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June 2010

Propeller Owner's Manual and Logbook

Steel Hub Reciprocating Propellers with Aluminum Blades

Two Blade

HC-A2(MV,V,X)20-4A1

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

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

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

A handwritten signature in black ink, appearing to read "Jim Brown", with a long, sweeping horizontal line extending to the right.

Jim Brown
Chairman, Hartzell Propeller Inc.

WARNING

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

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

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

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

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

For operators of noncertified or experimental aircraft an even greater level of vigilance is required in the maintenance and inspection of the propeller. Experimental installations often use propeller-engine combinations that have not been tested and approved. In these cases, the stress on the propeller and, therefore, its safety margin is unknown. Failure could be as severe as loss of propeller or propeller blades and cause loss of propeller control and/or loss of aircraft control.

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

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

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

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REVISION HIGHLIGHTS:

Revision 1, dated June 2010, incorporates the following:

- Revised the Cover and front matter
- Added [Service Documents List](#) and [Airworthiness Limitations](#) sections
- Introduction
 - Added information about [using approved corrosion protection](#)
 - Updated [Reference Publications](#) section
 - Updated [Warranty Service](#) information
 - Added information about [Hartzell Recommended Facilities](#)
 - [Incorporated TR-001](#)
- Description and Operation
 - Revised the [Aluminum Blade Model Identification](#) chart
- Installation and Removal
 - Added information about [reassembly of a propeller disassembled for shipment](#)
 - Corrected errors in [Figure 3-7](#)
- Testing and Troubleshooting
 - [Relocated Static RPM Check](#) chapter from the Maintenance Practices chapter
- Inspection and Check
 - Revised [Operational Checks and Pre-flight Checks](#) sections
 - [Incorporated TR-002](#) and revised Loose Blade limits
 - Added [warning about abnormal vibration](#)
 - Revised [Airworthiness Limitations](#) section
 - Revised the [definition of foreign object strike](#)
- Maintenance Practices
 - Revised the [Lubrication](#) section
 - Added [information about mixing Aeroshell greases 5 and 6](#)
 - Revised [Approved Paints Table 6-1](#)
 - Revised [Blade Repair](#) section
 - Added [Caution about shot peened blade identification](#)
 - Added [recommendation for dynamic balance to 0.2 IPS or less](#)
 - Revised the [Placement of Balance Weights for Dynamic Balance](#) section
 - Added section [Propeller Low Pitch Stop](#)
 - [Moved static RPM check and governor maximum RPM stop setting information to the Troubleshooting chapter](#)

REVISIONS HIGHLIGHTS

1. Introduction

A. General

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

B. Components

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

<u>Revision No.</u>	<u>Issue Date</u>	<u>Comments</u>
Original	Feb/02	New Issue
Revision 1	Jun/10	Minor Revision

RECORD OF REVISIONS

[illegible]

RECORD OF REVISIONS

[illegible]

RECORD OF TEMPORARY REVISIONS

[illegible]

TR No.	Issue Date	Date Inserted	Inserted By	Date Removed	Removed By
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[illegible]

SERVICE DOCUMENT LIST

[illegible]

[illegible]

AIRWORTHINESS LIMITATIONS

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

FAA APPROVED

by:



date:

6/30/10

Manager, Chicago Aircraft Certification

Office

ACE-115C

Federal Aviation Administration

Rev. No.	Description of Revision	Rev. No.	Description of Revision

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.

FAA APPROVEDby: date: 6/30/10

Manager, Chicago Aircraft Certification
Office.
ACE-115C

Federal Aviation Administration

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1. Purpose

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

This manual supports Hartzell Model HC-A2(MV,V,X)20-4A1 constant speed, counterweighted, nonfeathering propellers.

The purpose of this manual is to enable qualified personnel to install, operate, and maintain a Hartzell Model HC-A2(MV,V,X)20-4A1 constant speed propeller. Separate manuals are available addressing overhaul procedures and specifications for the propeller.

This manual covers one design type. Sample hub and blade model numbers within this design are covered in the Description and Operation chapter of this manual.

2. Airworthiness Limits

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

3. General**A. Personnel Requirements**

Personnel performing maintenance are expected to have sufficient training and certifications (when required by the applicable Aviation Authority) to accomplish the work required in a safe and airworthy manner.

B. Maintenance Practices

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

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

- (7) As necessary, use a soft, non-graphite pencil, crayon, or felt-tipped pen to make identifying marks on components.

- (8) As applicable, follow military standard NASM33540 for safety-wiring and cotter pinning general practices. Use 0.032 stainless steel safety wire unless otherwise indicated.

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

- (9) 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.
- (10) Approved corrosion protection followed by approved paint must be applied to all aluminum blades. For information concerning 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.

C. Continued Airworthiness

Operators are urged to keep abreast of Airworthiness information via Hartzell Service Bulletins and Service Letters which are available from Hartzell distributors, or from the Hartzell factory by subscription. Selected information is also available on Hartzell Propeller's website at www.hartzellprop.com.

4. Reference Publications

The following publications contain information vital to the airworthiness of the propeller models covered in this manual:

Hartzell Manual No. 114C (61-10-14) - Steel Hub Propeller Maintenance Manual

Hartzell Manual No. 126 (61-00-26) - Active Service Bulletins, Letters, Instructions, and Advisories

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

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

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

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

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

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

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

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5. Definitions

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

<u>Term</u>	<u>Definition</u>
Annealed	Softening of material due to overexposure to heat.
Blade Angle	Measurement of blade airfoil location described as the angle between the blade airfoil and the surface described by propeller rotation.
Brinelling.....	A depression caused by failure of the material in compression.
Chord.....	A straight line distance between the leading and trailing edges of an airfoil.
Cold Rolling	Compressive rolling process that provides improved strength and resistance to fatigue.
Constant Force	A force which is always present in some degree when the propeller is operating.
Constant Speed.....	A propeller system which employs a governing device to maintain a selected engine RPM.
Corrosion	Gradual material removal or deterioration due to chemical action.
Crack	Irregularly shaped separation within a material, sometimes visible as a narrow opening at the surface.
Depression	Surface area where the material has been compressed but not removed.
Distortion	Alteration of the original shape or size of a component
Erosion	Gradual wearing away or deterioration due to action of the elements.

Exposure	Leaving material open to action of the elements.
Feathering	A propeller with blades that may be rotated to a position parallel to the relative wind, thus reducing aerodynamic drag.
Gouge.....	Surface area where material has been removed
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.
Nick	Removal of paint and possibly a small amount of material.
Onspeed	Condition in which the RPM selected by the pilot through the propeller control lever and the actual engine (propeller) RPM are equal.
Overhaul	The periodic disassembly, inspection, repair, refinish, and reassembly of a propeller assembly to maintain airworthiness.
Overspeed	Condition in which the RPM of the propeller or engine exceeds predetermined maximum limits; the condition in which the engine (propeller) RPM is higher than the RPM selected by the pilot through the propeller control lever.
Overspeed Damage	Damage that occurs when the propeller hub assembly rotates at a speed greater than the maximum limit for which it is designed.
Pitch.....	Same as "Blade Angle" for constant speed propellers.

Pitting.....	Formation of a number of small, irregularly shaped cavities in surface material caused by corrosion or wear.
Propeller Repair Station.....	A repair facility that is appropriately licensed and approved by their local aviation authority.
Scratch	Same as "Nick".
Single Acting.....	Hydraulically actuated propeller which utilizes a single oil supply for pitch control.
Synchronizing.....	Adjusting the RPM of all the propellers of a multi-engine aircraft to the same RPM.
Synchrophasing.....	A form of propeller synchronization in which not only the RPM of the engines (propellers) are held constant, but also the position of the propellers in relation to each other.
Track.....	In an assembled propeller, a measurement of the location of the blade tip with respect to the plane of rotation, used to verify face alignment and to compare blade tip location with respect to the locations of the other blades in the assembly.
Underspeed	The condition in which the actual engine (propeller) RPM is lower than the RPM selected by the pilot through the propeller control lever.
Vertical Balance.....	Balance between the leading and trailing edges of a two-blade propeller, with the blades positioned vertically.
Variable Force	A force which may be applied or removed during propeller operation.
Windmilling	The rotation of an aircraft propeller caused by air flowing through it while the engine is not producing power.

6. Abbreviations

<u>Abbreviation</u>	<u>Term</u>
AMM	Aircraft Maintenance Manual
AN.....	Air Force-Navy (or Army-Navy)
AOG.....	Aircraft on Ground
FAA.....	Federal Aviation Administration
Ft-Lb	Foot-Pound
ID	Inside Diameter
In-Lb	Inch-Pound
Lbs.....	Pounds
MIL-X-XXX.....	Military Specification
MPI	Major Periodic Inspection (Overhaul)
MS	Military Standard
NAS	National Aerospace Standards
N•m.....	Newton-Meters
OD	Outside Diameter
POH.....	Pilot's Operating Handbook
PSI.....	Pounds per Square Inch
RPM.....	Revolutions per Minute
TBO	Time Between Overhaul
TSN	Time Since New
TSO	Time Since Overhaul

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

7. Hartzell Product Support

Hartzell Propeller is ready to assist you with questions concerning your propeller system. Hartzell Product Support may be reached during business hours (8:00 a.m. through 5:00 p.m., United States Eastern Time) at (937) 778-4379 or at (800) 942-7767, toll free from the United States and Canada.

After business hours, you may leave a message on our 24 hour product support line at (937) 778-4376 or at (800) 942-7767, toll free from the United States and Canada. A technical representative will contact you during normal business hours. Urgent AOG support is also available 24 hours per day, seven days per week via this message service.

Additional information is available on our website at www.hartzellprop.com

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

8. Warranty Service

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

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

9. Hartzell Recommended Facilities

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

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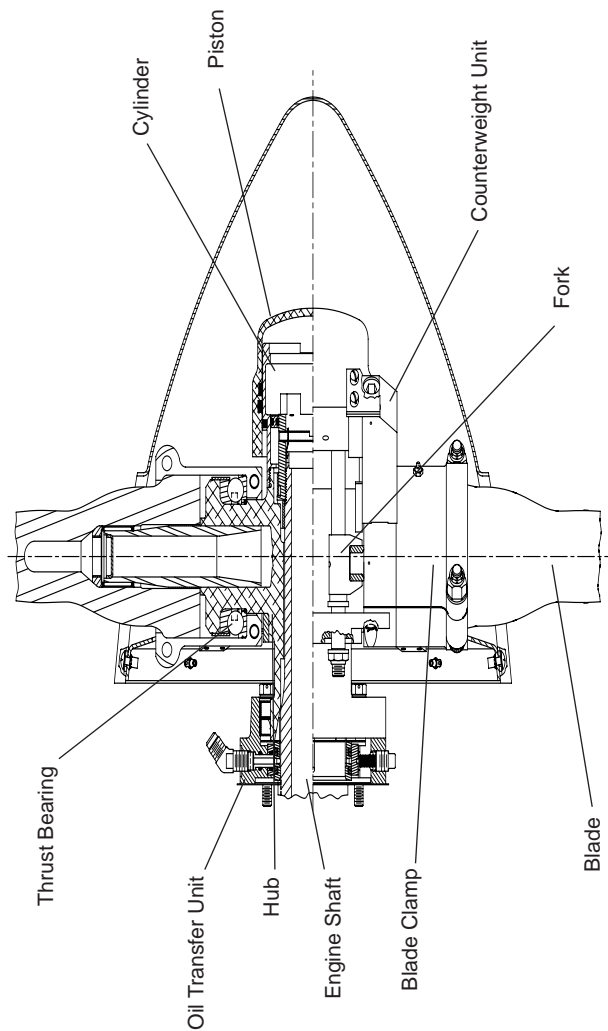
Governor in Overspeed Condition [Figure 2-4](#)..... 2-12

1. Description of Propeller and Systems

The Hartzell steel hub propeller covered in this manual is a constant speed assembly that uses a steel hub as a central component of the propeller.

The propeller attaches to the engine through a splined shaft. A spline shaft attachment uses a Society of Automotive Engineers (SAE) Number 20 spline (Figure 2-1).

NOTE: The SAE Number 20 spline shaft propeller is identified simply as a "20 spline shaft" propeller throughout the text of this manual.



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HC-A2(MV,V,X)20-4A1 Constant Speed, Counterweighted, Nonfeathering Propeller Assembly
Figure 2-1

A. Constant Speed, Counterweighted, Nonfeathering Propeller With External Oil Transfer System

Propeller models HC-A2(MV,V,X)20-4A1

Refer to Figure 2-1.

This constant speed, counterweighted, nonfeathering propeller is typically used on single engine aircraft with a damped

E-185, E-205, or E-225 Continental engine installed.

This type of engine has no provisions to drive a governor, nor does the engine crankshaft have provisions to supply governor control oil to the propeller.

The HC-A2(MV,V,X)20-4A1 propeller is designed to receive governor control oil for constant speed operation, external of the engine shaft, through an oil transfer unit that is supplied with the propeller.

The governor is mounted on a Hartzell supplied "T" drive adaptor that is installed between the fuel pump and the engine accessory drive pad. This propeller and control system is typically installed on a Beech Bonanza under the authority of STC number SA1-570 or on a Navion under the authority of STC number SA1-635.

Propeller blade angle change is actuated by a hydraulic piston/cylinder combination mounted on the forward end of the propeller hub. The linear motion of the hydraulic piston is transmitted to each blade through a sliding rod and fork system, connected to a blade clamp that rotates with the blade. Each blade is retained on the propeller hub by a blade clamp and thrust bearing. The thrust bearing allows the blade to change angle with the blade under centrifugal load.

Propeller forces consisting of blade counterweight centrifugal twisting moment and aerodynamic twisting moment of the blades in various combinations are constantly present while the propeller is operating. The summation of these forces causes the propeller to rotate to a higher blade angle. A variable hydraulic force (oil under pressure from the engine driven governor) toward a lower blade angle opposes the summation of these forces. Oil is metered by the governor to oppose these constant forces and maintain a constant engine RPM.

A counterweight is a weight that is attached to each blade clamp to cause the blade to rotate to a higher blade pitch. Counterweighted propellers require governor supplied oil to decrease blade pitch. If the oil supply is lost, the counterweighted propeller will go to high pitch, or low RPM.

The weight of each propeller blade when spinning, generates centrifugal force and a twisting force that attempts to rotate each blade to a lower blade angle.

Air flow around the blade generates lift and an aerodynamic twisting moment that will attempt to increase or decrease blade angle, depending on flight condition and blade design. This force is generally very small in relation to the other forces.

A governor is an engine speed-sensing device that maintains a constant engine/propeller RPM by changing blade angle, thereby varying the load on the engine.

The governor uses an internal pump that is driven by an accessory drive from the engine. This pump uses an engine oil supply and increases the engine oil pressure for supply to the propeller. Engine speed sensing hardware within the governor controls the supply of oil to, or drain of oil from the propeller, resulting in a change of blade pitch to maintain constant engine speed.

Oil pressure from the engine-driven governor is supplied to the propeller mounted hydraulic cylinder through the oil transfer unit and propeller hub. Increasing the oil volume within the hydraulic cylinder decreases blade angle to increase engine RPM. Decreasing the oil volume increases blade angle to decrease engine RPM. By changing the blade angle, the governor maintains constant engine RPM (within limits), independent of the throttle setting.

If oil pressure is lost at any time, the summation of propeller forces that is in direct opposition to the lost variable hydraulic force will increase blade angle.

