

Manual No. 486

61-00-86

Revision 11

June 2026



# Propeller Owner's Manual and Logbook

Raptor Turbine Propeller Series  
with Composite Blades

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## **Hartzell Propeller LLC**

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**HARTZELL PROPELLER OWNER'S MANUAL**  
**486**

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**COVER 61-00-86** Inside Cover  
Rev. 11 Jun/26

Fellow aviation enthusiasts, I urge you to read this Manual thoroughly. It contains a wealth of information about your new propeller.

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

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



JJ Frigge  
President, Hartzell Propeller LLC

# WARNING (Rev. 5)

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

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

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

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

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

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

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

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

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

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**REVISION 11 HIGHLIGHTS**

Revision 11, dated June 2026, incorporates the following:

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

Minor language/format changes and renumbering, if applicable are marked with a revision bar, but are not listed below.

**INSTALLATION AND REMOVAL**

- Revised the section, "Precautions" and added Figure 3-3

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## REVISION 11 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.

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| <u>Revision No.</u> | <u>Issue Date</u> | <u>Comments</u> |
|---------------------|-------------------|-----------------|
| Original            | Dec/15            | New Issue       |
| Revision 1          | Apr/17            | Minor Revision  |
| Revision 2          | May/19            | Minor Revision  |
| Revision 3          | Feb/21            | Minor Revision  |
| Revision 4          | Jun/21            | Minor Revision  |
| Revision 5          | Nov/21            | Minor Revision  |
| Revision 6          | Apr/23            | Major Revision  |
| Revision 7          | Jun/23            | Minor Revision  |
| Revision 8          | Apr/25            | Minor Revision  |
| Revision 9          | Jun/25            | Minor Revision  |
| Revision 10         | Aug/25            | Minor Revision  |
| Revision 11         | Jun/26            | Minor Revision  |

## RECORD OF REVISIONS

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## RECORD OF TEMPORARY REVISIONS

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SERVICE DOCUMENTS LIST

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

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

| Service Document Number | Incorporation Rev/Date |
|-------------------------|------------------------|
| HC-SL-61-364, original  | Rev. 3 (Feb/21)        |
| HC-SL-61-185, Rev. 3    | Rev. 2 (May/19)        |
| HC-SL-61-354, original  | Rev. 1 (Apr/17)        |
|                         |                        |
|                         |                        |
|                         |                        |
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|                         |                        |

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## 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:

Manager, Chicago ACO Branch  
Compliance & Airworthiness Division, AIR-7CO  
Federal Aviation Administration

THE FAA CHICAGO ACO BRANCH  
AIR-700, ACKNOWLEDGES RECEIPT AND  
• ACCEPTS THE APPROVAL  
• APPROVES RECOMMENDATION  
• FOR COMMENTS SEE FAA LETTER/EMAIL

APPROVED \_\_\_\_\_  
• FOR COMMENTS SEE \_\_\_\_\_  
DATED 3-18-19  
THIS DATA HAS BEEN ADDED TO OUR FILE  
DATE 3-18-19 ATM-7C3 3

ENGINEER

BRANCH

DATE \_\_\_\_\_

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AIRWORTHINESS LIMITATIONS

1. Replacement Time (Life Limits)

- A. 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.
- B. The following data summarizes all current information concerning Hartzell Propeller Inc. 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 (which may or may not be life limited).
- (1) The propeller models affected by this manual currently do not have any life limited parts.

THE FAA CHICAGO ACO BRANCH  
AIR-7CO, ACKNOWLEDGES RECEIPT AND  
ACCEPTS THE APPROVAL  
• APPROVES RECOMMENDATION  
• FOR COMMENTS SEE FAA LETTER/EMAIL  
DATED 3-18-19  
THIS DATA HAS BEEN ADDED TO OUR FILE  
3-18-19  
ENGINEER AIR-7C3 DATE

FAA APPROVED

by: \_\_\_\_\_ date: \_\_\_\_\_

Manager, Chicago ACO Branch  
Compliance & Airworthiness Division, AIR-7CO  
Federal Aviation Administration

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1. General (Rev. 2)

A. Statement of Purpose

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

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

- (2) The information in this manual can be used by qualified personnel to install, operate, and maintain the applicable Hartzell propeller assemblies.

- (a) Additional manuals are available that include overhaul procedures and specifications for the propeller.

- (3) This manual may include multiple design types.

