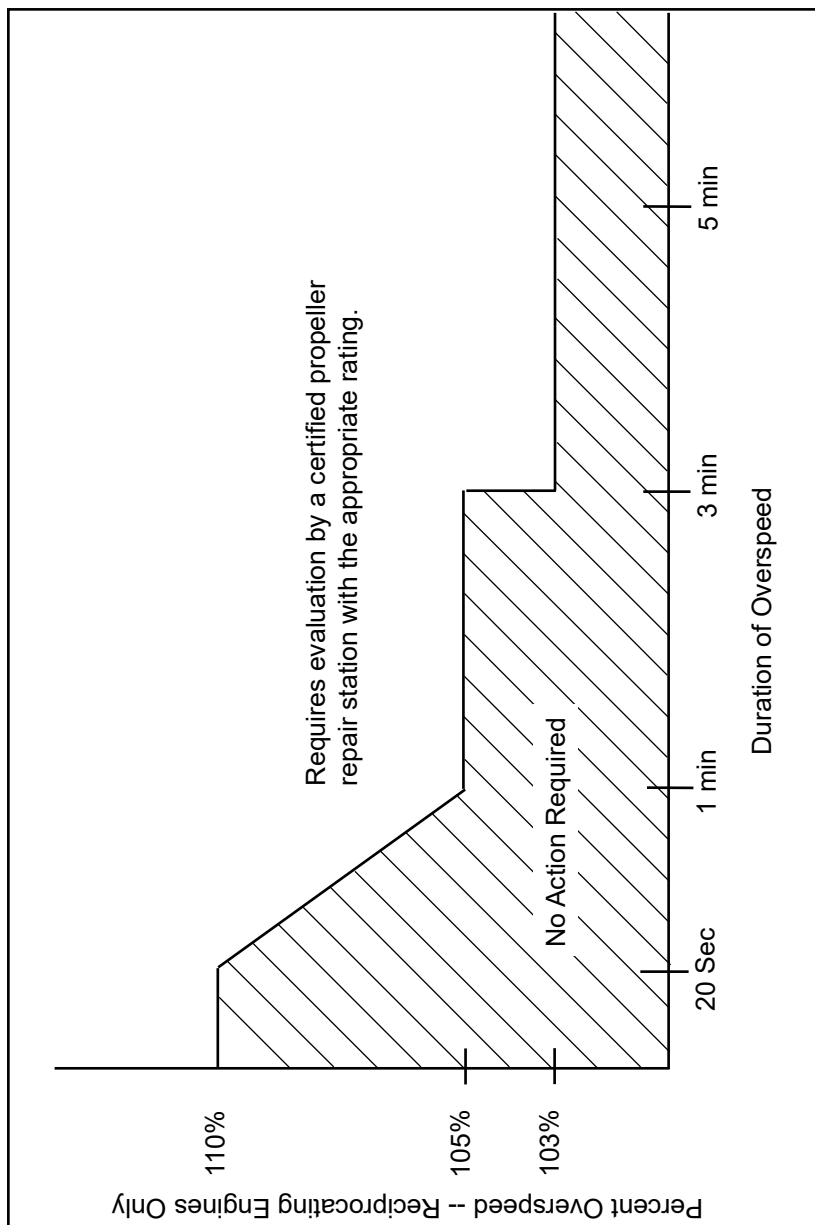
- (1) Inspect the spinner for cracks, missing hardware, or other damage.

- (a) Metal Spinners

- 1 For damage evaluation and repair information, refer to Hartzell Propeller Manual 127 (61-16-27) or a certified propeller repair station with the appropriate rating.
  - 2 Contact the local airworthiness authority for repair approval.

- (b) Composite Spinners

- 1 For damage evaluation and repair information, refer to Hartzell Propeller Composite Spinner Maintenance Manual 148 (61-16-48) or a certified propeller repair station with the appropriate rating.
  - 2 Contact the local airworthiness authority for repair approval.



**Reciprocating Engine Overspeed Limits**  
**Figure 5-4**

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 (Rev. 2)

- (1) An overspeed occurs when the propeller RPM exceeds the maximum RPM stated in the applicable Aircraft Type Certificate Data Sheet. The duration of time and magnitude of overspeed for a single event determines the corrective action that must be taken to make sure no damage to the propeller has occurred.
- (2) 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.
  - (a) When a propeller installed on a reciprocating engine has an overspeed event, refer to the Reciprocating Engine Overspeed Limits (Figure 5-4) to determine the corrective action to be taken.
  - (b) If an overspeed requiring propeller evaluation occurs on an aircraft using a Hartzell Propeller governor, the governor must be evaluated by a certified propeller repair station with the appropriate rating.
  - (c) Make a record of the overspeed event in the propeller logbook, indicating any corrective action(s) taken.

## B. Lightning Strike (Rev. 1)

**CAUTION:** REFER TO THE ENGINE AND AIRFRAME MANUFACTURER'S MANUALS FOR ADDITIONAL INSPECTIONS TO PERFORM AFTER A PROPELLER LIGHTNING STRIKE.

## (1) General

- (a) In the event of a propeller lightning strike, an inspection is required before further flight.
- (b) If the propeller meets the requirements of the "Temporary Operation Inspection" in this section, 10 hours of operation is permitted before propeller disassembly/inspection must be performed.