The oil transfer unit attaches to the engine case and encircles the engine shaft and engine side portion of the propeller hub. Refer to Figure 2-1.

The function of the oil transfer unit is to transfer governor control oil for constant speed operation from the non-rotating external hydraulic hose to the rotating propeller.

Basic components of the unit consist of a housing, slip ring, piston rings, outer ring, rear cone and lip seal. The housing supports the internal parts and contains the oil. The slip ring, piston rings, rear cone, and outer ring transfer the oil from the non-rotating housing to the rotating propeller. The rear cone also supports and centers the engine side of the propeller hub. The lip seal prevents leakage oil from the high pressure oil supply system from escaping outside of the housing.

Since the Continental E-185, E-205, and E-225 engines have no provision for a propeller governor, it is necessary to share an accessory drive on the engine with another accessory. Refer to Figure 3-12.

Hartzell supplies a "T" drive that installs between the engine and fuel pump and provides a second accessory drive for mounting the governor. The "T" drive allows an engine accessory drive pad to drive two accessories, instead of one.

Additional accessories (Figure 3-11) consist primarily of a Vernier control cable, from the instrument panel to the governor, for RPM control and a hydraulic hose from the "T" drive to the oil transfer unit.

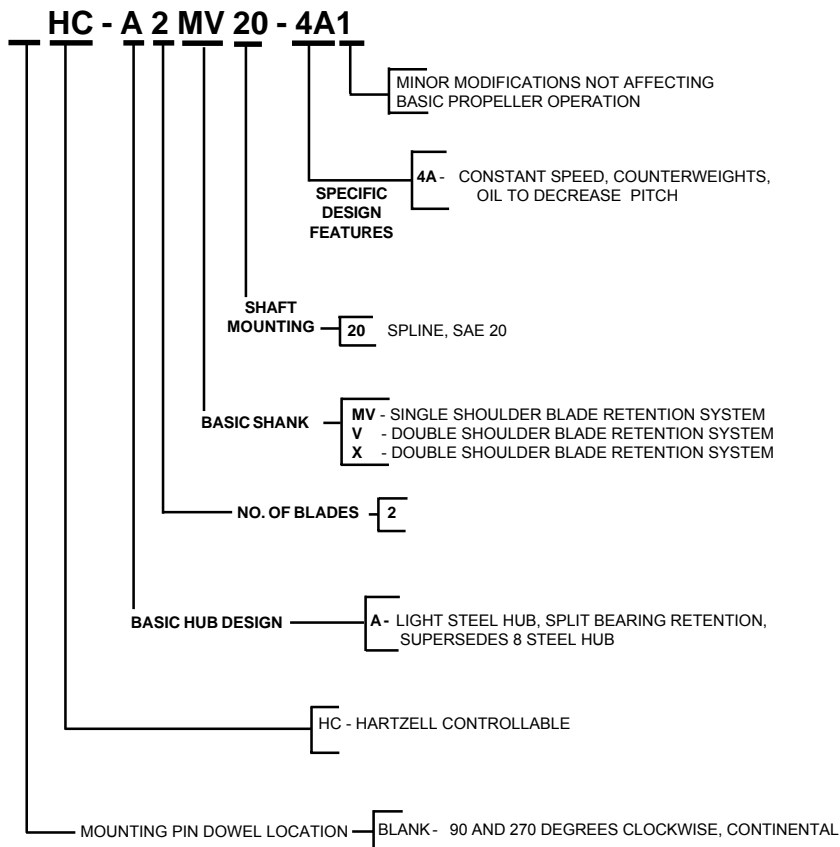
For specific technical details and installation information, consult STC SA1-570 for Bonanza installations and SA1-635 for Navion installations.

2. Model Designation

The following pages illustrate sample model designations for Hartzell steel hub reciprocating propeller hub assemblies and blades.

A. Steel Hub Propeller Model Identification

The propeller model number is impression stamped on the propeller hub.



B. Aluminum Blade Model Identification

Hartzell uses a model designation to identify specific blade assemblies. Example: HC-A2MV20-4A1/**MV8833N-4**.

A slash mark separates the propeller and blade model designations. The blade model designation is impression stamped on the blade butt end (internal) and is either on a decal or ink stamped on the blade camber side (external).

prop model/ **MV 88 33 N - 4**

Dash Number (or + number), diameter reduction (or increase) from basic design. In this example, the nominal 88 inch diameter has been reduced 4 inches = 84 inch diameter (with some exceptions) there may be a letter following the dash number:

R - specifically rounded tip

Q - Q-tip, factory 90 degree bent 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.)

Suffix letters:

blank - original design, no changes

N - shank modification (T, M, MV, V, and X shank pilot tube hole)

S - shot peen (Exception: Blade model M10476 was manufactured with a shot peened surface; however, the "S" shot peen designator was not included in the model number.)

Engineering designation for design characteristics

The first 2 or 3 numbers indicate initial design diameter (in inches) (not necessarily the actual propeller diameter)

Prefix of up to 3 letters:

MV - single shoulder blade retention

V - double shoulder blade retention, blade bore bearing

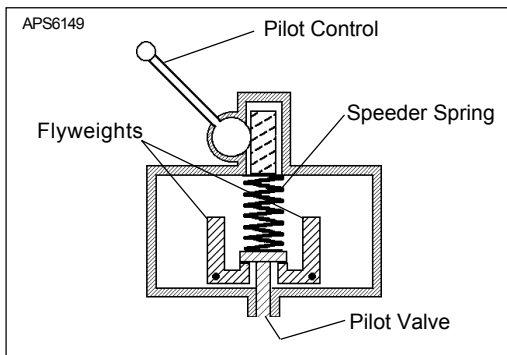
C. Conversion From V Shank to MV Shank

"V" shank models, which have double-shoulder configuration, have additional repetitive inspections required by Airworthiness Directive 97-18-02.

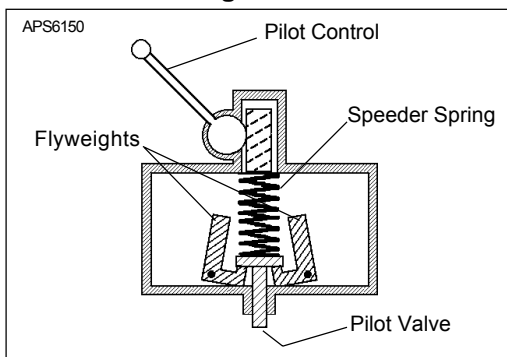
"MV" shank models, which have a single-shoulder configuration, are not affected by Airworthiness Directive AD 97-18-02.

"V" shank blades can be converted to "MV" shank to avoid the inspections required by the Airworthiness Directive. After conversion, the propeller model number changes to reflect the conversion. For example, HC-A2**V**20-4A1/**V**8833N-4 becomes HC-A2**MV**20-4A1/**MV**8833N-4.

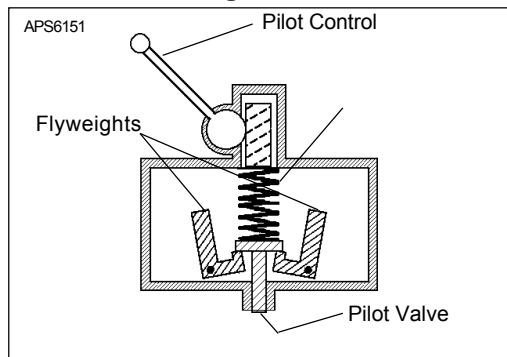
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**Governor in Onspeed Condition
Figure 2-2**



**Governor in Underspeed Condition
Figure 2-3**



**Governor in Overspeed Condition
Figure 2-4**

3. Governors

A. Theory of Operation

- (1) A governor is an engine RPM sensing device and high pressure oil pump. In a constant speed propeller system, the governor responds to a change in engine RPM by directing oil under pressure to the propeller hydraulic cylinder or by releasing oil from the hydraulic cylinder. The change in oil volume in the hydraulic cylinder changes the blade angle and 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 2-2. 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 2-3. 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 2-4. In an overspeed condition, the centrifugal force acting on the flyweights is greater than the speeder spring force. The flyweights tilt outward, and raise the pilot valve. The pilot valve then meters oil flow to increase propeller pitch and lower engine RPM.

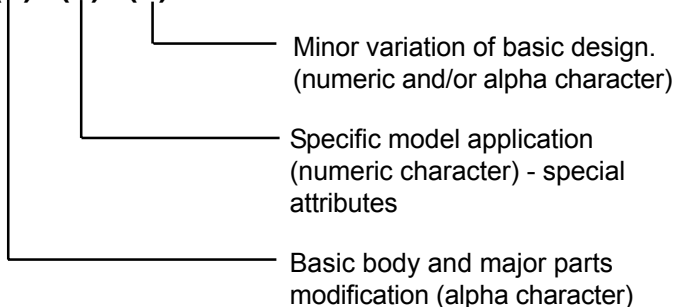
B. Governor Types

The governor used with this propeller is supplied by Hartzell. No other governor by any other manufacturer is certified for use with this propeller.

C. Identification of Hartzell Governors

A Hartzell governor may be identified by its model number as follows: Ex. A-1-C.

(X) - (X) - (X)



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

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1. Tools, Consumables, and Expendables

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

A. Tooling

- Safety wire pliers
- Torque wrench (1/2 inch drive)
- Shaft Nut Wrench (Hartzell P/N BST-2910)
- 5/8 inch open end wrench

B. Consumables

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

C. Expendables

- 0.032 Stainless Steel Aircraft Safety wire

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 hole, tear, or crushed appearance at the end of the box (blade tips) may indicate that the propeller was dropped during shipment, possibly damaging the blades.

B. Uncrating

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

C. Inspection after Shipment

- (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. O-ring, Gasket and Propeller Mounting Hardware Identification

Part	Part No.
Hex Head Bolt, 5/16-18 (Oil Transfer Unit mounting)	B-3805
Washer (Oil Transfer Unit mounting)	B-3851-0563
Gasket, Oil Transfer Unit Mounting	A-135
Gasket, Governor Mounting	B-1104-1
Nut, Spinner Mounting	A-1373
Bolt, Spinner Mounting	B-3387-11
Washer, Spinner Mounting	B-3851-0763
Felt Dust Seal	B-1843
Spring Pin	B-6580-1000
O-ring, Piston	C-3317-343-1
O-ring, Shaft Seal (inner)	C-3317-231
O-ring, Shaft Seal (outer)	C-3317-232
Seal, Shaft Nut	A-2054
Pin, Cotter (on shaft nut)	B-3838-3-3
Nut, flex lock (on piston rod)	A-848-2
Washer, (on piston rod)	A-965
Nut, Shaft/Hub (propeller mounting)	A-2053
Sleeve, Rod (on piston rod)	A-827-2
Spacer, High Stop (on piston rod)	A-970-()
Block, Pitch Change	A-95-A
Socket Set Screw (fork)	A-2039

O-ring and Propeller Mounting Hardware Identification
Table 3-1

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

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

WARNING 2: WHEN INSTALLING THE PROPELLER, FOLLOW THE AIRFRAME MANUFACTURER'S OR STC HOLDER'S MANUALS AND 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.

CAUTION: INSTALLATION OF STC PROPELLERS MUST BE ACCOMPLISHED PER THE REQUIREMENTS SET BY THE STC HOLDER, NOT PER THE AIRCRAFT MANUFACTURER'S INSTALLATION PROCEDURES SET FOR OTHER PROPELLERS INSTALLED ON THE SAME AIRCRAFT.

- (2) Follow the STC holder's instructions for propeller installation (Hartzell STC SA1-570, for the Beech Bonanza, and Hartzell Propeller STC SA1-635 for Navion aircraft). An STC packet for these aircraft may be obtained at no charge. Contact Hartzell Propeller Product Support at (937) 778-4379 or by E-mail at techsupport@hartzellprop.com.

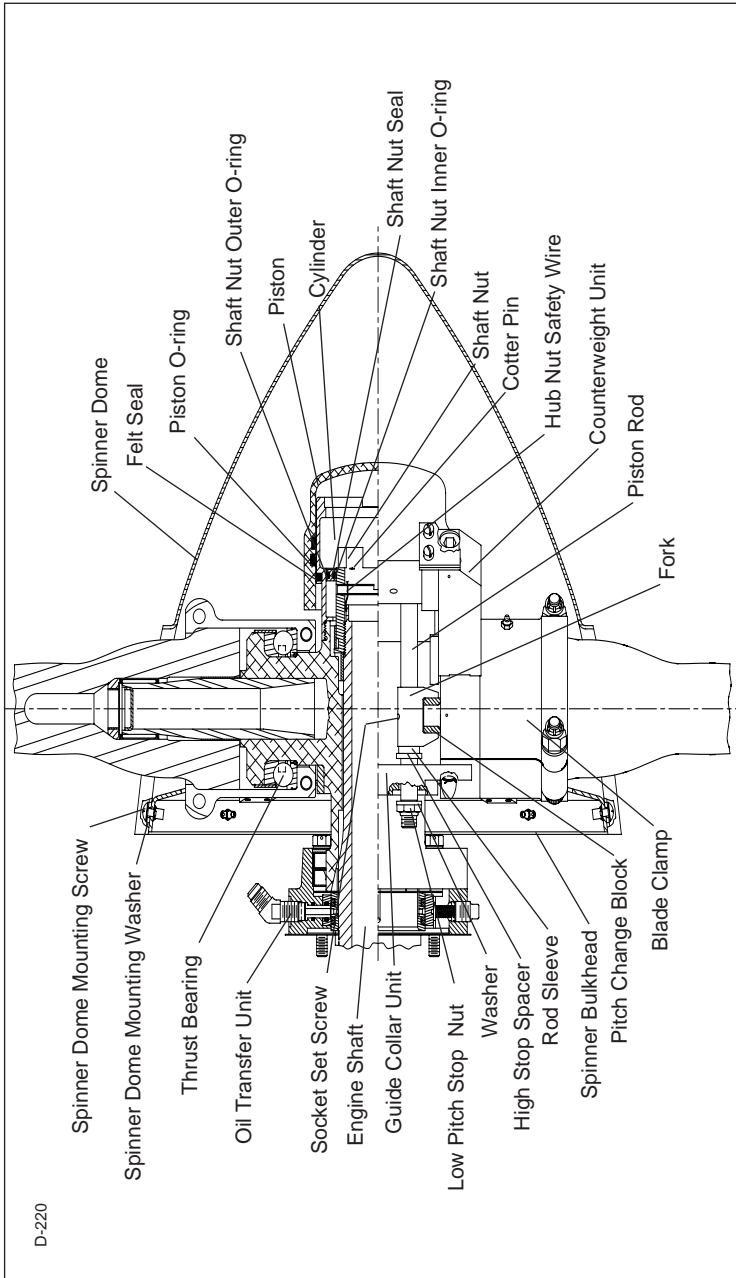
Shaft nut	
A-2053	300 Ft-Lb (407 N•m)*
Oil Transfer Unit mounting bolts	
B-3805	18-22 Ft-Lb (24-30 N•m)**
Piston Rod Nut	
A-848-2	20-22 Ft-Lb (27-29 N•m)
Spinner Mounting Nut	
A-1373	30 Ft-Lb (41 N•m)**
Nut (Governor- to- “T” drive)	
B-3808-5	18-20 Ft-Lb (24-26 N•m)**

* Torque tolerance is ± 10 Ft-Lb (± 13.6 N•m)

** Torque tolerance is ± 10 percent unless otherwise noted.

- NOTE 1: Torque values are based on non-lubricated threads.
- NOTE 2: Do not deviate from the torque values specified in this table when installing the propeller and component parts.