- (a) Parentheses shown in the propeller model designations in this or other Hartzell Propeller publications indicate letter(s) and/or number(s) that may or may not be present because of different configurations permitted on the various aircraft installations.

- 1 Refer to the Description and Operation chapter of this manual for propeller and blade model designation information.

- (4) Where possible, this manual is written in the format specified by ATA iSpec 2200.

## B. Maintenance Practices

- (1) The propeller and its components are highly vulnerable to damage while they are removed from the engine. Properly protect all components until they are reinstalled on the engine.
- (2) Never attempt to move the aircraft by pulling on the propeller.
- (3) Avoid the use of blade paddles. If blade paddles must be used, use at least two paddles. Do not put the blade paddle in the area of the de-ice or anti-icing boot when applying torque to a blade assembly. Put the blade paddle in the thickest area of the blade, just outside of the de-ice or anti-icing boot. Use one blade paddle per blade.
- (4) Use only the approved consumables, e.g., cleaning agents, lubricants, etc.
- (5) Observe applicable torque values during maintenance.
- (6) Propellers must be statically balanced before installing on the engine.
  - (a) Hartzell Propeller statically balances all new propellers.
  - (b) Overhauled propellers must be statically balanced by a certified propeller repair station with the appropriate rating before return to service.
- (7) Dynamic balance is recommended, but may be accomplished at the discretion of the operator, unless specifically required by the airframe or engine manufacturer.
  - (a) Perform dynamic balancing in accordance with the Maintenance Practices chapter of this manual.
  - (b) Additional procedures may be found in the aircraft maintenance manual.
- (8) As necessary, use a soft, non-graphite pencil or crayon to make identifying marks on components.
- (9) As applicable, follow military standard NASM33540 for safety wire, safety cable, and cotter pin general practices. Use 0.032 inch (0.81 mm) diameter stainless steel safety wire unless otherwise indicated.

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

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

### A. Propeller Stress Levels

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

## B. Engine Modifications

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

## 3. Restrictions and Placards (Rev. 1)

### A. Important Information

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

**4. Reference Publications**

**A. Hartzell Propeller Publications**

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

| <b>Manual No.<br/>(ATA No.)</b> | <b>Hartzell Propeller Manual Title</b>                                                                     |
|---------------------------------|------------------------------------------------------------------------------------------------------------|
| n/a                             | Active Hartzell Propeller Service Bulletins, Service Letters, Service Instructions, and Service Advisories |
| Manual 127<br>(61-16-27)        | Metal Spinner Maintenance Manual                                                                           |
| Manual 130B<br>(61-23-30)       | Mechanically Actuated Governors and Accessories Overhaul Manual                                            |
| Manual 135F<br>(61-13-35)       | Composite Blade Overhaul Manual                                                                            |
| Manual 159<br>(61-02-59)        | Application Guide                                                                                          |
| Manual 165A<br>(61-00-65)       | Illustrated Tool and Equipment Manual                                                                      |
| Manual 170<br>(61-13-70)        | Composite Blade Field Maintenance and Minor Repair Manual                                                  |

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| <b>Manual No.<br/>(ATA No.)</b> | <b>Hartzell Propeller Manual Title</b>             |
|---------------------------------|----------------------------------------------------|
| Manual 180<br>(30-61-80)        | Ice Protection System Manual                       |
| Manual 202A<br>(61-01-02)       | Standard Practices Manual,<br>Volumes 1 through 11 |
| Manual 496<br>(61-10-96)        | Raptor Turbine Propeller Overhaul Manual           |

**B. Vendor Publications**

None.

**5. Personnel Requirements** (Rev. 3)

**A. Service and Maintenance Procedures in this Manual**

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

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

## A. Special Tooling

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

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

## B. Consumable Materials

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

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

7. Safe Handling of Paints and Chemicals (Rev.1)

## A. Instructions for Use

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

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

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

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

A. Calendar Limits

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

B. Long Term Storage

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

9. Component Life and Overhaul (Rev. 4)

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

## A. Component Life

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

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

- (2) Time Since New (TSN) and Time Since Overhaul (TSO) records for the propeller hub and blades must be maintained in the propeller logbook.
- (3) Both TSN and TSO are necessary for defining the life of the component. Certain components or in some cases an entire propeller, may be "life limited", which means that they must be replaced after a specified period of use (TSN).
  - (a) Refer to Hartzell Propeller Service Letter HC-SL-61-61Y for definitions and instructions regarding TSN and TSO.
  - (b) Refer to the Airworthiness Limitations chapter in the applicable Hartzell Propeller Owner's Manual for a list of life limited components.