## (2) Temporary Operation Inspection

- (a) Remove the spinner dome and perform a visual inspection of the propeller, blades, spinner, and ice protection system for evidence of damage that would require repair before flight (such as broken wires or arcing damage to propeller hub).

**CAUTION:** IF THE PROPELLER EXPERIENCES A LIGHTNING STRIKE, REFER TO THE "ALUMINUM BLADES" SECTION IN THE MAINTENANCE PRACTICES CHAPTER OF THIS MANUAL TO EVALUATE THE DAMAGE BEFORE FURTHER FLIGHT.

- 1 If the only evident damage is minor arcing burns to the blades, temporary operation for up to 10 flight hours is permitted before propeller disassembly and inspection.

- 2 If there is evidence of additional damage, beyond minor arcing burns to the blades, temporary operation is not permitted. The propeller must be removed from the aircraft, disassembled, evaluated, and/or repaired by a certified propeller repair station with the appropriate rating before further flight.
  - (b) Make a record of the lightning strike in the propeller logbook, indicating any corrective action(s) taken.
- (3) For flight beyond the 10-hour temporary operation limit:
  - (a) The propeller must be removed from the aircraft, disassembled, evaluated, and/or repaired by a certified propeller repair station with the appropriate rating.

**C. Foreign Object Strike/Ground Strike (Rev. 3)**

**(1) General**

- (a) A foreign object/ground strike can include a broad spectrum of damage, from a minor stone nick to severe ground impact damage.
  - 1 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/ground 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.
    - a Examples of foreign object/ground 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(s).
    - b These cases should be handled as foreign object/ground 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.
    - (c) In the event of a foreign object/ground strike, an inspection is required before further flight.
  - (2) Inspection Procedure
    - (a) Examine the propeller assembly for damage related to the foreign object/ground strike.
    - (b) If any of the following indications are found, the propeller must be removed from the aircraft, disassembled, and overhauled by a certified propeller repair station with the appropriate rating.
      - 1 Blade(s) damaged, bent, or out of track/angle
      - 2 Blade(s) loose in the hub (if applicable)
        - a Refer to the section, "Blade Tolerances" in this chapter for the permitted limits of blade play.
      - 3 Blade(s) rotated in the clamp
      - 4 Any noticeable or **suspected** damage to the pitch change mechanism
      - 5 Any blade diameter reduction
      - 6 Bent, cracked, or failed engine shaft
      - 7 Vibration during operation (that was not present before the event)
    - (c) Aluminum Blades: Nicks, gouges, and scratches on blade surfaces or the leading and trailing edges must be removed before flight.
      - 1 Refer to the section, "Aluminum Blades" in the Maintenance Practices chapter of this manual (if applicable) for damage evaluation and repair information.

- (d) 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.

- 1 These components must be inspected and repaired in accordance with the applicable component maintenance manual.

- (e) Make a record of the foreign object/ground strike event in the propeller logbook, indicating any corrective action(s) taken.

D. Fire/Heat Damage (Rev. 1)

**WARNING:** HIGH TEMPERATURES CAN CAUSE SERIOUS DAMAGE TO PROPELLER HUBS, CLAMPS, AND BLADES (ALUMINUM AND COMPOSITE). THIS DAMAGE CAN RESULT IN CATASTROPHIC FAILURE CAUSING DEATH, SERIOUS BODILY INJURY, AND/OR SUBSTANTIAL PROPERTY DAMAGE.

- (1) A propeller that has been exposed to fire or high temperatures, such as an engine or hangar fire, must be inspected by a certified propeller repair station with the appropriate rating before further flight.

E. Sudden Stoppage (Rev. 1)

- (1) When there is a propeller sudden stoppage because of catastrophic engine failure or seizure, the propeller and any engine driven/powered accessory must be inspected and repaired in accordance with the applicable component maintenance manual.
- (2) If the sudden stoppage was caused by a foreign object strike, refer to the section, "Foreign Object/Ground Strike" in this chapter.

## F. Engine Oil Contamination (Rev. 1)

- (1) Following an incident of oil contamination, the components of the propeller that were exposed to oil contamination must be removed, cleaned, and inspected.
  - (a) A propeller that was exposed to oil contamination must be removed and sent to a certified propeller repair station with the appropriate rating for disassembly, cleaning, and inspection.
  - (b) A governor that was exposed to oil contamination must be inspected and repaired in accordance with the applicable component maintenance manual.

6. Long Term Storage (Rev. 1)

## A. Important Information

- (1) Parts shipped from Hartzell Propeller LLC are not shipped or packaged in a container that is designed for long term storage.
- (2) Long term storage procedures are detailed in Hartzell Propeller Standard Practices Manual 202A (61-01-02).
- (3) Information regarding the return of a propeller assembly to service after long term storage is detailed in Hartzell Propeller Standard Practices Manual 202A (61-01-02).

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1. Cleaning (Rev. 2)

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: BEFORE CLEANING THE PROPELLER, BE SURE THE PROPELLER HAS BEEN INSPECTED IN ACCORDANCE WITH THE REQUIRED PERIODIC INSPECTIONS SPECIFIED IN THIS MANUAL. CLEANING THE PROPELLER PRIOR TO INSPECTION MAY REMOVE EVIDENCE OF A CONDITION THAT REQUIRES CORRECTIVE ACTION.