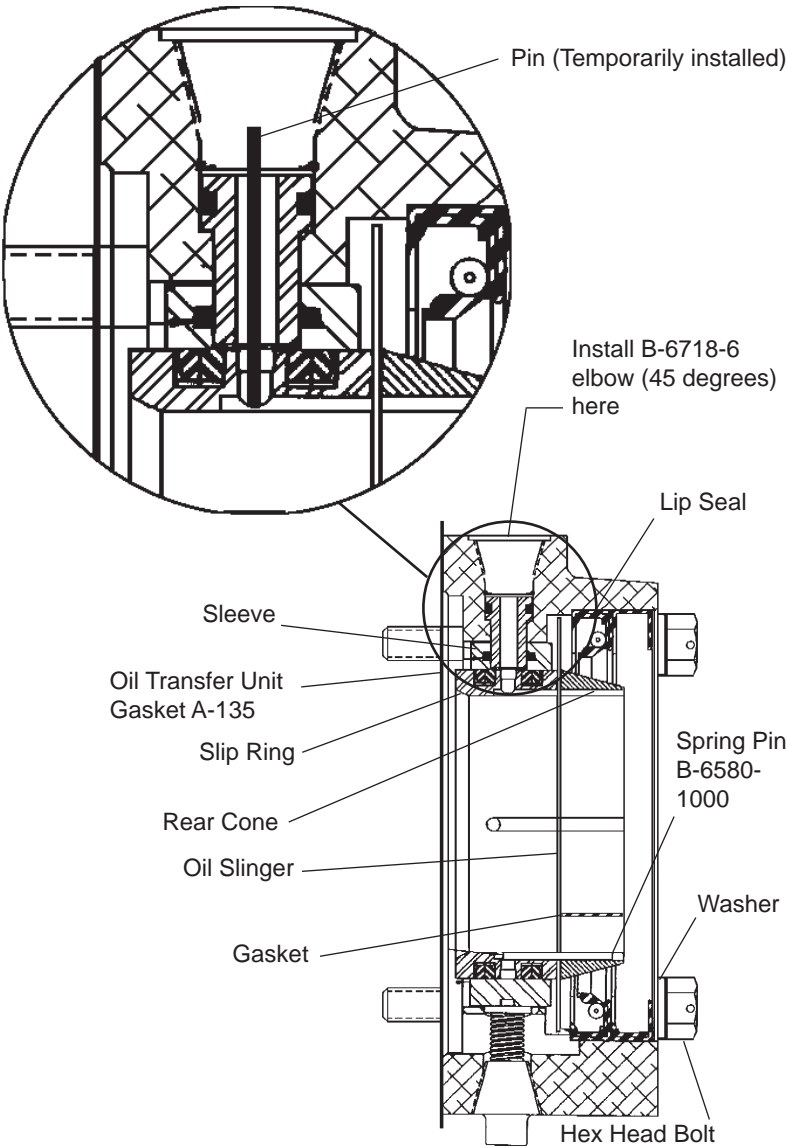
Torque Values
Table 3-2



HC-A2(MV,V,X)20-4A1 Propeller Assembly
Figure 3-1

D-220

A-224-4



Oil Transfer Unit Installation
Figure 3-2

B. O-ring and Propeller Mounting Hardware Identification

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

C. Installing A-224-() Oil Transfer Unit

Refer to Figures 3-1 and 3-2.

WARNING: CLEANING AGENT METHYL-ETHYL-KETONE (MEK) IS FLAMMABLE AND TOXIC TO THE SKIN, EYES AND RESPIRATORY TRACT. SKIN AND EYE PROTECTION ARE REQUIRED. AVOID PROLONGED CONTACT. USE IN WELL VENTILATED AREA.

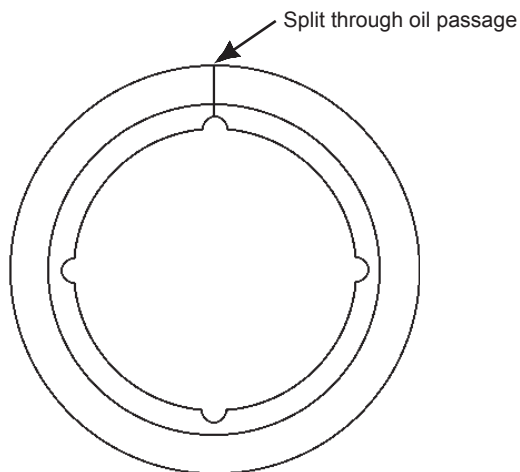
- (1) Verify that the crankshaft seal (Continental P/N 530589) is not installed. Remove the seal if it is installed.
- (2) Using Quick Dry Stoddard Solvent or MEK, clean the engine case encircling the engine shaft where the oil transfer unit will mount.

- (3) Install the oil transfer unit mounting gasket (Figure 3-2, Table 3-1) around the engine shaft on the engine case.

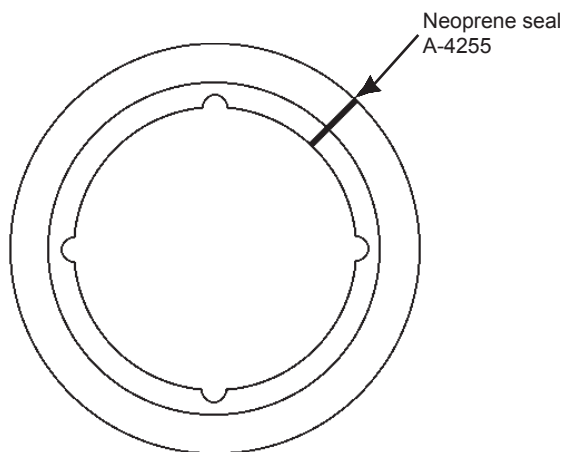
NOTE: Align the four holes in the gasket with the four threaded holes in the engine case.

- (4) A new oil transfer unit is shipped from the factory with a temporary pin installed in the oil port to prevent the slip ring from moving and becoming misaligned. If not already installed, install a temporary pin, as shown in Figure 3-2, to prevent the slip ring from moving during installation of the oil transfer unit.

A4254



Previous style rear cone, split at oil passage, no seal in split area



Current style rear cone, saw cut between oil passages with
neoprene seal

Rear Cone
Figure 3-3

CAUTION 1: DO NOT REMOVE THE TEMPORARY PIN FROM THE OIL TRANSFER UNIT UNTIL THE OIL TRANSFER UNIT IS BOLTED TO THE ENGINE CASE.

CAUTION 2: DO NOT FORCE THE OIL TRANSFER UNIT ON THE ENGINE SHAFT. THIS WILL PUSH THE OIL RING OUT OF POSITION.

- (5) Position the oil transfer unit around the engine shaft, against the gasket on the engine case and align the four through-holes in the oil transfer unit housing with the four gasket holes and engine case threaded holes.

NOTE: The lip seal must face toward the propeller.

- (6) Install one washer (Table 3-1) on each of the four hex head oil transfer unit mounting bolts (Table 3-1).
- (7) Slide the hex head bolts (with installed washers) through each of the four transfer unit housing through-holes, and thread the bolts into the engine case.
- (8) Using a staggered sequence, torque the four hex head bolts per Torque Values Table 3-2.
- (9) Remove the temporary pin (Figure 3-2) that was previously installed to prevent the slip ring from moving during installation of the oil transfer unit.
- (10) Install the spring pin into one of four oil passages between the oil slinger, slip ring and engine shaft.

NOTE 1: The oil passages are cut into the slip ring ID and are positioned parallel to the engine shaft centerline.

CAUTION 1: THE TAPERED END OF THE REAR CONE MUST FACE TOWARD THE PROPELLER SO THE PROPELLER WILL INSTALL PROPERLY. REFER TO FIGURE 3-2.

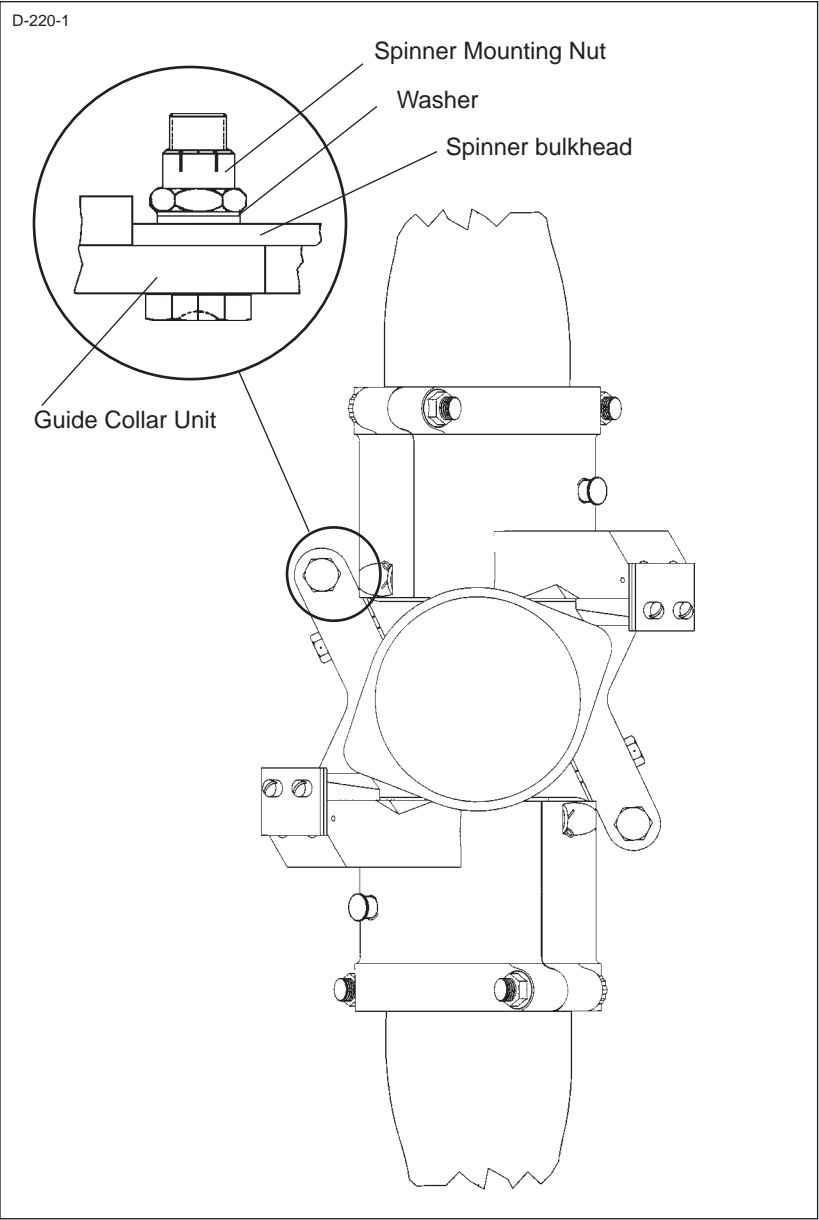
CAUTION 2: A PREVIOUSLY MANUFACTURED REAR CONE WAS SPLIT THROUGH ONE OF THE OIL PASSAGES, AS SHOWN IN FIGURE 3-3. NO GASKET WAS INSTALLED IN THIS SPLIT. A REAR CONE OF CURRENT DESIGN IS CUT BETWEEN THE OIL PASSAGES, AND A NEOPRENE GASKET IS INSTALLED AS SHOWN IN FIGURE 3-3. WHEN USING A REAR CONE OF CURRENT DESIGN, THE GASKET MUST BE INSTALLED.

- (11) If not already installed or if missing, install the A-4255 neoprene seal in the rear cone.
- (a) Thoroughly clean the saw cut area of the rear cone to remove any oil or foreign material.
 - (b) Install the A-4255 neoprene seal, as shown in Figure 3-3, using Loctite 495 Super Bond.

NOTE: It is not necessary to trim the excess material from the neoprene seal.

- (12) Slide the rear cone over the engine shaft and align one of the four ID oil passages with the spring pin.
- (13) Slide the rear cone over the spring pin and against the slinger ring.

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Spinner Bulkhead Installation
Figure 3-4

D. Propeller and Spinner Bulkhead Installation

CAUTION 1: THE PROPELLER IS STATICALLY BALANCED USING THE BULKHEAD AS A POINT FOR ATTACHING THE BALANCE WEIGHTS.

CAUTION 2: DO NOT INSTALL THE BALANCE WEIGHTS ON THE BLADE CLAMP.

(1) Installation of Spinner Bulkhead

CAUTION: IF INSTALLING A NEW OR OVERHAULED REPLACEMENT SPINNER BULKHEAD, THE BALANCE WEIGHTS FROM THE PREVIOUS BULKHEAD MUST BE TRANSFERRED TO THE REPLACEMENT BULKHEAD.

- (a) If installing a new or overhauled replacement spinner bulkhead, install the bulkhead in relation to the blade and balance weights from the previous spinner bulkhead.
- (b) Align the index marks on the propeller guide collar with the marks on the bulkhead.
- (c) Refer to Figure 3-4. Install the spinner bulkhead to the propeller guide collar at four locations.
- (d) Torque the spinner mounting nuts in accordance with Torque Values Table 3-2.

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

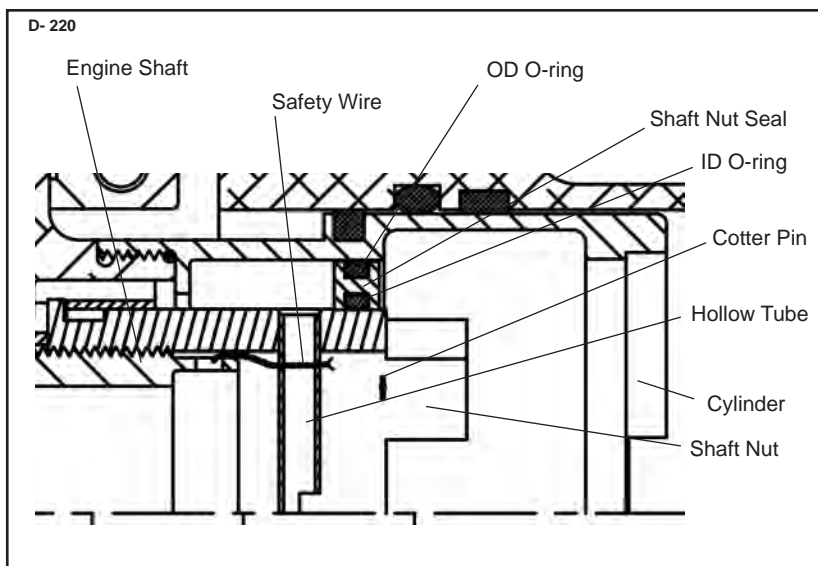
(2) Propeller Installation

- (a) With a suitable crane hoist and sling, carefully move the propeller assembly to the aircraft engine shaft in preparation for installation.

CAUTION: THE PISTON MUST BE REMOVED BEFORE INSTALLING THE PROPELLER ON THE AIRCRAFT. IF THE PISTON HAS ALREADY BEEN REMOVED, PROCEED TO STEP 4.D.(4).

- (3) Remove the piston
- (a) Remove the self-locking nut and washer from the end of each guide rod.
 - (b) Loosen the set screw in each fork.
 - (c) Rotate the forks away from the clamp link screws.
 - (d) The piston ears, pitch change forks, pitch change blocks, guide collar, and counterweights should have corresponding index numbers (1 and 2) marked with a felt-tipped pen. If they are not marked, number them with a felt-tipped pen.