**B. Overhaul**

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

10. Damage/Repair Types (Rev. 2)

## A. Airworthy/Unairworthy Damage

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

## B. Minor/Major Repair

## (1) Minor Repair

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

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

## (2) Major Repair

- (a) Major repair cannot be done by elementary operations.
- (b) Major repair work must be accepted by an individual that is certified by the Federal Aviation Administration (FAA) or international equivalent.

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

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

11. Propeller Critical Parts (Rev. 2)

## A. Propeller Critical Parts

- (1) Procedures in this manual may involve Propeller Critical Parts (PCP).

- (a) These procedures have been substantiated based on Engineering analysis that expects this product will be operated and maintained using the procedures and inspections provided in the Instructions for Continued Airworthiness (ICA) for this product.

- (b) Refer to the Illustrated Parts List chapter in the applicable Hartzell Propeller maintenance manual to identify the Propeller Critical Parts.

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

## 12. Warranty Service (Rev. 2)

### A. Warranty Claims

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

## 13. Hartzell Propeller Contact Information (Rev. 2)

### A. Product Support Department

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

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

  - (a) The Product Support Department may be reached during business hours (8:00 a.m. through 5:00 p.m., United States Eastern Time) at (937) 778-4379 or at (800) 942-7767, toll free from the United States and Canada.
  - (b) The Product Support Department can also be reached by fax at (937) 778-4215, and by e-mail at [techsupport@hartzellprop.com](mailto:techsupport@hartzellprop.com).

(c) After business hours, you may leave a message on our 24 hour product support line at (937) 778-4376 or at (800) 942-7767, toll free from the United States and Canada.

- 1 A technical representative will contact you during normal business hours.
- 2 Urgent AOG support is also available 24 hours per day, seven days per week via this message service.

(d) Additional information is available on the Hartzell Propeller website at [www.hartzellprop.com](http://www.hartzellprop.com).

**B. Technical Publications Department**

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

Hartzell Propeller LLC  
Attn: Technical Publications Department  
One Propeller Place  
Piqua, Ohio 45356-2634 U.S.A.

Telephone: 937.778.4200

Fax: 937.778.4215

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

**C. Recommended Facilities**

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

#### 14. "Video" Icon/QR Code

##### A. Instructions for Use

- (1) The "Video" icon/QR code (refer to Figure 1) that appears in this manual allows you to access a video or animated demonstration of the applicable procedure.

**CAUTION:** THESE VIDEOS/ANIMATIONS ARE INTENDED TO SUPPLEMENT THE APPLICABLE INSTRUCTIONS. THEY SHOULD NOT BE USED WITHOUT FIRST READING AND UNDERSTANDING THE LATEST REVISION OF THE PROCEDURE AND ANY APPLICABLE WARNINGS/CAUTIONS.

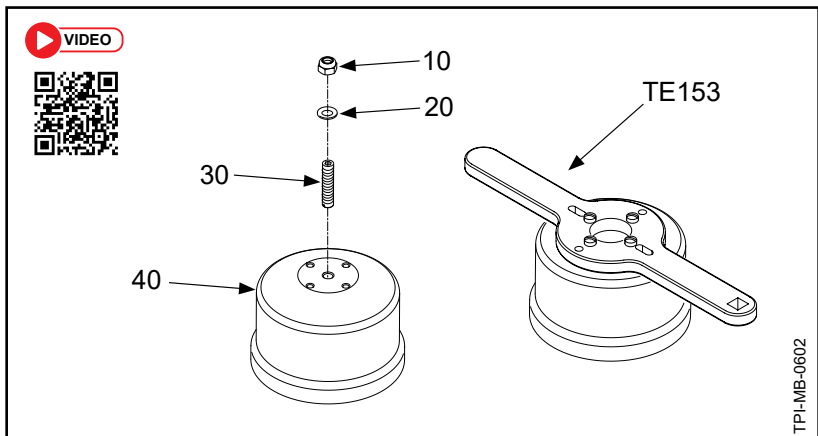
- (2) To access the video/animated demonstration:

- (a) If viewing the document file digitally:

1 Click on the QR code

- (b) From a printed copy of the page:

1 Scan the QR code from any mobile device equipped with a QR reader application.



"Video" Icon/QR Code  
Figure 1

**15. Definitions** (Rev. 5)

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

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

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

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| <b>Term</b>                  | <b>Definition</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Constant Force               | A force that is always present in some degree when the propeller is operating                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Constant Speed               | A propeller system that employs a governing device to maintain a selected engine RPM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Corrosion (Aluminum)         | The chemical or electrochemical attack by an acid or alkaline that reacts with the protective oxide layer and results in damage of the base aluminum. Part failure can occur from corrosion due to loss of structural aluminum converted to corrosion product, pitting, a rough etched surface finish, and other strength reduction damage caused by corrosion.                                                                                                                                                                                                                                                                     |
| Corrosion (Steel)            | Typically, an electrochemical process that requires the simultaneous presence of iron (component of steel), moisture and oxygen. The iron is the reducing agent (gives up electrons) while the oxygen is the oxidizing agent (gains electrons). Iron or an iron alloy such as steel is oxidized in the presence of moisture and oxygen to produce rust. Corrosion is accelerated in the presence of salty water or acid rain. Part failure can occur from corrosion due to loss of structural steel converted to corrosion product, pitting, a rough etched surface finish and other strength reduction damage caused by corrosion. |
| Corrosion Product (Aluminum) | A white or dull gray powdery material that has an increased volume appearance (compared to non-corroded aluminum). Corrosion product is not to be confused with damage left in the base aluminum such as pits, worm holes, and etched surface finish.                                                                                                                                                                                                                                                                                                                                                                               |

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| <b>Term</b>               | <b>Definition</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Corrosion Product (Steel) | When iron or an iron alloy such as steel corrodes, a corrosion product known as rust is formed. Rust is an iron oxide which is reddish in appearance and occupies approximately six times the volume of the original material. Rust is flakey and crumbly and has no structural integrity. Rust is permeable to air and water, therefore the interior metallic iron (steel) beneath a rust layer continues to corrode. Corrosion product is not to be confused with damage left in the base steel such as pits and etched surface finish. |
| Crack                     | Irregularly shaped separation within a material, sometimes visible as a narrow opening at the surface                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Debond                    | Separation of two materials that were originally bonded together in a separate operation                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Defect                    | An imperfection that affects safety or utility                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Delamination              | Internal separation of the layers of composite material                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Dent                      | The permanent deflection of the cross section that is visible on both sides with no visible change in cross sectional thickness                                                                                                                                                                                                                                                                                                                                                                                                           |
| Depression                | Surface area where the material has been compressed but not removed                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Distortion                | Alteration of the original shape or size of a component                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Edge Alignment            | Distance from the blade centerline to the leading edge of the blade                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Erosion                   | Gradual wearing away or deterioration due to action of the elements                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Exposure                  | Leaving material open to action of the elements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

| <b>Term</b>                | <b>Definition</b>                                                                                                                                                                                                                                                                                           |
|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Face                       | The surface of the blade that is directed toward the rear of the aircraft. The face side is the high pressure, or thrusting, side of the blade. The blade airfoil sections are normally cambered or curved such that the face side of the blade may be flat or even concave in the midblade and tip region. |
| Face Alignment             | Distance from the blade centerline to the highest point on the face side perpendicular to the chord line                                                                                                                                                                                                    |
| Feathering                 | The capability of blades to be rotated parallel to the relative wind, thus reducing aerodynamic drag                                                                                                                                                                                                        |
| Fraying                    | A raveling or shredding of material                                                                                                                                                                                                                                                                         |
| Fretting                   | Damage that develops when relative motion of small displacement takes place between contacting parts, wearing away the surface                                                                                                                                                                              |
| Galling                    | To fret or wear away by friction                                                                                                                                                                                                                                                                            |
| Gouge                      | Surface area where material has been removed                                                                                                                                                                                                                                                                |
| Hazardous Propeller Effect | The hazardous propeller effects are defined in Title 14 CFR section 35.15(g)(1)                                                                                                                                                                                                                             |
| Horizontal Balance         | Balance between the blade tip and the center of the hub                                                                                                                                                                                                                                                     |
| Impact Damage              | Damage that occurs when the propeller blade or hub assembly strikes, or is struck by, an object while in flight or on the ground                                                                                                                                                                            |
| Inboard                    | Toward the butt of the blade                                                                                                                                                                                                                                                                                |
| Intergranular Corrosion    | Corrosion that attacks along the grain boundaries of metal alloys                                                                                                                                                                                                                                           |
| Jog                        | A term used to describe movement up/down, left/right, or on/off in short incremental motions                                                                                                                                                                                                                |