CAUTION 3: 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) Remove the spinner dome in accordance with the Installation and Removal chapter in this manual.

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

- (2) Using a clean cloth dampened with Stoddard solvent CM23 or equivalent, wipe the inside of the spinner dome to remove grease, oil, and other residue.
  - (a) Immediately dry the inside of the spinner dome using a clean dry cloth.
- (3) Using a clean cloth dampened with Stoddard solvent CM23 or equivalent, wipe the accessible surfaces of the hub, counterweight clamps, slip ring, and bulkhead to remove grease, oil, and other residue.
- (4) Fill a tank sprayer with a non-caustic/non-acidic soap solution.

**IMPORTANT:** WHEN PERFORMING STEPS 5 THRU 7, THE BLADE(S) TO BE CLEANED MUST POINT DOWNWARD. THIS WILL PREVENT THE SOAP SOLUTION AND/OR CONTAMINANTS FROM FLOWING INTO THE HUB/BLADE SEAL AREA.

**CAUTION:** DO NOT LET THE SOAP SOLUTION DRY ON THE SURFACES OF THE HUB, BULKHEAD, OR SLIP RING.

- (5) Using the tank sprayer, apply a fine mist of the soap solution to the surfaces of the downward facing blades, and the hub, bulkhead, and slip ring around the downward facing blades.
  - (a) Use a cloth or soft nylon brush to loosen dirt and unwanted material on the surfaces where the soap solution was applied, particularly on the inboard surface of the counterweight clamp.
- (6) Using clean potable water at low pressure, rinse the surfaces where the soap solution was applied to remove dirt, unwanted material, and soap residue.
- (7) Use a clean dry cloth to dry the surfaces cleaned in the previous steps.
- (8) Rotate the propeller so that the next blade(s) to be cleaned are pointing downward, then repeat steps 5 thru 7.
  - (a) Repeat steps 5 thru 8 until all blades have been cleaned and dried.
- (9) Let the propeller dry.
- (10) Install the spinner dome in accordance with the Installation and Removal chapter in this manual.

**B. Spinner Cleaning and Polishing**

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

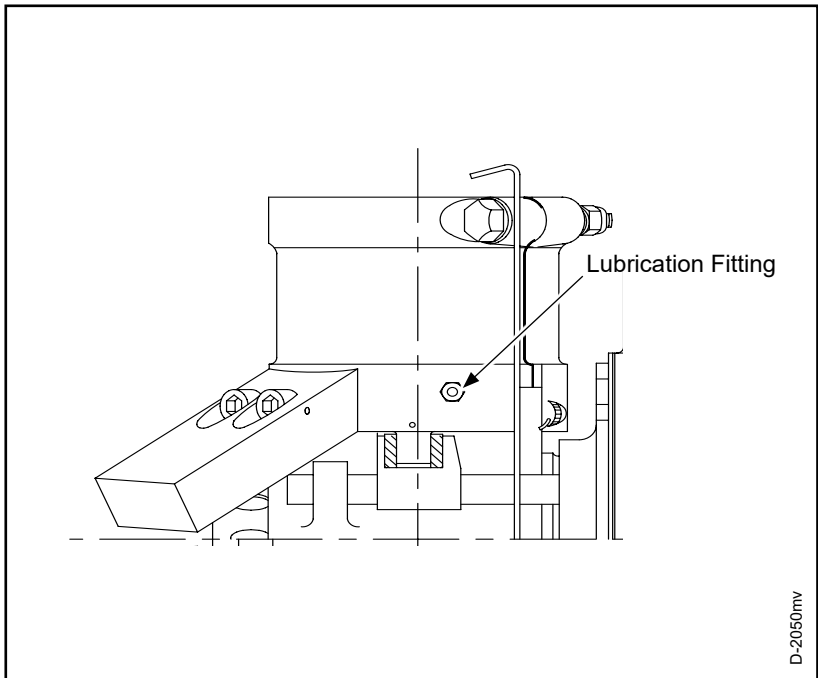
**2. Lubrication** (Rev. 6)

**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 intervals not to exceed 400 hours or 12 calendar months, whichever occurs first.
  - (a) Inspection and maintenance specified by an airframe manufacturer's maintenance program and approved by the applicable airworthiness agency may not coincide with the lubrication interval specified.
    - 1 In this situation, the airframe manufacturer's schedule may be applied as long as the calendar limit for the lubrication interval does not exceed twelve (12) months.
  - (b) 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.
  - (c) If the propeller is leaking grease, the lubrication interval should be reduced to 100 hours until the grease leak issue is resolved.
- (2) Owners of high use aircraft may wish to extend their lubrication interval. The lubrication interval may be gradually extended after evaluating bearing wear and internal corrosion when the propeller is overhauled.

- (3) Hartzell Propeller LLC recommends that new or newly overhauled propellers be lubricated after approximately the first ten hours of operation, because centrifugal loads will pack and redistribute grease which can result in a propeller imbalance. Redistribution of grease may also result in voids in the blade bearing area where moisture can collect.
- (a) Purchasers of new aircraft should check the propeller logbook to verify whether the propeller was lubricated by the manufacturer during flight testing. If it was not lubricated, the propeller should be serviced at the earliest convenience.