NOTE: This will insure that the components are reassembled in their original locations.



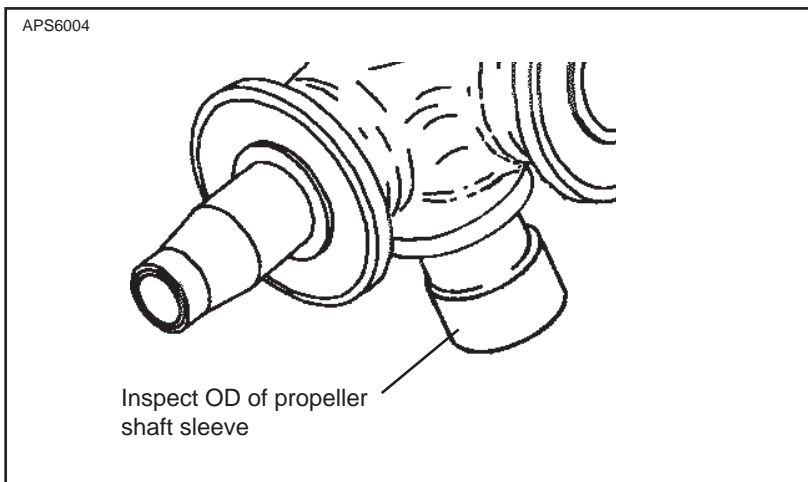
Safetying the Shaft Nut
Figure 3-5

- (e) Slide the piston away from the hub and to the low pitch position, until the piston rods clear the guide collar, sleeve, and fork.

NOTE: Make sure that the sleeve, spacer, and fork remain with each piston rod. Use tape to hold them in place.

CAUTION: TO PREVENT OIL LEAKAGE, THE OUTSIDE SURFACE OF THE PROPELLER SHAFT SLEEVE FACING THE OIL TRANSFER UNIT MUST BE SMOOTH.

- (4) Inspect the OD of the propeller shaft sleeve installed on the hub shaft end facing the oil transfer unit (Figure 3-6). The propeller shaft sleeve must be smooth and free of nicks or gouges.
- (5) Replace the propeller shaft sleeve if nicks or gouges are present. Refer to the Maintenance Practices chapter of this manual for removal and installation procedures.

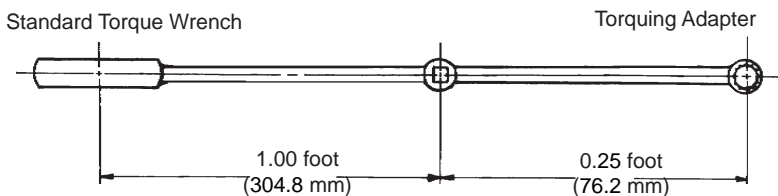


**Inspection of Propeller Shaft Sleeve OD
Figure 3-6**

- (6) Earlier manufacture propeller hubs were chromium plated in the seal area for the A-224-4 oil transfer unit. If any damage or grooves are present in this area of the hub, or if there is an existing Speedi Sleeve installed that has damage, install a Hartzell A-249 Speedi Sleeve as follows:
- Thoroughly clean the ID of the A-249 Speedi Sleeve and the area where the hub seals in the oil transfer unit contact.
 - Apply a liberal coating of RTV-732 silicone on the hub.
 - Using the installation tool supplied with the A-249 Speedi Sleeve, press the sleeve over the hub so the rear surface of the sleeve is flush or no more than 1/8 inch (3.17 mm) past the rear most hub surface.
 - Wipe off any excess silicone sealant.
 - Allow the silicone to cure before reinstalling the propeller.

NOTE: Cure time may vary slightly. A 24-hour cure time is sufficient.

APS0212A



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

EXAMPLE:

$$\frac{100 \text{ Ft-Lb (136 N}\cdot\text{m)} \times 1 \text{ ft (304.8 mm)}}{1 \text{ ft (304.8 mm)} + 0.25 \text{ ft (76.2 mm)}} = 80 \text{ Ft-Lb (108 N}\cdot\text{m)}$$

reading on torque wrench with 3-inch (76.2 mm) adapter for actual torque of 100 Ft-Lb (136 N·m)

Determining Torque Value When Using a Torquing Adapter

Figure 3-7

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 WELL VENTILATED AREA.

- (7) Clean the propeller hub spline and engine spline surfaces with Quick Dry Stoddard Solvent or MEK.
- (8) Slide the propeller hub on the engine shaft and into the lip seal in the oil transfer unit.
- (9) Turn the propeller shaft nut onto the engine shaft threads.

CAUTION: OVERTORQUE OF THE SHAFT NUT WILL CAUSE COLLAPSE OF THE OIL TRANSFER UNIT SLIP RING. EXCESSIVE WEAR, INTERNAL LEAKAGE, IMPROPER PERFORMANCE, AND PREMATURE REPLACEMENT OF THE OIL TRANSFER UNIT WILL RESULT.

- (10) Using tool BST-2910, torque the shaft nut on the engine shaft. Refer to Table 3-2 and Figure 3-7 to determine the proper torque value to which the torque wrench must be set.
- (11) Safety wire the shaft nut to the engine shaft with 0.032 inch (0.81 mm) minimum diameter stainless steel wire.

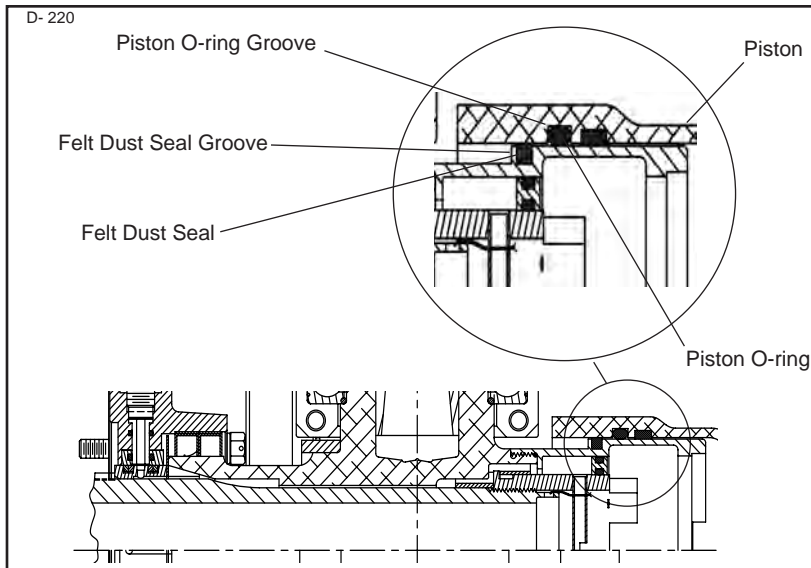
NOTE: The safety wire should be routed between a hole in the end of the engine shaft and the hollow tube attached to the shaft nut. Refer to Figure 3-5.

- (12) Lubricate the inner and outer shaft seal O-rings (Table 3-1) with reciprocating engine oil and install them in the shaft nut seal. Refer to Figure 3-5.
- (13) Slide the shaft nut seal over the shaft nut and inside the cylinder. Refer to Figure 3-5.

NOTE: The shaft nut seal will insure that the piston cavity is purged of air to eliminate the possibility of surging.

- (13) Install the four cotter pins (Table 3-1) into the shaft nut holes (from ID to OD), bending the ends of each cotter pin perpendicular to the engine shaft, to secure the shaft nut seal in place. Refer to Figure 3-5.
- (14) If the piston O-ring (Table 3-1) and the felt dust seal are not already installed, perform the following steps. Refer to Figure 3-8:
 - (a) Lubricate the piston O-ring with aviation grade reciprocating engine oil and carefully install it in the groove provided for it in the piston.
 - (b) Cut the felt dust seal material to the necessary length.

NOTE: The felt seal material should be cut on a 30 degree diagonal so there will be an overlap with a smooth, fuzz-free surface.
 - (c) Install the felt dust seal material in the groove provided for it in the cylinder.



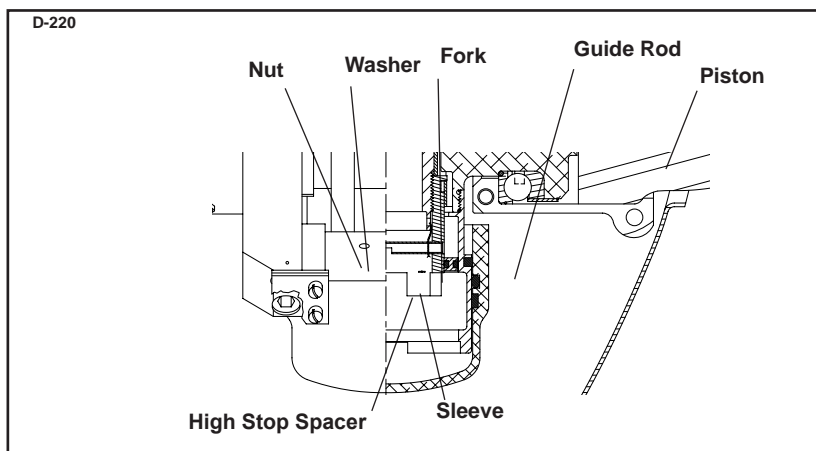
Installing Piston O-Ring and Felt Dust Seal
Figure 3-8

CAUTION: TO MAINTAIN PROPER BLADE ANGLES, IT IS IMPORTANT THAT THE PISTON, SLEEVE, AND FORK BE REINSTALLED IN THE SAME POSITION AS WHEN IT WAS ORIGINALLY ASSEMBLED. INDEX NUMBERS ON THE PISTON AND THE GUIDE COLLAR ARE PROVIDED TO INSURE PROPER POSITIONING.

- (15) Locate and match up the index numbers (1 and 2) on the forks and piston ears with the corresponding index numbers on the counterweights.

NOTE: The index marks will be either impression stamped or drawn with a felt-tipped pen.

- (16) If applicable, remove the tape that was applied to each rod sleeve and high stop spacer to keep them with the piston.
- (17) Remove the rod sleeve and high pitch stop spacer from each piston rod.
- (18) Install the high pitch stop spacer (Table 3-1) on each rod sleeve.
- (19) Install the rod sleeve, with high pitch stop spacer, in the guide collar, aligning it with the appropriate index numbers (1 and 2) on the pitch change block. Refer to Figure 3-9.



Guide Rod Attachment Details
Figure 3-9

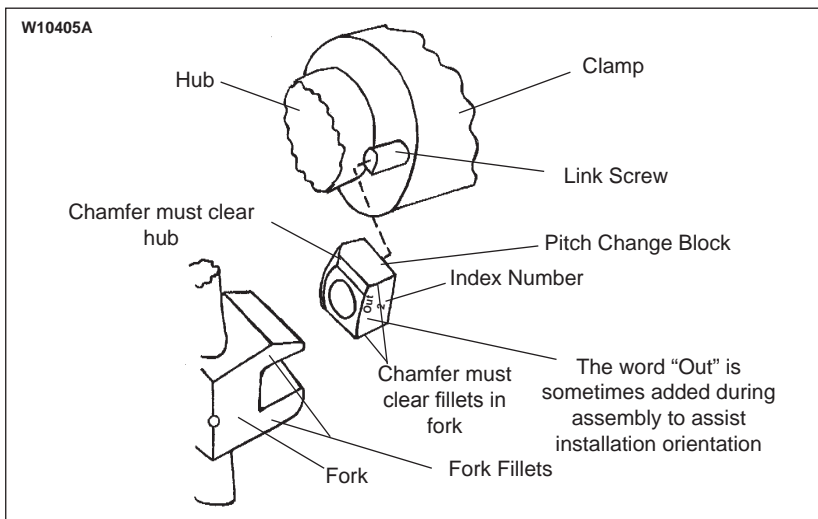
- (20) Lubricate the entire outside diameter surface of the cylinder with reciprocating engine oil.
- (21) Locate and match the index numbers (1 and 2) on the pitch change blocks with the corresponding index numbers on the counterweights.
- (22) Position the pitch change block on the clamp linkscrew, as shown in Figure 3-10.

NOTE: Position the word "OUT" on the pitch change block if present. Refer to Figure 3-10.

- (23) Remove the fork from each piston rod.

CAUTION: POSITION THE THICK SIDE OF THE FORK ON THE ENGINE SIDE OF THE PITCH CHANGE BLOCK.

- (24) Install the fork on the pitch change block, matching the index numbers (1 and 2) on the counterweights.
- (25) Slide the piston on the cylinder while sliding the piston rods through the bores in the fork, rod sleeve, high stop spacer, guide collar unit.



Positioning Pitch Change Block on Linkscrew
Figure 3-10

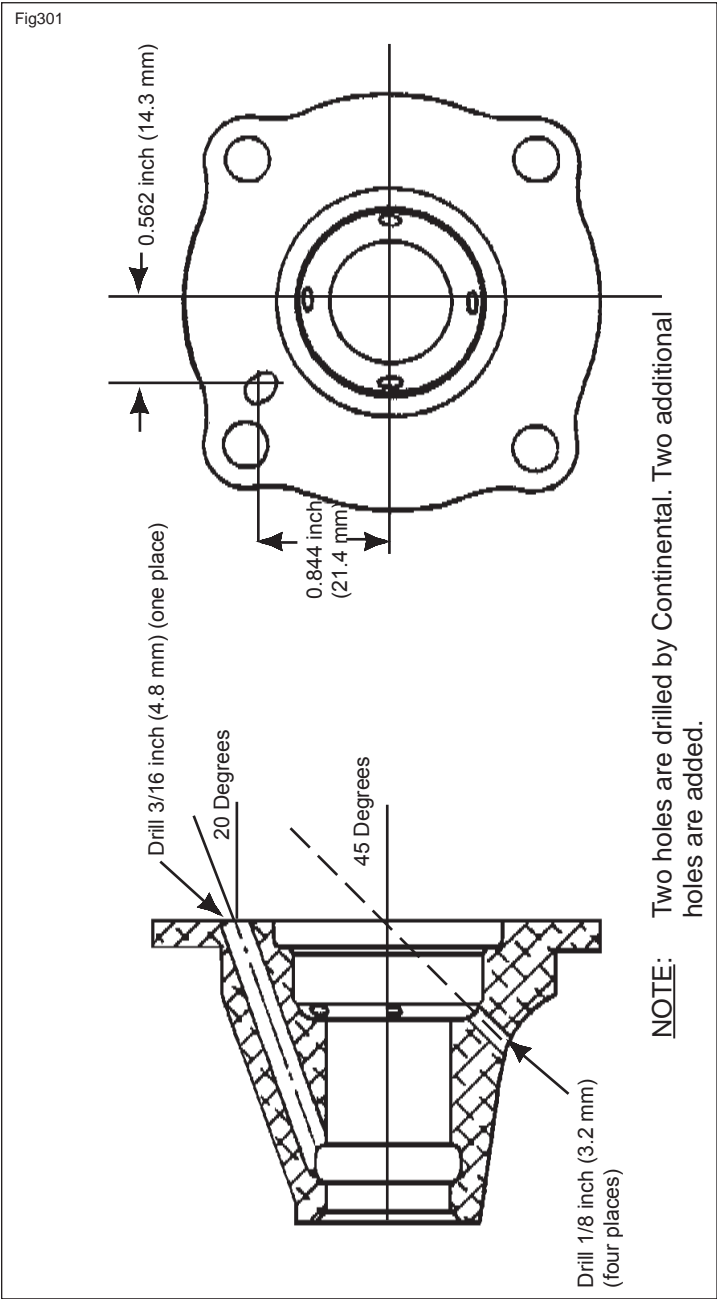
- (26) Position the fork.
- (27) Install the washer and self-locking nut (Table 3-1) on the end of each of the guide rods.
- (28) Torque the self-locking nut against the sleeve on the piston guide rod. Refer to Table 3-2.
- (29) Tighten the set screw in the fork until slightly snug.
- (30) Peen the edge of the hole over the set screw to safety the set screw in the fork.
- (31) Install the spinner dome as follows:

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

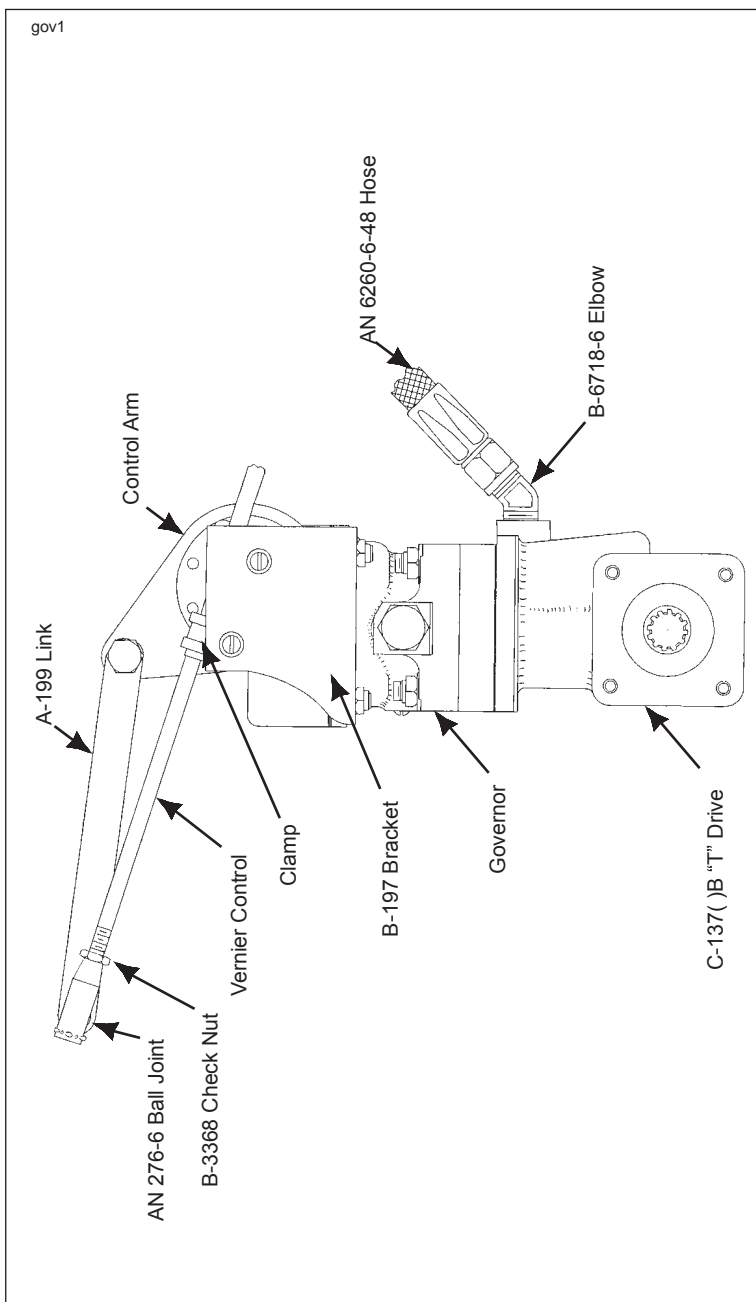
CAUTION 1: TO PREVENT DAMAGE TO THE BLADE AND BLADE PAINT, WRAP THE BLADE SHANKS IN SEVERAL LAYERS OF MASKING OR DUCT TAPE BEFORE INSTALLING THE SPINNER DOME. REMOVE THE TAPE AFTER THE SPINNER IS INSTALLED.

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

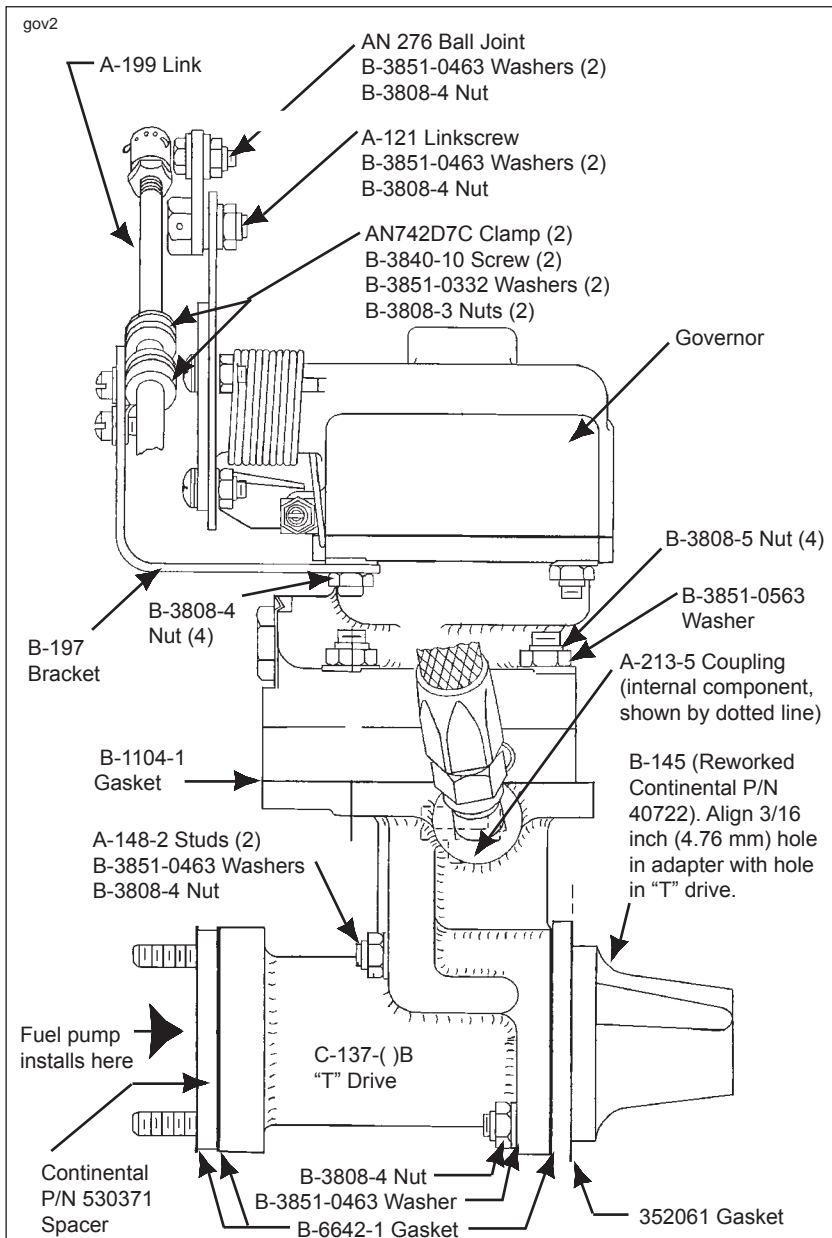
- (a) Carefully slide the spinner dome over the reassembled propeller.
- (b) Secure the spinner dome to the spinner bulkhead with the supplied screws and washers.



Modification of Shaft Gear Adapter (Continental P/N 40722)
Figure 3-11



**Installation of Governor and T-Drive
Figure 3-12**



**Installation of Governor and T-Drive
Figure 3-13**

E. Installation of Governor and "T" Drive

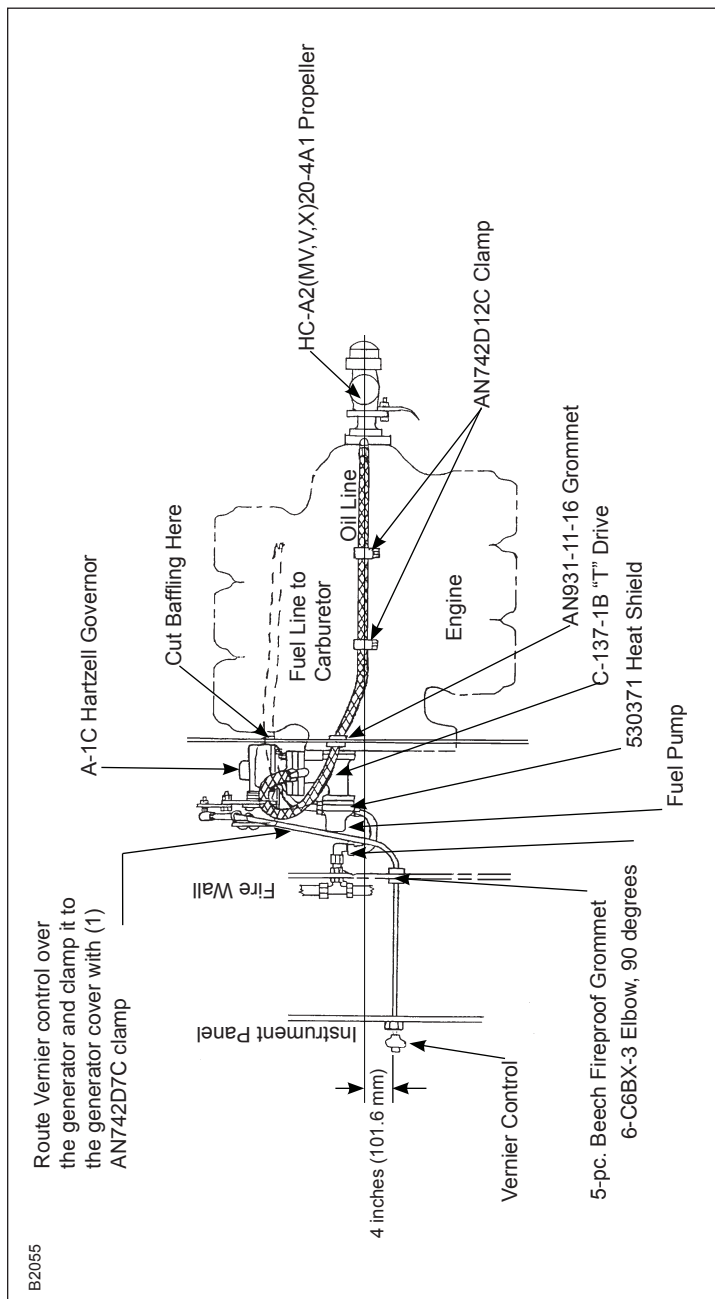
CAUTION: MAKE SURE THE A-213-5 COUPLING IS IN PLACE BEFORE INSTALLING THE GOVERNOR ON THE "T" DRIVE. REFER TO FIGURE 3-13.

- (1) Install the B-6718-6 elbow (45 degrees) on the C-137-1B "T" drive unit, as shown in Figure 3-12.
- (2) Install the gasket on the governor pad, as shown in Figure 3-12.
- (3) Install the B-197 bracket on the governor, as shown in Figure 3-13.
 - (a) Remove the two (2) B-3808-4 nuts and washers from the B-197 bracket.
 - (b) Install the B-197 bracket on the governor with the two (2) B-3808-4 nuts and washers, as shown in Figure 3-13.
- (4) Install the governor on the governor pad C-137-1B "T" drive, with four (4) B-3808-5 nuts and B-3851-0563 washers.
- (5) Torque the four (4) B-3808-5 nuts in accordance with Torque Values Table 3-2.
- (6) Install the A-199 link on the governor, with the A-121 linkscrew, (2) B-3851-0463 washers, and B-3808-4 nut, as shown in Figure 3-13.
- (7) Install the (2) AN742D7C clamps on the B-197 bracket, as shown in Figure 3-13, but do not tighten the screws.
- (8) Remove the fuel pump from the pad on the engine. Cover the opening of the fuel lines with tape.

NOTE: Do not stuff material in the lines.

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

NOTE: On dry sump (Bonanza) engines, the shaft gear will remain in the engine due to the scavenge pump. The Woodruff drive key will not pass through the forward bearing. Remove only the 40722 adapter on these engines.



**Installation of Oil Line and Vernier Control
Figure 3-14**

- (10) On Navion (wet sump) engines only, 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 as shown in Figure 3-11.

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) For Bonanza installations only:
- (a) Use an AN742D4C clamp to secure the cabin heater control line to the fire wall.
 - (b) Bend the hydraulic brake reservoir supply line to clear the governor "T" drive-fuel pump assembly.
 - (c) Alter the cowl flap mechanism for clearance.
 - 1 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.
 - 2 Looking at the left side of the engine, turn the pear-shaped control arm clockwise 75 degrees.
 - 3 Mark the position of the new bolt hole on the right side of the engine.
 - 4 Remove the shaft and drill a new hole.
 - 5 Reassemble the cowl flap mechanism.
 - (d) Relocate the fuel pump drain hole and bend the fuel pump air blast tube as necessary.
- (15) Remove the fuel lines leading to the fire wall and carburetor.
- (16) Replace the fuel line with AN6260-6-29 hose and reroute the hose under the engine cylinders with (2) AN742D12C clamps.

- (17) On a Bonanza installation only, install the 6-C6BX-S bulkhead elbow on the fuel line fire wall fitting and install the original fuel line.
 - (18) Remove the two outboard studs on the engine pad and install the longer studs A-148-2, as shown in Figure 3-13.
 - (19) Install a new gasket 352061 on the pad of the engine, as shown in Figure 3-13.
 - (20) On a Navion installation only, replace the gear shaft in the adaptor.
 - (21) Replace this assembly in the engine, aligning the 3/16 inch (4.76 mm) hole with the hole in the "T" drive, as shown in Figure 3-13.
 - (22) Install the new AN4045-1 gasket on the adaptor B-145 (Reworked Continental Engines P/N 40722).
 - (23) Install the governor "T" drive assembly on the engine pad using (4) B-3808-4 nuts and (4) B-3851-0463 washers.
 - (24) Install a new B-6642-1 gasket on the fuel pump pad of C-137-1B "T" drive, and a new B-6642-1 gasket between the heat shield and the fuel pump. Refer to Figure 3-12.
- NOTE:** An AN-4045-1 gasket may be used in place of the B-6642-1 gasket. A total of three would be required for the "T" drive and fuel pump installation.
- (25) Install the fuel pump on the "T" drive with the #530371 heat shield between the fuel pump and the "T" drive.
 - (26) Remove the tape from the opening of the fuel lines.

CAUTION: **MAKE SURE THAT THE FITTING
INSTALLED IN THE OIL TRANSFER
HOUSING DOES NOT BOTTOM AGAINST
THE OIL TRANSFER PLUG.**

- (27) 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.

- (28) Attach the hose to the engine with the AN 742C12C clamps, as shown in Figure 3-14.