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| <b>Term</b>               | <b>Definition</b>                                                                                                                                                                                                                                                                     |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Laminate                  | To unite composite material by using a bonding material, usually with pressure and heat                                                                                                                                                                                               |
| Lengthwise                | A direction that is generally parallel to the pitch axis                                                                                                                                                                                                                              |
| Loose Material            | Material that is no longer fixed or fully attached                                                                                                                                                                                                                                    |
| Low Pitch                 | The lowest blade angle attainable by the governor for constant speed operation                                                                                                                                                                                                        |
| Major Propeller Effect    | The major propeller effects are defined in Title 14 CFR section 35.15(g)(2)                                                                                                                                                                                                           |
| Minor Deformation         | Deformed material not associated with a crack or missing material                                                                                                                                                                                                                     |
| Monocoque                 | A type of construction in which the outer skin carries all or a major part of the load                                                                                                                                                                                                |
| Nick                      | Removal of paint and possibly a small amount of material                                                                                                                                                                                                                              |
| Non-Aviation Certified    | Intended for non-aircraft application, such as Hovercraft or Wing in Ground Effect (WIG) applications. These products are certificated by an authority other than FAA. The hub and blades will be stamped with an identification that is different from, but comparable to TC and PC. |
| Non-Aviation Experimental | Intended for non-aircraft application, such as Hovercraft or Wing-In-Ground effect (WIG) applications. Products marked with an "X" at or near the end of the model number or part number are not certified by any authority and are not intended for use on certificated craft.       |
| Onspeed                   | Condition in which the RPM selected by the pilot through the propeller control/condition lever and the actual engine (propeller) RPM are equal                                                                                                                                        |

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| <b>Term</b>              | <b>Definition</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Open Circuit             | Connection of high or infinite resistance between points in a circuit which are normally lower                                                                                                                                                                                                                                                                                                                                                                                                   |
| Outboard                 | Toward the tip of the blade                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Overhaul                 | The periodic disassembly, inspection, repair, refinish, and reassembly of a propeller assembly to maintain airworthiness                                                                                                                                                                                                                                                                                                                                                                         |
| Overspeed                | Condition in which the RPM of the propeller or engine exceeds predetermined maximum limits; the condition in which the engine (propeller) RPM is higher than the RPM selected by the pilot through the propeller control/condition lever                                                                                                                                                                                                                                                         |
| Pitch                    | Same as "Blade Angle"                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Pitting                  | Formation of a number of small, irregularly shaped cavities in surface material caused by corrosion or wear                                                                                                                                                                                                                                                                                                                                                                                      |
| Pitting (Linear)         | The configuration of the majority of pits forming a pattern in the shape of a line                                                                                                                                                                                                                                                                                                                                                                                                               |
| Porosity                 | An aggregation of microvoids. See "voids".                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Propeller Critical Parts | A part on the propeller whose primary failure can result in a hazardous propeller effect, as determined by the safety analysis required by Title 14 CFR section 35.15                                                                                                                                                                                                                                                                                                                            |
| Reference Blade Radius   | <p>Refers to the propeller reference blade radius in an assembled propeller, e.g., 30-inch radius. A measurement from the propeller hub centerline to a point on a blade, used for blade angle measurement in an assembled propeller. An adhesive stripe (blade angle reference tape CM160) is usually located at the reference blade radius location.</p> <p><u>Note:</u> Do not confuse <i>reference blade radius</i> with <i>blade station</i>; they may not originate at the same point.</p> |