**Lubrication Fitting**  
**Figure 6-1**

## B. Lubrication Procedure

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

(1) Remove the propeller spinner.

**CAUTION:** STEEL BLADE CLAMPS PRODUCED BEFORE 1967 MAY HAVE ONLY ONE LUBRICATION FITTING. DO NOT REMOVE THIS FITTING WHEN SERVICING.

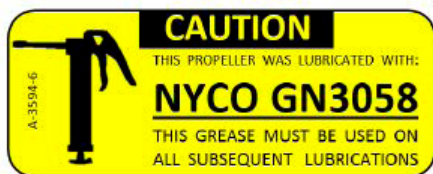
(2) Remove the outboard lubrication fitting from the blade clamp, and the cap from the inboard lubrication fitting. Refer to Figure 6-1.

**CAUTION:** USE CARE NOT TO DAMAGE THE THREADED HOLE WHEN REMOVING A BLOCKAGE.

(3) If there is a blockage in the threaded hole where the lubrication fitting was removed (ex. hardened grease), bend a piece of safety wire and use the bent end to loosen the blockage.

THIS PROPELLER WAS  
LUBRICATED WITH \_\_\_\_\_  
THIS GREASE MUST BE USED ON  
ALL SUBSEQUENT LUBRICATIONS.

LABEL A-3594



**Lubrication Label**  
**Figure 6-2**

**CAUTION:** USE ONLY HARTZELL PROPELLER APPROVED GREASE. DO NOT MIX DIFFERENT SPECIFICATIONS AND/OR BRANDS OF GREASE EXCEPT AS NOTED IN THIS SECTION.

(4) A label is normally applied to the propeller to indicate the type of grease previously used. Refer to Figure 6-2.

- (a) The same grease type should be used during re-lubrication unless the propeller has been disassembled and the old grease removed.
- 1 It is not possible to purge old grease through lubrication fittings.
  - 2 To completely replace one grease with another, the propeller must be disassembled and cleaned in accordance with the applicable overhaul manual.

(5) If different grease types are accidentally mixed, the propeller must be disassembled and cleaned in accordance with the applicable overhaul/maintenance manual within three months or 30 flights whichever occurs first.

- (a) EXCEPTION: Aeroshell 5 and Aeroshell 6 greases both have a mineral oil base and the same thickening agent; therefore, mixing of these two greases is permitted in Hartzell propellers.

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

**CAUTION 1:** IF A PNEUMATIC GREASE GUN IS USED, EXTRA CARE MUST BE TAKEN TO AVOID EXCESSIVE PRESSURE BUILDUP.

CAUTION 2: GREASE MUST BE APPLIED TO ALL BLADES OF A PROPELLER ASSEMBLY AT THE TIME OF LUBRICATION.

CAUTION 3: DO NOT ATTEMPT TO PUMP MORE THAN 1 FL. OZ. (30 ML) OF GREASE INTO THE LUBRICATION FITTING. USING MORE THAN 1 FL. OZ. (30 ML) OF GREASE COULD RESULT IN OVER SERVICING OF THE PROPELLER. VERIFY THE OUTPUT OF THE GREASE GUN BEFORE SERVICING THE PROPELLER.

CAUTION 4: OVER LUBRICATING A STEEL HUB PROPELLER MAY CAUSE THE GREASE TO DISLODGE THE CLAMP GASKET OR SEAL, LEADING TO A POTENTIAL GREASE LEAK. THE CLAMP MUST THEN BE DISASSEMBLED TO REMOVE THE SEAL OR CLAMP GASKET.

(6) Apply grease in accordance with the applicable step below.

(a) For blade clamps with two lubrication fittings:

- 1 Pump a maximum of 1 fl. oz. (30 ml) grease into the into the inboard lubrication fitting lubrication fitting or until grease emerges from the hole where the lubrication fitting was removed, whichever occurs first.