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

- (29) Remove the plastic plug and alignment pin from the pressure port of the oil transfer unit.
- (30) Install a B-6718-6 elbow (45 degrees) on the pressure side of the oil transfer unit, as shown in Figure 3-2.
- (31) Attach the oil line from the "T" drive to the elbow.
- (32) On engines that previously had an HC-12(X,V)20-7 propeller installed:
- (a) Remove the old pressure and drain the lines.
 - (b) Install 1/8 inch (3.17 mm) pipe plugs in the engine where the lines were removed.
- (33) Install the vernier control 4 inches (101.6 mm) to the right of the center of the cockpit, just below the dashboard.
- (a) The vernier control is part number A-970BLO563 (Gerdes), 3A729-7 (Shakespeare) or A-970-10-0563 (ACS).
 - (b) The control should go straight forward, through the 3/4 inch (19.05 mm) hole in the fire wall and through the five-piece Beech fireproof grommet.
- NOTE:** The grommet consists of (1) 112436-6 retainer, (2) 112413-4 ball half, and (2) 112412 split grommet.
- (c) Route the control over the generator and use the AN742D7C clamp to secure the control to the generator cover.
 - (d) Route the control through the AN742D7C clamps on the B-197 Bracket. (See Figures 3-13 and 3-14).
- (34) Install the B-3368 check nut and the AN276-6 ball joint on the vernier control. Refer to Figure 3-11.

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

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

(36) Attach the ball joint to the A-199 link with (2) AN960-416 washers and (1) B-3308-4 nut, as shown in Figure 3-13.

(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.

5. Post-Installation Checks

- A. Refer to the airframe manufacturer's or STC instructions for post-installation checks.
- B. Perform a static RPM check as outlined in the Maintenance Practices chapter of this manual.

6. Propeller Assembly Removal

A. Spinner Dome 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.

- (1) Remove the screws and washers that secure the spinner dome to the spinner bulkhead.
- (2) Remove the spinner dome.
- (3) Remove layers of masking or duct tape from each blade shank, if applicable.

B. Propeller Removal

Refer to Figures 3-1 and 3-2.

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 AND RESULT IN AN AIRCRAFT ACCIDENT.

WARNING 2: DURING PROPELLER REMOVAL, AIRFRAME MANUFACTURER'S OR STC HOLDER'S MANUALS AND PROCEDURES MUST BE FOLLOWED BECAUSE THEY MAY CONTAIN ISSUES VITAL TO AIRCRAFT SAFETY THAT ARE NOT CONTAINED IN THIS MANUAL OR IN THE HARTZELL PROPELLER OVERHAUL MANUALS.

CAUTION: OIL WILL FLOW OUT OF THE PROPELLER WHEN THE PISTON IS REMOVED. PLACE A DRIP PAN UNDER THE PROPELLER TO CATCH THE EXCESS OIL.

- (1) Remove the self-locking nut from each piston rod.
- (2) Remove the washer from each piston rod.
- (3) Loosen the set screw in each fork.
- (4) The piston ears, forks, pitch change blocks, counterweights, and guide collar should have corresponding index numbers (1 and 2) impression stamped or marked with a felt-tipped pen. If they are not marked, number them with a felt-tipped pen.

NOTE: Marking the components will insure that the they are reassembled in their original location.

- (5) Slide the piston away from the hub and to the low pitch position, until the piston rods clear the sleeve and fork.
- (6) Slide the piston out of the forks, away from the clamp, link screws, and pitch change blocks.

- (7) Slide the piston off the cylinder and remove it from the propeller.
- (8) To prevent the loss of the sleeve, fork, and high pitch stop spacers, reinstall the washer and self-locking nut on each piston rod.
- (9) The pitch change blocks should have index numbers (1 and 2) marked with a felt-tipped pen to correspond to the numbers on the piston ears, forks, counterweights, and guide collar. If they are not marked, number them with a felt-tipped pen.

NOTE: Marking the components will insure that they are reassembled in their original location.

- (10) Remove the pitch change block from each clamp linkscrew.
- (11) Remove the safety wire from between the engine shaft and the hollow tube in the shaft nut. Refer to Figure 3-5.
- (12) Completely loosen the shaft nut from the engine shaft threads.

NOTE: Because the shaft nut is pulling the propeller hub off the tapered rear cone, there will be significant initial resistance to the loosening of the shaft nut. If the shaft nut cannot be loosened, contact Hartzell Propeller Product Support.

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

- (13) Support the propeller assembly with a sling.
- (14) Slide the propeller from the engine splined shaft and lift the propeller from the engine.

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

(15) Remove the rear cone.

(16) Place the propeller on a suitable cart for transportation.

C. Removal of A-224-() Transfer Unit

- (1) Disconnect the oil supply line from the governor to the oil transfer unit.
- (2) Insert a locally manufactured pin into the oil transfer plug and slip ring before removing the oil transfer unit. Refer to Figure 3-2.
- (3) Remove the spring pin that protrudes from the oil slinger
- (4) Remove the four bolts and washers that attach the oil transfer unit to the engine.

CAUTION: HANDLE THE OIL TRANSFER UNIT CAREFULLY TO PREVENT THE SLIP RING AND ATTACHED SPRING STEEL OIL RINGS FROM SLIDING OUT OF THE OIL TRANSFER UNIT; OTHERWISE, RECOMPRESSION OF THE SPRING STEEL OIL RINGS WILL BE REQUIRED DURING REINSTALLATION ON THE ENGINE.

- (5) Remove the oil transfer unit from the engine.

CAUTION: IT MAY BE NECESSARY TO SCRAPE THE GASKET FROM THE ENGINE OR OIL TRANSFER UNIT. USE CARE TO AVOID DAMAGING THE ENGINE AND OIL TRANSFER UNIT.

- (6) Remove the gasket from the engine or oil transfer unit, or both.

- D. Removal of the Governor from the "T" Drive Unit.
- (1) Remove the governor from the oil transfer line. Refer to Figure 3-13.
 - (a) Remove the B-3808-4 nut and the A-121 link screw.
 - (b) Remove the B-3808-3 nuts and the B-3840-10 clamp screws.
 - (c) Remove the four B-3808-5 nuts and washers.

CAUTION: DO NOT LOOSEN THE A-213-5 DRIVE COUPLING.

- (d) Remove the governor from the "T" drive.
- (2) Remove the "T" Drive from the engine. Refer to Figure 3-13.
 - (a) Disconnect the oil line hose.
 - (b) Disconnect the fuel lines from the fuel pump.
 - (c) Remove the fuel pump from the "T" drive.
 - (d) Remove the four B-3803-4 nuts and B-3851-0463 washers from the A-148-2 studs.
 - (e) Remove the "T" drive from the engine.

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1. Operational Tests

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

A. Initial Run-Up

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

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

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

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

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

B. Static RPM Check

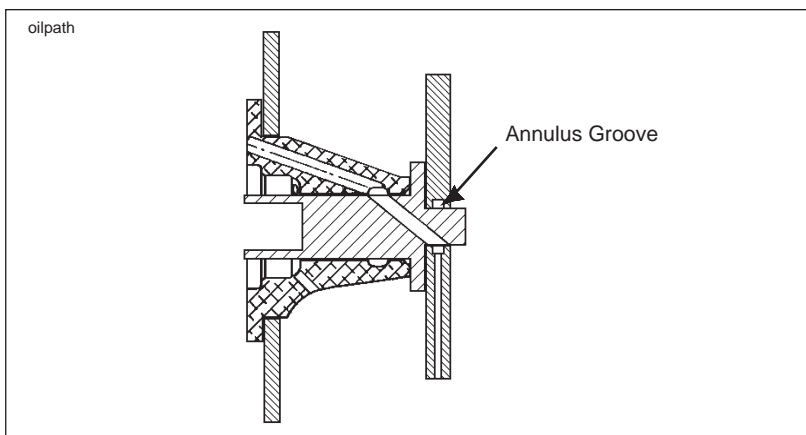
NOTE: This operational check should be performed after installation, maintenance, or propeller adjustment.

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 governor Maximum RPM Stop 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 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 Testing and Troubleshooting chapter and perform the adjustments under Max. RPM (Static) Low Pitch Stop Adjustment.
 - (7) Stop the engine.
 - (8) Return the governor Maximum RPM Stop to the original position, or adjust the governor to the rated RPM with the Maximum RPM Stop screw.
- C. Post-Run Check

After engine shutdown, check the propeller for signs of engine oil leakage.



Shaft Gear Adapter
Figure 4-1

■ 2. Troubleshooting

- A. Engine will not turn over, following propeller installation
 - (1) The oil transfer unit is installed incorrectly.
 - (a) Remove the propeller and oil transfer unit.
 - (b) Inspect the oil transfer unit for damage.
- B. Low Maximum RPM (on ground) following recent engine overhaul or repair:
 - (1) Shaft seal (Continental P/N 25102) is installed in shaft gear adapter.
 - (a) Remove the seal to correct.
 - (2) Shaft gear adapter is incorrectly installed on the engine accessory case, or the engine accessory case is missing the oil transfer annulus groove at the "T" drive mount (Figure 4-1).
 - (a) Remove the shaft gear adapter and verify proper alignment.
 - (b) Verify the presence of the annulus groove at the "T" drive mount. Refer to Figure 4-1.
- C. Low Maximum RPM (on ground), following recent propeller and oil transfer unit removal:
 - (1) Misalignment of the oil transfer unit slip ring and oil slinger ring with the rear cone
 - (a) Line the oil grooves in the slip ring, oil slinger ring and rear cone with the B-6580-1000 spring pin.
NOTE: Do not remove the spring pin after alignment.
- D. Low Maximum RPM (on ground)
 - (1) Oil transfer unit is incorrectly installed.
 - (a) Line the oil grooves in the slip ring, oil slinger ring and rear cone with the B-6580-1000 spring pin.
NOTE: Do not remove the spring pin after alignment.
 - (2) Oil transfer unit is damaged.
 - (a) Oil seal rings (A-221 and A-221-1) have excessive wear or the end gap of the oil seal rings exceeds the allowable tolerance. Send the oil transfer unit to an authorized repair facility.

- (3) Rear cone is missing the seal at the cut. Refer to Figure 3-3.
 - (a) Install the seal as described in Figure 3-3.
- (4) Rear cone, oil slinger, and slip ring are not in alignment
 - (a) Line the oil grooves in the slip ring, oil slinger ring and rear cone with the B-6580-1000 spring pin.
NOTE: Do not remove the spring pin after alignment.
- (6) Malfunctioning governor, clogged governor mounting gasket screen, or incorrect gasket
 - (a) Remove the governor and inspect the gasket. Verify that the gasket is correct.
 - (b) Inspect the governor for proper operation.
- (6) Incorrect governor maximum RPM stop setting
 - (a) Adjust the RPM setting to the specified static RPM requirements.
- (7) Failure, collapse, or restriction of the oil line installed between the governor and the oil transfer unit
 - (a) Replace the oil line as required.
- (8) Incorrect propeller blade angle
 - (a) With a blade angle protractor, check blade angles at the propeller 30 inch station, to confirm the correct blade angle settings. (Refer to the STC blade angle requirements.)
 - (b) If adjustment of the propeller low pitch blade angle is required, adjustment must be performed by an appropriately licensed propeller repair station or by the Hartzell factory.
- (9) Follow aircraft POH and/or AMM recommended checks to determine if the engine power is low.
 - (a) If the engine power is low, refer to an appropriately licensed engine repair station or the engine manufacturer.
 - (b) If the engine power is within acceptable limits, examine the maximum RPM stop setting of the governor.

- E. Maximum RPM is High
 - (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.
 - (2) If the engine power is within acceptable limits, examine the maximum RPM stop setting of the governor.
- F. 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 1 inch (25.4 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.
 - (8) If the engine speed does not increase from the RPM that it was previously running, then the propeller low pitch angle is probably incorrect.
 - (9) For low pitch setting verification, refer to the procedures in the Maintenance Practices chapter of this manual.

I G. Hunting and Surging

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

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

- (a) Missing shaft nut oil seal
- (b) Governor
- (c) Fuel control

(2) If the propeller is surging:

- (a) Perform the steps 1.A.(1) through 1.A.(5) under Operational Tests section in this chapter to release trapped air from the propeller. If surging reoccurs it is most likely due to a faulty governor. Have the governor tested by an appropriately licensed propeller repair station.
- (b) Hunting and/or surging may also be caused by friction or by internal propeller corrosion, which causes the propeller to react slower to governor commands.

NOTE: The propeller must be tested on a test bench at a propeller repair facility to isolate these faults.

I H. Engine Speed Varies with Airspeed

- (1) Constant speed propeller models will experience some small variances in engine speed that are normal and are no cause for concern.
- (2) Increase in engine speed while descending or increasing airspeed:
 - (a) Governor is not reducing oil volume in the propeller
 - 1** Install an in-line high pressure oil gauge in the oil line, between the governor and the oil transfer unit, to check the governor pressure function.

- (b) Excessive friction in the blade bearings or the pitch change mechanism
 - 1 With the engine not running and the propeller control pulled to the full-out position, manually move the blades from low pitch to high pitch.
NOTE: The blades should move with little resistance, once the oil is forced from the propeller hub cavity.
- (3) Decrease in engine speed while increasing airspeed:
 - (a) Governor pilot valve is stuck and is excessively decreasing oil volume.
 - 1 Install an in-line high pressure oil gauge in the oil line, between the governor and the oil transfer unit, to check the governor pressure function.
- (4) Increase in engine speed while decreasing airspeed:
 - (a) Governor pilot valve is stuck and is excessively increasing oil volume.
 - 1 Install an in-line high pressure oil gauge in the oil line, between the governor and the oil transfer unit, to check the governor pressure function.
- (5) Decrease in engine speed while decreasing airspeed:
 - (a) Governor is not increasing oil volume in the propeller.
 - 1 Install an in-line high pressure oil gauge in the oil line, between the governor and the oil transfer unit, to check the governor pressure function.
 - a Monitor the oil pressure gauge. The pressure should be 225 +/- 10 PSI at 1700 RPM.
 - b If the pressure cannot be maintained at 225 +/- 10 PSI, there is indication of internal leakage in the system.
 - c To establish that the correct pressure is being produced by the propeller governor, install a valve between the gauge and the oil transfer unit.
 - d With the engine running at a low RPM, momentarily close the valve and observe the pressure indicated on the gauge. The pressure must be 225 +/- 10 PSI.

- (b) Excessive friction in the blade bearings or pitch change mechanism

- 1 With the engine not running and the propeller control pulled to the full-out position, manually move the blades from low pitch to high pitch.

NOTE: The blades should move with little resistance, once the oil is forced from the propeller hub cavity.

I. Loss of Propeller Control

- (1) Propeller goes to uncommanded high pitch (low RPM)

- (a) Loss of oil pressure - check:

- 1 Governor pressure relief valve for proper operation
 - a Refer to G.(1)(b) for corrective action.
 - 2 Governor drive for damage
 - a Refer to G.(1)(b) for corrective action.
 - 3 Adequate engine oil supply
 - a Refer to G.(1)(b) for corrective action.
 - 4 Oil supply hose to oil transfer unit kinked or collapsed
 - a Refer to G.(1)(b) for corrective action.
 - 5 Excessive wear in the oil transfer unit
 - a Oil transfer unit must be removed and inspected for excessive wear or incorrect end gap in the A-221 and A-221-1 oil seal rings.