| Term           | Definition                                                                                                                                                                                                                                         |
|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Reversing      | The capability of rotating blades to a position to generate reverse thrust to slow the aircraft or back up                                                                                                                                         |
| Scratch        | Same as "Nick"                                                                                                                                                                                                                                     |
| Short Circuit  | Connection of low resistance between points on a circuit between which the resistance is normally much greater                                                                                                                                     |
| Shot Peening   | Process where steel shot is impinged on a surface to create compressive surface stress, that provides improved strength and resistance to fatigue                                                                                                  |
| Single Acting  | Hydraulically actuated propeller that utilizes a single oil supply for pitch control                                                                                                                                                               |
| Split          | Delamination of blade extending to the blade surface, normally found near the trailing edge or tip                                                                                                                                                 |
| Station Line   | See "Blade Station"                                                                                                                                                                                                                                |
| Synchronizing  | Adjusting the RPM of all the propellers of a multi-engine aircraft to the same RPM                                                                                                                                                                 |
| Synchrophasing | A form of propeller synchronization in which not only the RPM of the engines (propellers) are held constant, but also the position of the propellers in relation to each other                                                                     |
| Ticking        | A series of parallel marks or scratches running circumferentially around the diameter of the blade                                                                                                                                                 |
| Track          | In an assembled propeller, a measurement of the location of the blade tip with respect to the plane of rotation, used to verify face alignment and to compare blade tip location with respect to the locations of the other blades in the assembly |

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

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**16. Abbreviations** (Rev. 2)

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

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

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| <b>Abbreviation</b> | <b>Term</b>                     |
|---------------------|---------------------------------|
| PSI                 | Pounds per Square Inch          |
| RF                  | Reference                       |
| RPM                 | Revolutions per Minute          |
| SAE                 | Society of Automotive Engineers |
| STC                 | Supplemental Type Certificate   |
| TBO                 | Time Between Overhaul           |
| TC                  | Type Certificate                |
| TSI                 | Time Since Inspection           |
| TSN                 | Time Since New                  |
| TSO                 | Time Since Overhaul             |
| UID                 | Unique Identification           |
| WIG                 | Wing-In-Ground-Effect           |

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DESCRIPTION AND OPERATION - CONTENTS

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## 1. Description of Propellers and Systems

### A. ( )D3( )-( ) ( ) Propellers

The propellers described in this section are constant speed, feathering and reversing. They use a single oil supply from a governing device to hydraulically actuate a change in blade angle. The propellers are used primarily on Pratt & Whitney turbine engines.

A two piece aluminum hub retains each propeller blade on a thrust bearing. A cylinder is attached to the hub and contains a feathering spring and piston. The hydraulically actuated piston transmits linear motion through a pitch change rod and fork to each blade to result in blade angle change.

While the propeller is operating the following forces are constantly present: 1) spring force, 2) counterweight force, 3) centrifugal twisting moment of each blade and 4) blade aerodynamic twisting forces. The spring and counterweight forces attempt to rotate the blades to higher blade angle while the centrifugal twisting moment of each blade is generally toward lower blade angle. Blade aerodynamic twisting force is generally very small in relation to the other forces and can attempt to increase or decrease blade angle.

Summation of the propeller forces is toward higher pitch (low RPM) and is opposed by a variable force toward lower pitch (high RPM). The variable force is oil under pressure from a governor with an internal pump that is mounted on and driven by the engine. The oil from the governor is supplied to the propeller and hydraulic piston through a hollow engine shaft. Increasing the volume of oil within the piston and cylinder will decrease the blade angle and increase propeller RPM.

Decreasing the volume of oil will increase blade angle and decrease propeller RPM. By changing the blade angle, the governor can vary the load on the engine and maintain constant engine RPM (within limits), independent of where the power lever is set. The governor uses engine speed sensing mechanisms that permit it to supply or drain oil as necessary to maintain constant engine speed (RPM).

If governor supplied oil is lost during operation, the propeller will increase pitch and feather. Feathering occurs because the summation of internal propeller forces causes the oil to drain out of the propeller until the feather stop position is reached.

Normal in-flight feathering is accomplished when the pilot retards the propeller condition lever past the feather detent. This permits control oil to drain from the propeller and return to the engine sump. Engine shutdown is normally accomplished during the feathering process.

Normal in-flight unfeathering is accomplished when the pilot positions the propeller condition lever into the normal flight (governing) range and restarts the engine. As engine speed increases, the governor supplies oil to the propeller and the blade angle decreases.

In reverse mode of operation the governor operates in an underspeed condition to act strictly as a source of pressurized oil, without attempting to control RPM. Control of the propeller blade angle in reverse is accomplished with the beta valve for propellers with beta feedback block assemblies, and with the PCU for propellers with electronic beta sensors.

**NOTE:** For installations with beta feedback block assemblies, the beta valve is normally built into the base of the governor. For installations with beta sensors, the beta valve function is built into the PCU control system.