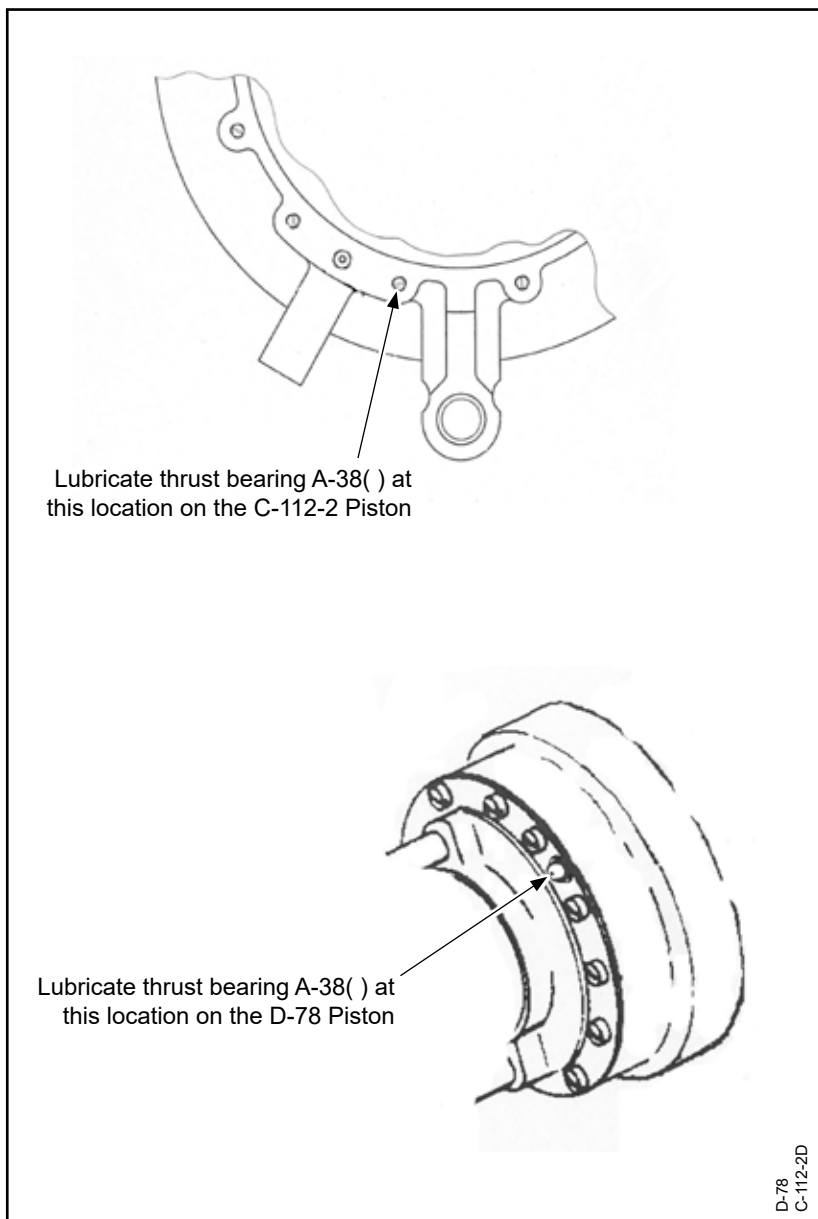
a Repeat for each blade clamp assembly.

(b) For blade clamps with only one lubrication fitting:

- 1 Without using excessive pressure, slowly pump a maximum of 1 fl. oz. (30 ml) grease into the lubrication fitting.

a If there is too much pressure, loosen the lubrication fitting used to add the grease, then tighten the fitting until snug.

b Repeat for each blade clamp assembly.



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

- (7) Reinstall the lubrication fittings on each blade clamp that were removed at the beginning of this procedure.
- (8) Tighten the lubrication fittings until snug.
  - (a) Make sure the ball of each lubrication fitting is properly seated.
- (9) Install a lubrication fitting cap on each lubrication fitting.
- C. Approved Lubricants
  - (1) For a list of lubricants approved for use in Hartzell propellers, refer to the Consumable Materials chapter of Hartzell Propeller Standard Practices Manual 202A (61-01-02).
- 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 P/N CM139-2, lubricate the A-38( ) thrust bearing in accordance with Figure 6-3.

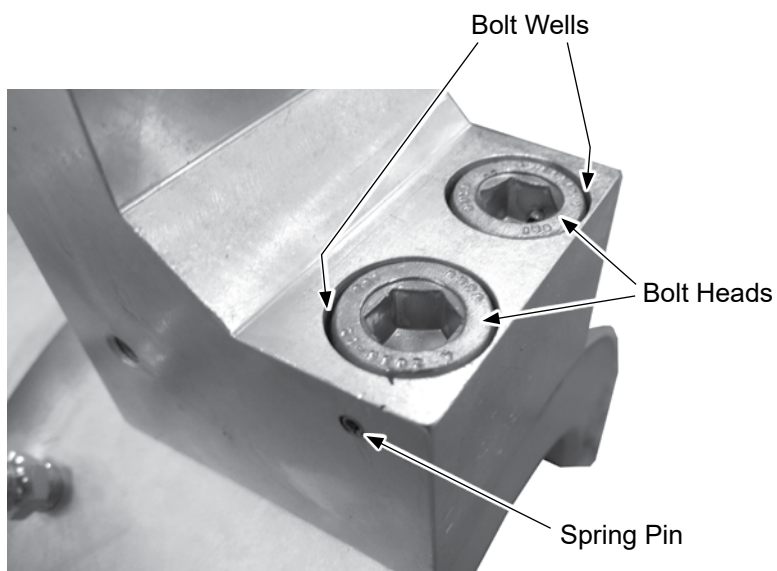
**3. Corrosion Inhibitor** (Rev. 2)

**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. Application Intervals**

- (1) The bolt-on, steel counterweights on propellers manufactured after the release date of Service Letter HC-SL-61-364 dated April, 3, 2020 will be coated with corrosion inhibitor CM352 by Hartzell Propeller during the assembly process.
  - (a) Corrosion inhibitor CM352 is applied to prevent corrosion on the counterweight.
  - (b) Periodic re-application of the corrosion inhibitor CM352 will provide extended protection from corrosion.
    - 1 Hartzell Propeller LLC recommends re-application of the corrosion inhibitor CM352 at regularly scheduled intervals, similar to the lubrication interval specified in this propeller owner's manual.

NOTE: Non-painted clamp unit is shown.