- (b) Corrective action for G.(1)(a)1 through G(1)(a)4:
 - 1 Install an in-line high pressure gauge in the oil line, between the governor and oil transfer unit, to check the governor pressure function.
 - a Monitor the oil pressure gauge. The pressure should be 225 +/- 10 PSI at 1700 RPM.
 - b If the pressure cannot be maintained at 225 +/- 10 PSI, there is indication of internal leakage in the system.
 - c To establish that the correct pressure is being produced by the propeller governor, install a valve between the gauge and the oil transfer unit.
 - d With the engine running at a low RPM, momentarily close the valve and observe the pressure indicated on the gauge. The pressure must be 225 +/- 10 PSI.
- (2) Engine RPM decreases during flight, or at high oil temperature (+180 degrees).
 - (a) Rear cone seal is missing (see Figure 3-3).
 - (b) Oil transfer unit is not holding pressure.
- (3) Propeller goes to uncommanded low pitch (high RPM)
 - (a) Governor pilot valve is sticking.
 - (b) Check the clamps at the governor bracket for slippage in the control shaft housing.
- (4) RPM increases with power and airspeed, propeller RPM control has little or no effect.
 - (a) Excessive friction in the blade bearings or pitch change mechanism
 - 1 With the engine not running and the propeller control pulled to the full-out position, manually move the blades from low pitch to high pitch.
NOTE: The blades should move with little resistance, once the oil is forced from the propeller hub cavity.

- (b) Governor is not reducing oil volume in the propeller.
 - 1 Install an in-line high pressure oil gauge in the oil line, between the governor and the oil transfer unit, to check the governor pressure function.
 - 2 Governor problem
 - 3 Seal is installed in the shaft gear adapter.

J. Vibration

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

NOTE: Vibration problems due to 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, which is potentially harmful to the propeller. Avoid operation until the propeller can be checked by an appropriately licensed repair station.

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

- (j) Hub, blade or blade clamp for damage or cracking
- (k) Grease or oil leakage from a seemingly solid surface of the hub, blade clamp or blade
- (m) Blade deformation

NOTE: Dynamic balancing is recommended after installing or performing maintenance on a propeller. While normally an optional task, it may be required by the engine or airframe manufacturer to make certain the propeller/engine combination is balanced within close tolerances before operation. Refer to the engine or airframe manuals, and the Maintenance Practices chapter of this manual.

K. Propeller Overspeed

(1) Check:

- (a) Tachometer error
- (b) Low pitch stop adjustment
- (c) Governor maximum RPM set too high
- (d) Governor pilot valve jammed, supplying high pressure only

L. Propeller Underspeed

(1) Check:

- (a) Tachometer error
- (b) Excessive oil transfer unit leakage
- (c) Governor oil pressure low
- (d) Governor oil passage clogged
- (e) Governor pilot valve is jammed

I M. 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) Grease Leakage - Probable Cause:

NOTE: The blade clamp/split-bearing is the only source of grease leakage.

- (a) Overlubrication
- (b) Improperly torqued or loose lubrication fitting. (Tighten the fitting in accordance with Torque Values Table 3-2).
- (c) Defective lubrication fitting. (Replace the fitting).
- (d) Incorrect O-ring between the blade clamp and the propeller hub. (Refer to an appropriately licensed propeller repair facility for replacement of the O-ring).
- (e) Grease leaks past the blade clamp seal gaskets. (Replace gaskets).
- (f) Grease leaks from between the blade clamp and the blade. (Refer to an appropriately licensed propeller repair facility for replacement of sealant).
- (g) Grease leaks from the clamp when the blade is pointed up and in a static condition.

1 Oil separating from the grease

(2) Oil Leakage - Probable Cause

- (a) Damaged or deteriorated oil transfer unit seal
- (b) Damaged or deteriorated O-ring seal between the hub and the cylinder
- (c) Damaged or deteriorated O-ring seal between the piston and the cylinder
- (d) Displaced felt seal between the piston and the cylinder
- (e) Worn phenolic piston guide bushing

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1. Pre-Flight Checks

Follow propeller preflight inspection procedures as specified in the Pilot Operating Handbook (P.O.H.) or this manual. In addition, perform the following inspections:

A. Blades

- (1) Visually inspect the entire blade (lead, trail, face, and camber sides) for nicks, gouges, erosion and cracks. Refer to the Maintenance Practices chapter of this manual for blade repair information. Normal blade lead edge erosion (sand-blasted appearance) is acceptable and does not require removal before further flight.
- (2) Visually inspect the blades for lightning strike. Refer to the Lightning Strike Damage section in this chapter for a description of damage.

B. Inspect the spinner and visible blade retention components for damage or cracks. Repair or replace components as required before further flight.

C. Check for loose or missing hardware. Tighten or reinstall as necessary.

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

D. Inspect for grease and oil leakage and determine its source.

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

E. Check the blades for radial play or movement of the blade tip (in and out or, fore and aft, end play). Refer to Loose Blades, in the Periodic Inspections section of this chapter, for blade play limits.

F. Refer to the Periodic Inspections section in this chapter for additional inspection information and possible corrections to any discrepancies discovered as a result of preflight checks.

2. Operational Checks

- A. Following propeller installation and before flight, perform initial run-up as outlined in Operational Tests in the Testing and Troubleshooting chapter of this manual.
- B. Check the propeller speed control and operation through 200 RPM, using the procedure specified in the Pilot Operating Handbook (POH) for the aircraft.
 - (1) Perform all ground functional and cycling checks with a minimum propeller RPM drop required to demonstrate function.
 - (2) A typical RPM drop is 100 to 300 RPM for non-feathering propellers.

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

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

3. Required Periodic Inspections and Maintenance**A. Periodic Inspection**

Perform detailed inspection procedures, as follows, at 100 hour intervals, not to exceed twelve (12) calendar month.

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

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

- (1) Remove the spinner dome.
- (2) Visually inspect the blades for nicks, gouges, and cracks. If any damage is discovered, refer to the Blade Repairs section in the Maintenance Practices chapter of this manual for additional information. A cracked blade must be referred to an appropriately licensed propeller repair station.
- (3) Inspect all visible propeller parts for cracks, wear or unsafe conditions.
- (4) Check for oil and grease leaks. Refer to Oil and Grease Leakage in the Inspection Procedures section of this chapter.
- (5) Check the blade track. Refer to Blade Track in the Inspection Procedures section of this chapter.
- (7) Check the accuracy of the tachometer. Refer to Tachometer Inspection in the Inspection Procedures section of this chapter.
- (8) Make an entry in this log book verifying this inspection.

B. Periodic Maintenance

- (1) Lubricate the propeller assembly. Refer to the Maintenance Practices chapter of this manual for applicable 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 require mandatory replacement of specified parts after a defined number of hours and/or cycles of use.
- (2) Life limited component times may exist for the propeller models covered in this manual. Refer to the Airworthiness Limitations chapter of this manual.
- (3) Operators are urged to keep informed of airworthiness information via Hartzell Service Bulletins and Service Letters, which are available from Hartzell distributors or from the Hartzell factory by subscription. Selected information is also available on Hartzell Propeller's website at www.hartzellprop.com.

D. Overhaul Periods

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

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

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

- (1) Hartzell HC-A2(V,X)20-4A1 propellers must be overhauled at intervals as follows:
 - (a) All non-aerobatic and non agricultural applications - 1000 hours or 60 calendar months (whichever occurs first).
- (2) Hartzell HC-A2MV20-4A1 propellers must be overhauled at intervals as follows:
 - (a) All non-aerobatic and non agricultural applications - 2000 hours or 60 calendar months (whichever occurs first).

4. Inspection Procedures

The following inspections must be made on a regular basis, either before flight, during required periodic inspection, as described in this chapter, or if a problem is noted. Possible corrections to problems discovered during inspections, additional inspections, and limits are detailed in the following inspection procedures.

A. Blade Damage

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

B. Grease or Oil Leakage

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

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. Leakage repairs should be referred to an appropriately licensed propeller repair station. An instance of abnormal grease leakage should be inspected using the following procedure:

(1) Remove the spinner dome.

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

(2) 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.

- (3) 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.
- (4) If cracks or failing components are found, these parts must be replaced before further flight. Report such occurrences to airworthiness authorities and to Hartzell Propeller Inc. Product Support.

C. Vibration

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

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

- (1) Perform troubleshooting and evaluation of possible sources of vibration in accordance with engine or airframe manufacturer's instructions.
- (2) Refer to the Vibration section in the Testing and Troubleshooting chapter of this manual. Perform the checks to determine possible cause of the vibration. If no cause is found, then consider that the origin of the problem could be the propeller and proceed with steps 4.C.(3) through 4.C.(8) in this chapter.
- (3) Remove the spinner dome.

- (4) Perform a visual inspection for cracks in the hub, blade clamps and blades.

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

- (5) If cracks are suspected, additional inspections must be performed before further flight. These inspections must be performed by qualified personnel at an appropriately licensed propeller repair station to verify the condition. Such inspections typically include disassembly of the propeller followed by inspection of parts, using nondestructive methods in accordance with published procedures.
- (6) Check the blades and compare blade to blade differences:
 - (a) Inspect the propeller blades for unusual looseness or movement. Refer to the Loose Blades section of this chapter.
 - (b) Check blade track. Refer to the Blade Track section of this chapter.

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

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

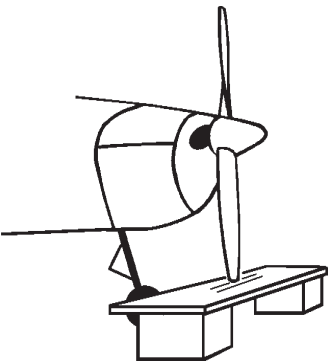
D. Tachometer Inspection

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

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

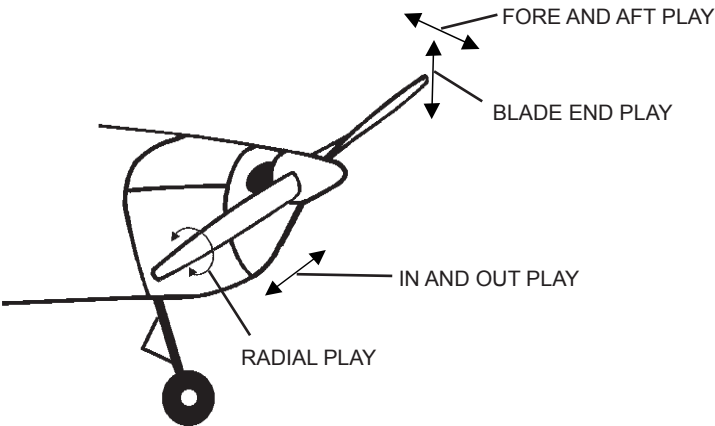
- (1) Accuracy of the engine tachometer should be verified at 100 hour intervals or at annual inspection, whichever occurs first.
- (2) Calibration of the engine tachometer may be performed using the Vu-Thru II Tachometer (P/N C-4670), which can be purchased from Hartzell Propeller. Equivalent calibration equipment is also acceptable for use.

APS6155



Checking Blade Track
Figure 5-1

APS6163a



Blade Play
Figure 5-2

E. Blade Track

(1) Check the blade track as follows:

- (a) Chock the aircraft wheels securely.
- (b) Refer to Figure 5-1. Place a fixed reference point beneath the propeller, within 0.25 inch (6.0 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 blade.
- (e) Tracking tolerance is ± 0.062 inch (1.57 mm) or 0.125 inch (3.17 mm) total.

(2) Possible Correction

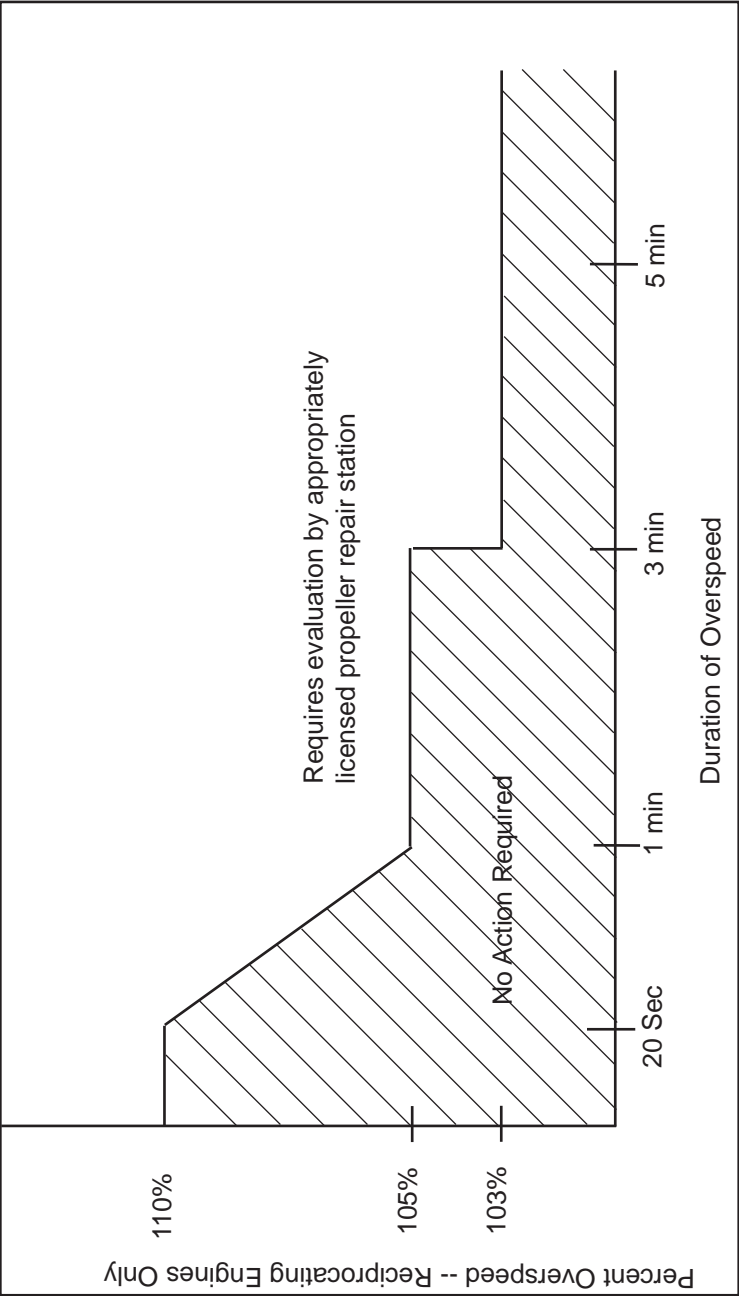
- (a) Remove foreign matter from the propeller rear cone.
- (b) If no foreign matter is present, refer to an appropriately licensed propeller repair facility.

F. Loose Blades

Refer to Figure 5-2. Blade movement is measured at the tip. Limits are as follows:

End Play	± 0.06 inch (1.5 mm)
Fore & Aft Movement	± 0.06 inch (1.5 mm)
In and Out Movement	± 0.032 inch (0.81 mm)
Radial Play (pitch change)	± 0.5 degree (1 degree total)

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



Reciprocating Engine Overspeed Limits
Figure 5-3

G. Corrosion

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

Light corrosion on blades may be removed by qualified personnel in accordance with the Blade Repairs section in the Maintenance Practices chapter of this manual.

Heavy corrosion that results in severe pitting must be referred to an appropriately licensed propeller repair station.

H. Spinner Damage

Inspect the spinner for cracks, missing hardware, or other damage. Refer to an appropriately licensed propeller repair station for spinner damage acceptance and repair information. There are no Hartzell approved field repairs to metal spinners. Contact the local airworthiness authority for repair approval.