For installations with beta feedback block assemblies, the propeller is reversed by manually repositioning the cockpit-control to cause the beta valve to supply oil from the governor pump to the propeller. Several external propeller mechanisms, which include a beta ring and beta feedback block assembly, communicate propeller blade angle position to the beta valve.

When the propeller reaches the desired reverse position, movement of the beta ring and beta feedback block assembly initiated by the propeller piston, causes the beta valve to shut off the flow of oil to the propeller. Any additional unwanted movement of the propeller toward reverse, or any movement of the manually positioned beta valve control toward high pitch position will cause the beta valve to drain oil from the propeller to increase pitch.

For installations with electronic beta sensors, the propeller is reversed by manually repositioning the cockpit-control to cause the PCU to supply oil from the PCU pump to the propeller. The electronic beta sensor reads the position of the specially designed beta ring and communicates propeller blade angle position to the FADEC.

When the propeller reaches the desired reverse position, the electronic beta sensor determines the movement of the specially designed beta ring, initiated by propeller piston, and the FADEC tells the PCU to stop the flow of the oil to the propeller. Any additional unwanted movement of the propeller toward reverse, or any movement of the cockpit control toward the high pitch position will cause the PCU to drain oil from the propeller to increase pitch.

On certain installations, the engine may not have sufficient power to start up with the propeller in feather position. These installations typically incorporate propeller start locks. Start locks contain spring energized latch pins to prevent the propeller from going to feather position during normal engine shutdown.

If propeller rotation is above a predetermined RPM, the start locks disengage from the piston by centrifugal force acting on the latch pins to compress the spring (within the units). When propeller rotation drops below the predetermined RPM, the springs overcome the centrifugal force and move the latch pins to engage the piston, preventing blade angle movement to feather.

Shortly after start up with the propeller RPM above 800, the latch pins in the start locks will still retain the blade angle. To release the latch pins, it is necessary to manually actuate the propeller slightly toward reverse. This will move the piston, allowing the latch pins to slide freely. Centrifugal force will compress the springs and disengage the pins from the piston.

#### B. ( )D5( )-( ) ( ) ( ) Propellers

The propellers described in this section are constant speed, feathering and reversing. They use a single oil supply from a governing device to hydraulically actuate a change in blade angle. The propellers are used primarily on Honeywell turbine engines.

A two piece aluminum hub retains each propeller blade on a thrust bearing. A cylinder is attached to the hub and contains a feathering spring and piston. The hydraulically actuated piston transmits linear motion through a pitch change rod and fork to each blade to result in blade angle change.

While the propeller is operating the following forces are constantly present: 1) spring force, 2) counterweight force, 3) centrifugal twisting moment of each blade and 4) blade aerodynamic twisting forces. The spring and counterweight forces attempt to rotate the blades to higher blade angle while the centrifugal twisting moment of each blade is generally toward lower blade angle. Blade aerodynamic twisting force is generally very small in relation to the other forces and can attempt to increase or decrease blade angle.

Summation of the propeller forces is toward higher pitch (low RPM) and is opposed by a variable force toward lower pitch (high RPM). The variable force is oil under pressure from a governor with an internal pump that is mounted on and driven by the engine. The oil from the governor is supplied to the propeller and hydraulic piston through a hollow engine shaft. Increasing the volume of oil within the piston and cylinder will decrease the blade angle and increase propeller RPM.

Decreasing the volume of oil will increase blade angle and decrease propeller RPM. By changing the blade angle, the governor can vary the load on the engine and maintain constant engine RPM (within limits), independent of where

the power lever is set. The governor uses engine speed sensing mechanisms that permit it to supply or drain oil as necessary to maintain constant engine speed (RPM).

If governor supplied oil is lost during operation, the propeller will increase pitch and feather. Feathering occurs because the summation of internal propeller forces causes the oil to drain out of the propeller until the feather stop position is reached.

Normal in-flight feathering is accomplished when the pilot retards the propeller condition lever past the feather detent. This permits control oil to drain from the propeller and return to the engine sump. Engine shutdown is normally accomplished during the feathering process.

Normal in-flight unfeathering is accomplished when the pilot positions the propeller condition lever into the normal flight (governing) range and restarts the engine. As engine speed increases, the governor supplies oil to the propeller and the blade angle decreases.

In reverse mode of operation the governor operates in an underspeed condition to act strictly as a source of pressurized oil, without attempting to control RPM. Control of the propeller blade angle in reverse is accomplished with the beta valve.