TPH-LW-202A-VOL-5-00402

**Applying Corrosion Inhibitor**  
**Figure 6-4**

## B. Application Procedure

- (1) Remove the spinner dome in accordance with the Installation and Removal chapter of this manual.

**CAUTION:** DO NOT APPLY CORROSION INHIBITOR CM352 ONTO ICE PROTECTION SYSTEM COMPONENTS (TERMINAL STRIPS, BOOTS, HARNESSES, ETC.).

- (2) Spray the corrosion inhibitor CM352 into a cup or container, then use a soft bristled brush to apply the corrosion inhibitor CM352 to the bolt heads, spring pins, and bolt wells of the counterweight. Refer to Figure 6-4.
  - (a) Use caution when applying the corrosion inhibitor CM352 around ice protection system components (terminal strips, boots, harnesses, etc.).
  - (b) Make sure the bolt heads, spring pins, and bolt wells are completely covered by the corrosion inhibitor CM352.
  - (c) Optionally, corrosion inhibitor CM352 can be applied to all exposed surfaces of the counterweight.
- (3) Let the corrosion inhibitor CM352 cure for a minimum of three hours before flight.

**4. Aluminum Blades** (Rev. 6)

**WARNING:** NICKS, GOUGES, OR SCRATCHES OF ANY SIZE CAN CREATE A STRESS RISER THAT COULD POTENTIALLY LEAD TO BLADE CRACKING. ALL DAMAGE SHOULD BE VISUALLY EXAMINED CAREFULLY BEFORE FLIGHT FOR THE PRESENCE OF CRACKS OR OTHER ABNORMALITIES.

**CAUTION 1:** BLADES THAT HAVE BEEN PREVIOUSLY REPAIRED OR OVERHAULED MAY HAVE BEEN DIMENSIONALLY REDUCED. BEFORE REPAIRING SIGNIFICANT DAMAGE OR MAKING REPAIRS ON BLADES THAT ARE APPROACHING SERVICEABLE LIMITS, CONTACT A CERTIFIED PROPELLER REPAIR STATION WITH THE APPROPRIATE RATING OR THE HARTZELL PRODUCT SUPPORT DEPARTMENT FOR BLADE DIMENSIONAL LIMITS.

**CAUTION 2:** 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. Important Information**

- (1) Nicks, gouges, and scratches on blade surfaces or on the leading or trailing edges of the blade, that are greater than 0.031 inch (0.79 mm) wide or deep, must be repaired before flight.

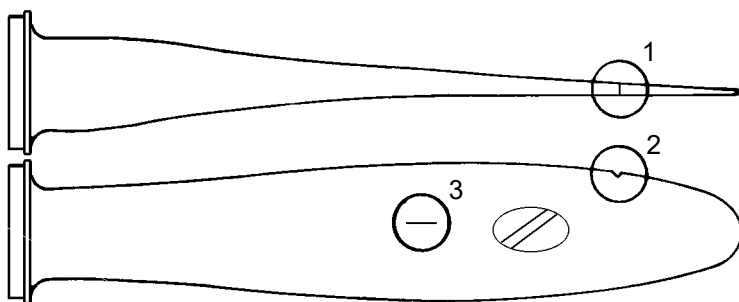
- (2) Field repair of small nicks and scratches may be performed by qualified personnel in accordance with FAA Advisory Circular 43.13-1B, and the procedures specified in this section.
- (3) Normal erosion (sand-blasted appearance) on the leading edge of the blade is acceptable, and does not require removal before further flight.

B. Repair of Nicks and Gouges

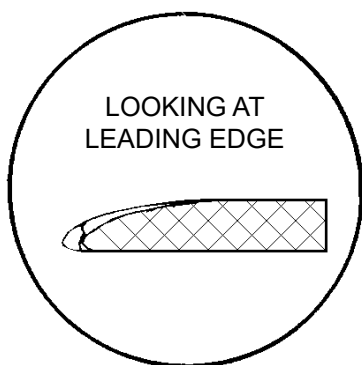
- (1) Local repairs may be made using files, electrical or air powered equipment. Use emery cloth, scotch brite, and crocus cloth for final finishing.

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

**CAUTION 2:** SHOT PEENED BLADES ARE IDENTIFIED WITH AN "S" IMMEDIATELY FOLLOWING THE BLADE MODEL NUMBER, AS DESCRIBED IN THE DESCRIPTION AND OPERATION CHAPTER OF THIS MANUAL. BLADES THAT HAVE DAMAGE IN 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 A CERTIFIED PROPELLER REPAIR STATION WITH THE APPROPRIATE RATING IN ACCORDANCE WITH HARTZELL PROPELLER ALUMINUM BLADE OVERHAUL MANUAL 133C (61-13-33).



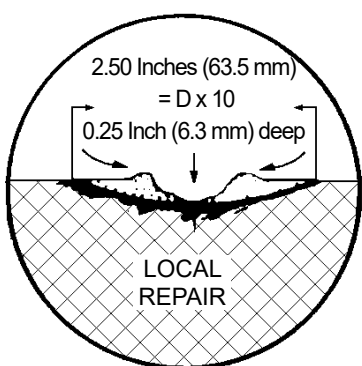
Example 1



LOOKING AT  
LEADING EDGE

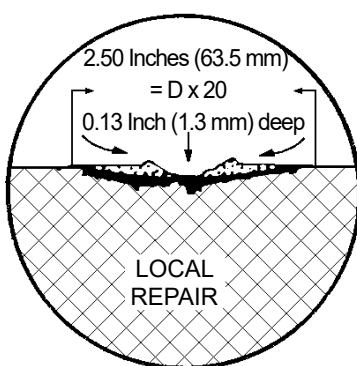
Finish repair must maintain  
original airfoil shape.