5. Special Inspections**A. Overspeed**

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

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

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

B. Lightning Strike

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

(1) General

In the event of a propeller lightning strike, an inspection is required before further flight. It may be permissible to operate a propeller for an additional ten (10) hours of operation if the propeller is not severely damaged and meets the requirements in paragraph 5.B.(2) of this chapter. Regardless of the outcome of the initial inspection, the propeller must eventually be removed from the aircraft, disassembled, evaluated, and/or repaired by an appropriately licensed propeller repair station.

(2) Procedure for Temporary Operation

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

- (a) Remove the spinner dome and perform a visual inspection of the propeller and spinner for evidence of significant damage that would require repair before flight (such as arcing damage to propeller hub).

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

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

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

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

I (2) Procedure

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

D. Fire Damage or Heat Damage

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

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

6. Long Term Storage

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

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1. Cleaning

CAUTION: 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 THE PROPELLER COMPONENTS MAY OCCUR.

(1) Wash the propeller with a noncorrosive soap solution.

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

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

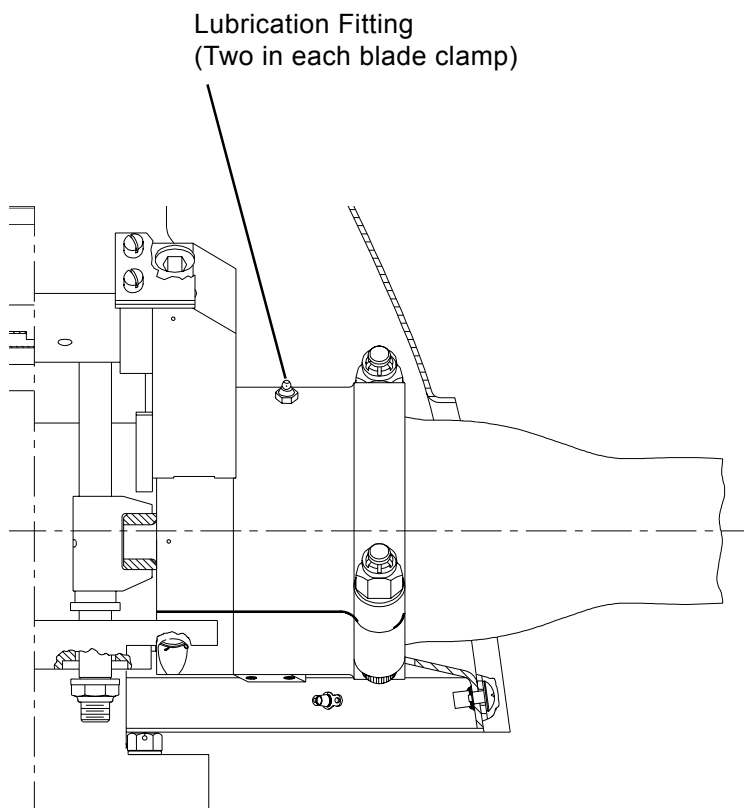
(3) Thoroughly rinse with water and allow to dry.

B. Spinner Cleaning and Polishing

(1) Clean the spinner using the General Cleaning procedures above.

(2) Polish the dome (if required) with an automotive-type aluminum polish.

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**Lubrication Fitting
Figure 6-1**

2. Lubrication

A. Lubrication Intervals

- (1) The propeller must be lubricated at intervals not to exceed 100 hours or 12 months, whichever occurs first.

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

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

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

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

B. Lubrication Procedure

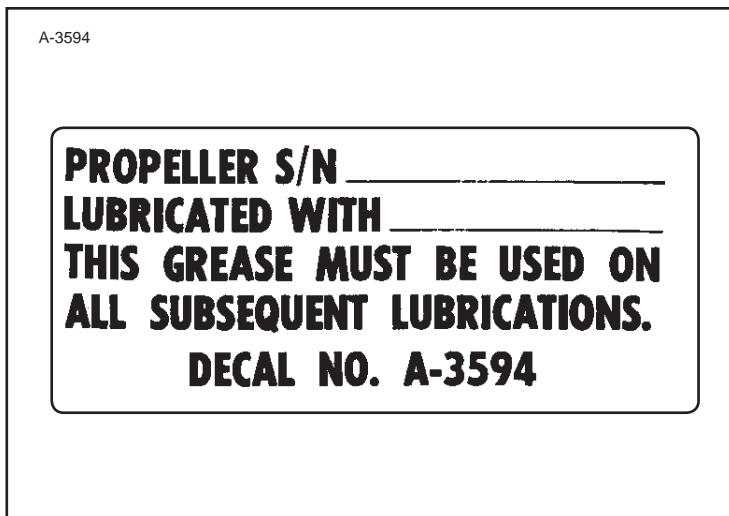
CAUTION: FOLLOW LUBRICATION PROCEDURES CORRECTLY TO MAINTAIN AN ACCURATE BALANCE OF THE PROPELLER ASSEMBLY.

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

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

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

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



Lubrication Label
Figure 6-2

- (4) A label (Hartzell P/N A-3594) is normally applied to the propeller to indicate the type of grease previously used (Figure 6-2).
 - (a) This grease type should be used during re-lubrication unless the propeller has been disassembled and the old grease removed.
 - (b) Purging of old grease through lubrication fittings is only about 30 percent effective.
 - (c) To completely replace one grease with another, the propeller must be disassembled in accordance with the applicable overhaul manual.

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

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

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

- (6) Repeat step 2.B.(4) for each blade clamp assembly.
- (7) Reinstall the removed lubrication fitting on each clamp.
- (8) Tighten the lubrication fittings until snug.

NOTE: Make sure the ball of each lubrication fitting is properly seated.

- (9) Install a new lubrication fitting cap on each lubrication fitting.

C. Approved Lubricants

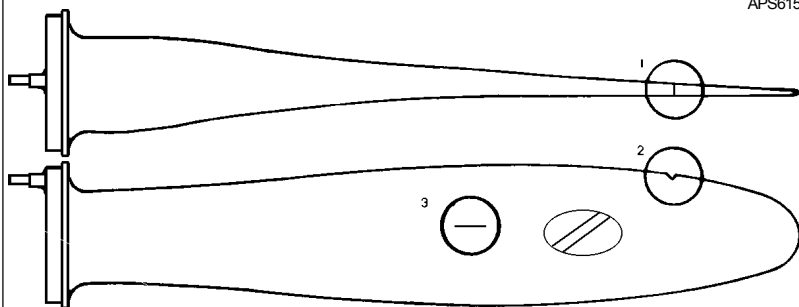
- (1) The following lubricants are approved for use in Hartzell propellers:

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

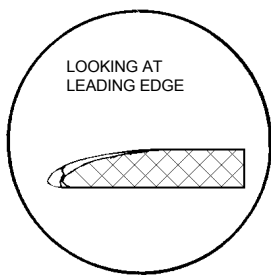
- (2) A label (Figure 6-2) indicating the type of grease used for previous lubrication (if used) is installed on the propeller piston or on the blade clamp. If the propeller must be lubricated with a different type of grease, the propeller must be disassembled and cleaned of old grease before relubricating.

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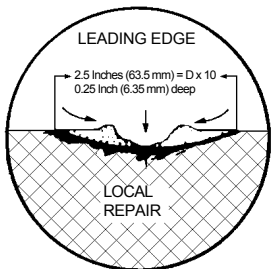
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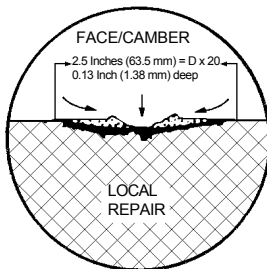
Example 1



Example 2



Example 3



To determine amount of rework needed, use the following formula:

On the leading and trailing edge of the blade, measure the depth of the damage, and multiply this number x 10 (see Example 2, above). Rework the area surrounding the damage 10 times the depth of the damage.

On the face and camber of the blade, measure the depth of the damage, and multiply this number x 20 (see Example 3, above). Rework the area surrounding the damage 20 times the depth of the damage.

Repair Limitations Figure 6-3

3. Blade Repairs

WARNING: ALL 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: 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 AN APPROPRIATELY LICENSED PROPELLER REPAIR FACILITY OR THE HARTZELL PRODUCT SUPPORT DEPARTMENT FOR BLADE DIMENSIONAL LIMITS.

Nicks, gouges, and scratches on blade surfaces or on the leading or trailing edges of the blade, greater than 1/32 inch wide or deep, must be removed before flight. Field repair of small nicks and scratches may be performed by qualified personnel in accordance with FAA Advisory Circular 43.13-1B, as well as the procedures specified below. Normal blade lead edge erosion (sand-blasted appearance) is acceptable, and does not require removal before further flight.

A. Repair of Nicks or Gouges

Local repairs may be made using files, electrical or air powered equipment. Emery cloth, scotch brite, and crocus cloth must be used for final finishing. Refer to Figure 6-3.

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

CAUTION 2: SHOT PEENED BLADES ARE IDENTIFIED WITH AN "S" FOLLOWING THE BLADE MODEL NUMBER, AS DESCRIBED IN THE DESCRIPTION AND OPERATION CHAPTER OF THIS MANUAL. BLADES THAT HAVE DAMAGE IN THE SHOT PEENED AREAS IN EXCESS OF 0.015 INCH (0.38 MM) DEEP ON THE FACE OR CAMBER OR 0.250 INCH (6.35 MM) ON THE LEADING OR TRAILING EDGES MUST BE REMOVED FROM SERVICE, AND THE REWORKED AREA SHOT PEENED BEFORE FURTHER FLIGHT. SHOT PEENING OF AN ALUMINUM BLADE MUST BE ACCOMPLISHED BY AN APPROPRIATELY LICENSED AND APPROVED REPAIR FACILITY IN ACCORDANCE WITH HARTZELL ALUMINUM BLADE MANUAL 133C (61-13-33).

- (1) Repairs to the leading or trailing edge must be accomplished by removing material from the bottom of the damaged area. Remove material from this point out to both sides of the damage, providing a smooth, blended depression which maintains the original airfoil general shape.
- (2) Repairs to the blade face or camber should be made in the same manner as above. Repairs that form a continuous line across the blade section (chordwise) are unacceptable.

- (3) The area of repair should be determined as follows:
Leading and trailing edge damage: Depth of nick x 10.
Face and camber: Depth of nick x 20. Refer to Figure 6-3.

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

- (4) After filing or sanding of the damaged area, the area must then be polished with emery cloth, and finally with crocus cloth to remove any traces of filing.
- (5) Inspect the repaired area with a 10X magnifying glass and dye penetrant. Make sure that no indication of the damage, file marks, or coarse surface finish remain.
- (6) Treat the repaired area to prevent corrosion. Properly apply chemical conversion coating and approved paint to the repaired area before returning the blade to service. Refer to Painting After Repair in this section.

B. Repair of Bent Blades

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

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

4. Painting After Repair

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

It is permissible to perform a blade touch-up with aerosol paint in accordance with the procedures in Painting of Aluminum Blades, below.

The following paints (Table 6-1) are approved for blade touch-up:

Vendor	Color/Type	Vendor P/N	Hartzell P/N
Tempo	Epoxy Black	A-150	n/a
Tempo	Epoxy Gray	A-151	n/a
Tempo	Epoxy White (tip stripe)	A-152	n/a
Tempo	Epoxy Red (tip stripe)	A-153	n/a
Tempo	Epoxy Yellow (tip stripe)	A-154	n/a
Sherwin-Williams	Black	F75KXB9958-4311	A-6741-145-1
Sherwin-Williams	Gray	F75KXA10445-4311	A-6741-146-1
Sherwin-Williams	White (tip stripe)	F75KXW10309-4311	A-6741-147-1
Sherwin-Williams	Red (tip stripe)	F75KXR12320-4311	A-6741-149-1
Sherwin-Williams	Yellow (tip stripe)	F75KXY11841-4311	A-6741-150-1
Sherwin-Williams	Silver Metallic	F63BXS0627-4389	A-6741-163-1

Approved Paints
Table 6-1

The paint manufacturers may be contacted as listed below:

Tempo Products Co.

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

Sherwin Williams Co.

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

A. Painting of Aluminum Blades

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

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

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

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

- (3) Use acetone, #700 lacquer thinner, or MEK to wipe the surface of the blade. Allow solvent to evaporate.

- (4) Before refinishing the blades, apply an approved corrosion preventive coating to the bare aluminum surface. Oakite 31, Chromicote L-25, or Alodine 1201 are approved chemical conversion coatings. Apply these coatings in accordance with the directions provided by the product manufacturer.
- (5) Mask off 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 WELL VENTILATED AREA.

CAUTION: APPLY ONLY ENOUGH FINISH COATING TO UNIFORMLY COVER THE REPAIR/ EROSION. AVOID EXCESSIVE PAINT BUILD-UP ALONG THE TRAILING EDGE TO AVOID CHANGING BLADE PROFILE.

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

5. Dynamic Balance**A. Overview**

WARNING: WHEN USING REFLECTIVE TAPE FOR DYNAMIC BALANCING, DO NOT APPLY THE TAPE ON EXPOSED BARE METAL OF THE 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 which 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: Some engine manufacturers' instructions also contain information on dynamic balance limits.

- (4) Unless otherwise specified by the engine or airframe manufacturer, Hartzell recommends that the propeller be dynamically balanced to a reading of 0.2 IPS, or less.

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 and inner surface of the spinner dome.

- (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 it before relubricating the propeller and dynamic balancing.
- (3) Before dynamic balance, record the number and location of all balance weights.
- (4) Static balance is accomplished at a propeller overhaul facility when an overhaul or major repair is performed.

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

C. Placement of Balance Weights for Dynamic Balance

- (1) Attach dynamic balance weight slugs only to the nut plates mounted on the spinner bulkhead. A maximum of four (4) A-48 weight slugs per location is allowed.
- (2) If reflective tape is used for dynamic balancing, remove the tape immediately after balancing is completed.
- (3) Make a record in the propeller logbook of the number and location of dynamic balance weights and static balance weights, if they have been reconfigured.

6. Propeller Low Pitch Stop

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

A. Low Pitch Stop

- (a) The propeller low pitch stop is set at the factory to the aircraft TC or STC Holder's requirements and should not require any additional adjustment.
- (b) The aircraft 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.
- (c) Be aware that the aircraft TC or STC holder may specify the static RPM to be less than the RPM to which the engine is rated.

B. Propeller Low Pitch Measurement

- (a) Perform the following steps for low pitch measurement:

- 1** Rotate the blades by hand to move the blades and piston to low pitch.

NOTE: Low pitch is reached when a washer on the end of each piston guide rod stops against the guide collar.

- 2** With the blade in a horizontal position, measure the low pitch blade angle.
 - 3** Check the measured blade angle against the required blade angle as specified in accordance with the aircraft TC or STC Holder's requirements.
 - 4** If the blade angle requires adjustment, have the low pitch blade angle adjusted by an appropriately licensed propeller repair facility or by the Hartzell factory.

7. Propeller High Pitch (Minimum RPM) Stop

- A. The high pitch stop is set at the factory per the aircraft manufacturer's or STC holder's recommendations. These stops are adjustable only by an appropriately licensed propeller repair facility or the Hartzell factory.

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Not applicable.

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CONTENTS

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2. [Record Keeping](#) 8-3

 A. [Information to be Recorded](#) 8-3

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1. Introduction

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

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

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

- (1) Information that is required to be recorded is listed in Part 43 of the U.S. Federal Aviation Regulations.
- (2) The log book may also be used to record:
 - (a) Propeller position (on aircraft)
 - (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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