Example 2  
LEADING EDGE



LOCAL  
REPAIR

Example 3  
FACE/CAMBER



LOCAL  
REPAIR

APS6157

Repair Limitations  
Figure 6-5

- (2) Calculate the area of repair using Figure 6-5 and the following formulas:
  - (a) For leading and trailing edge damage:  
Depth of the damage x 10. Refer to Example 1 and 2.  
**NOTE:** The leading edge includes the first 10% of chord from the leading edge. The trailing edge consists of the last 20% of chord adjacent to the trailing edge.
  - (b) For face and camber side damage:  
Depth of damage x 20. Refer to Example 3.
- (3) Repair damage to the leading or trailing edge of the blade by removing material from the bottom of the damaged area.
  - (a) Remove material from this point out to both sides of the damage to form a smooth, blended depression that maintains the original shape of the blade airfoil.
- (4) Repair damage to the blade face or camber side by removing material from the bottom of the damaged area.
  - (a) Remove material from this point out to both sides of the damage to form a smooth, blended depression that maintains the original shape of the blade airfoil.
  - (b) Repairs that form a continuous line across the blade section (chordwise) are not permitted.
- (5) After filing or sanding the damaged area, use emery cloth to polish the area, then remove any file marks using crocus cloth.
- (6) Inspect the repaired area with a 10X magnifying glass.
  - (a) Be sure that no indication of the damage, file marks, or coarse surface finish remain.
- (7) If inspections show any remaining blade damage, repeat steps (5) and (6) of this procedure until no damage remains.
- (8) After repair, Hartzell Propeller recommends penetrant inspection of the blade in accordance with Hartzell Propeller Standard Practices Manual 202A (61-01-02).

- (9) 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.

(a) Refer to the section, "Blade Paint Touch-Up" in this chapter.

C. Repair of Bent Blades

**CAUTION:** DO NOT ATTEMPT TO "PRE-STRAIGHTEN" A BLADE BEFORE DELIVERY TO A CERTIFIED PROPELLER REPAIR STATION WITH THE APPROPRIATE RATING. THIS WILL CAUSE THE BLADE TO BE REPLACED BY THE REPAIR FACILITY.

- (1) Repair of a bent blade or blades is considered a major repair. This type of repair must be accomplished by a certified propeller repair station with the appropriate rating, and only within approved guidelines.

5. Blade Paint Touch-Up (Rev. 3)

**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. Important Information

- (1) Blade paint touch-up on Hartzell propeller blades may be permitted when performed in accordance with the instructions in this section.

(a) Aluminum Blades Only:

- 1 Blade paint touch-up is permitted for any size area on an aluminum blade.

## B. Paint

(1) The paints listed in Table 6-1 have been tested by Hartzell Propeller LLC and are recommended for blade touch-up.

(a) Alternate paints may be used for blade touch-up, but Hartzell Propeller LLC accepts no responsibility for wear or adhesion-related issues.

| Vendor           | Color/Type                | Vendor P/N                     | Hartzell Propeller LLC P/N |
|------------------|---------------------------|--------------------------------|----------------------------|
| Tempo            | Epoxy Black               | A-150                          | A-6741-145-2               |
| Tempo            | Epoxy Gray                | A-151                          | A-6741-146-2               |
| Tempo            | Epoxy White (tip stripe)  | A-152                          | A-6741-147-2               |
| Tempo            | Epoxy Red (tip stripe)    | A-153                          | A-6741-149-2               |
| Tempo            | Epoxy Yellow (tip stripe) | A-154                          | A-6741-150-2               |
| Sherwin-Williams | Black                     | F75KXB9958-4311                | A-6741-145-1               |
| Sherwin-Williams | Gray                      | F75KXA10445-4311               | A-6741-146-1               |
| Sherwin-Williams | Gray Metallic             | F75KXM9754-4311                | A-6741-148-1               |
| 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 Metallic           | F63TXS30880-4311               | A-6741-163-1               |
| Sherwin-Williams | Silver                    | F75KXS13564-4311               | A-6741-190-1               |
| Sherwin-Williams | Bright Red                | 1326305 or<br>F63TXR16285-4311 | A-6741-200-5               |
| Sherwin-Williams | Bright Yellow             | 1326313 or<br>F63TXY16286-4311 | A-6741-201-5               |
| Sherwin-Williams | Bright Silver             | 1334259                        | A-6741-203-5               |
| Sherwin-Williams | Prop Gold                 | F63TXS17221-4311               | A-6741-204-5               |

## Touch-up Paints

Table 6-1

(2) Touch-up paint manufacturer's contact information:

(a) **Tempo Products Company**

A Plasti-kote Company

1000 Lake Road

Medina, OH 44256

Tel: 800.321.6300

Fax: 216.349.4241

Cage Code: 07708

(b) **Sherwin-Williams Company**

Refer to the Sherwin-Williams

Product Finishes Global Finishes Group website at:

<http://oem.sherwin-williams.com>

C. Procedure

**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 a clean cloth moistened with acetone, #700 lacquer thinner, or MEK, wipe the surface of the blade to remove any contaminants.

(2) Permit the solvent to evaporate.

**CAUTION 1:** EXCESSIVE SANDING ON COMPOSITE BLADES WILL CAUSE "FUZZING" OF THE KEVLAR® MATERIAL. THIS CAN RESULT IN A ROUGH FINISH AND/OR DAMAGE TO THE BLADE.

**CAUTION 2:** BE SURE TO SAND/FEATHER THE EXISTING COATINGS TO PREVENT EXCESSIVE PAINT BUILDUP.

- (3) Using 120 to 180 grit sandpaper, sand to feather the existing coatings away from the eroded or repaired area.
  - (a) Erosion damage is typically very similar on all blades in a propeller assembly. If one blade has more extensive damage, e.g. in the tip area, sand all the blades in the tip area to replicate the repair of the most severely damaged blade tip. This practice is essential in maintaining balance after refinishing.
- (4) Using acetone, #700 lacquer thinner, or MEK, wipe the surface of the blade.
- (5) Permit the solvent to evaporate.
- (6) Aluminum Blades Only:
  - (a) Apply an approved corrosion preventative coating to the bare aluminum surface of the blade in accordance with the manufacturer's instructions.
    - 1 Oakite 31, Chromicote L-25, or Alodine 1201 are approved chemical conversion coatings.
- (7) Apply masking material to the erosion shield, anti-icing or de-ice boot, and tip stripes, as needed.

**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 A WELL VENTILATED AREA.

**CAUTION:** APPLY FINISH COATING TO UNIFORMLY COVER THE REPAIR/ EROSION. AVOID EXCESSIVE PAINT BUILDUP ALONG THE TRAILING EDGE TO AVOID CHANGING THE BLADE PROFILE AND/OR P-STATIC CHARACTERISTICS.

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

6. 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 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.

## C. Placement of Balance Weights for Dynamic Balance

NOTE 1: 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 2: 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.
- (2) The maximum number of balance weights per location is four.

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 a dynamic balance label p/n A-2803 (Figure 6-6) 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.



**Dynamic Balance Label**  
**Figure 6-6**

7. 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.

NOTE: 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.

## A. Overspeed/Underspeed

- (1) 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.
- (2) An underspeed during the maximum power static condition may be caused by any one or a combination of the following:
  - (a) The propeller low pitch blade angle is too high
  - (b) The governor is improperly adjusted
  - (c) The engine is not producing rated power

**8. Tachometer Calibration** (Rev. 2)

**WARNING:** OPERATION WITH AN INACCURATE TACHOMETER CAN CAUSE RESTRICTED RPM OPERATION AND DAMAGING HIGH STRESSES. PROPELLER LIFE WILL BE SHORTENED AND COULD CAUSE CATASTROPHIC FAILURE.

**A. Important Information**

- (1) All engine/propeller combinations have operating conditions at which the propeller blade stresses begin to reach design limits.
  - (a) In most cases, these conditions occur above the maximum rated RPM of the engine.
  - (b) Some engine/propeller combinations have certain ranges of RPM that are less than maximum engine speed, where stresses are at a level considered too high for continuous operation. This results in a restricted operating range where continuous operation is not permitted. A placard on the instrument panel or yellow arc on the tachometer will inform the pilot to avoid operation in this range.
  - (c) In other cases, the limiting condition occurs at an RPM only slightly above the maximum engine RPM.
  - (d) For these reasons, it is very important to accurately monitor engine speed.
- (2) The accuracy of the tachometer is critical to the safe operation of the aircraft.
  - (a) Some tachometers have been found to be in error by as much as 200 RPM.
  - (b) Operating the aircraft with an inaccurate tachometer could cause continued operation at unacceptably high stresses, including repeatedly exceeding the maximum engine RPM.
  - (c) Continuous operation in a restricted RPM range subjects the propeller to stresses that are higher than the design limits.
  - (d) Stresses that are higher than the design limits will shorten the life of the propeller and could cause a catastrophic failure.

## B. Tachometer Calibration

- (1) Hartzell Propeller LLC recommends that propeller owners/operators calibrate the engine tachometer in accordance with the National Institute of Standards and Technology (NIST) or similar national standard (traceable).
- (2) Contact Hartzell Propeller LLC if the propeller was operated in a restricted RPM range because of a tachometer error.

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**ANTI-ICE AND DE-ICE SYSTEMS**

**NOTE:** The propellers covered in this manual do not use anti-ice or de-ice systems.

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RECORDS - CONTENTS

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1. Record Keeping (Rev. 1)

## A. General

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

## B. Information to be Recorded

- (1) Refer to Part 43 of the U.S. Federal Aviation Regulations for a list of information that must be recorded.
- (2) The logbook may also be used to record:
  - (a) Propeller position (on aircraft)
  - (b) Propeller model
  - (c) Propeller serial number
  - (d) Blade design number
  - (e) Blade serial numbers
  - (f) Spinner assembly part number
  - (g) Propeller pitch range
  - (h) Aircraft information (aircraft type, model, serial number and registration number).

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