**NOTE:** The beta valve is normally located on the side of the reduction gearbox opposite the propeller.

The propeller is reversed by manually repositioning the cockpit-control to cause the beta valve to supply oil from the governor pump to the propeller. A beta rod inserted into the front of the propeller communicates propeller blade angle position to the beta valve.

When the propeller reaches the desired reverse position, movement of the beta rod initiated by the propeller piston, causes the beta valve to shut off the flow of oil to the propeller. Any additional unwanted movement of the propeller toward reverse, or any movement of the manually positioned beta valve control toward high pitch position will cause the beta valve to drain oil from the propeller to increase pitch.

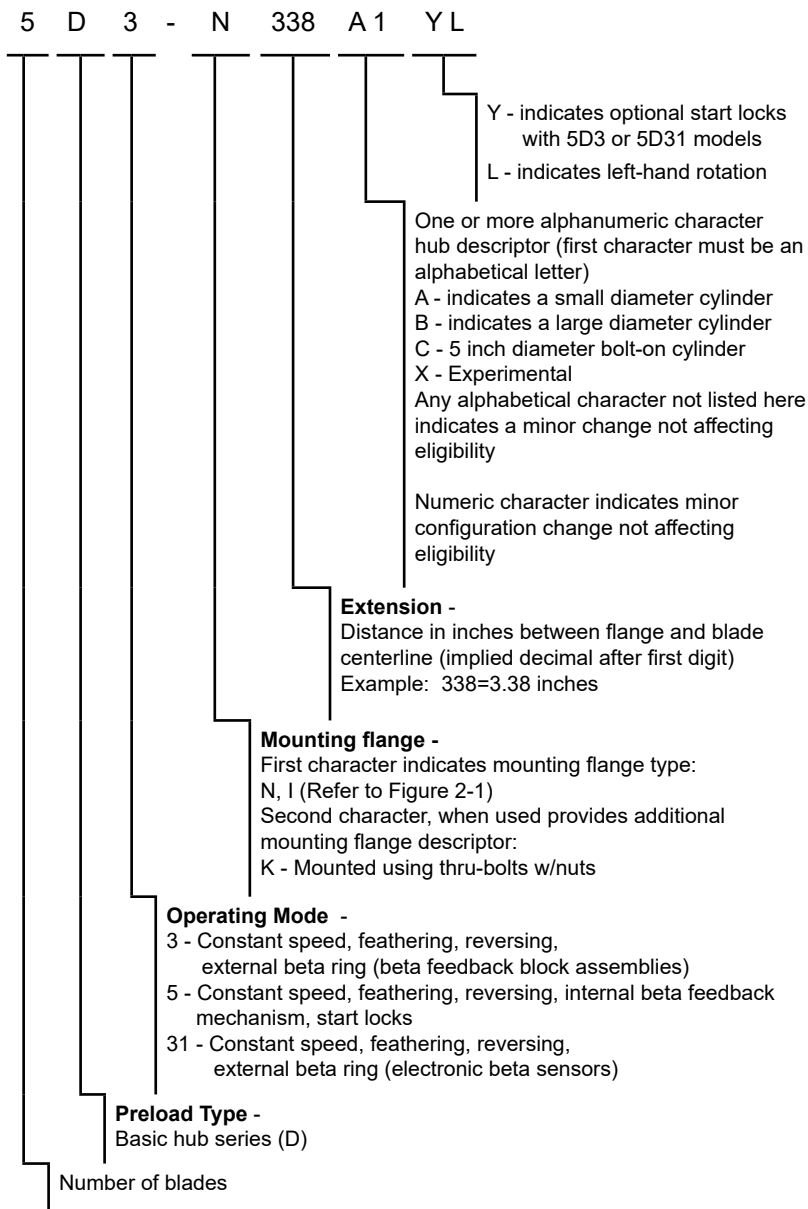
On certain installations, the engine may not have sufficient power to start up with the propeller in feather position. These installations typically incorporate propeller start locks. Start locks contain spring energized latch pins to prevent the propeller from going to feather position during normal engine shutdown.

If propeller rotation is above a predetermined RPM, the start locks disengage from the piston by centrifugal force acting on the latch pins to compress the spring (within the units). When propeller rotation drops below the predetermined RPM, the springs overcome the centrifugal force and move the latch pins to engage the piston, preventing blade angle movement to feather.

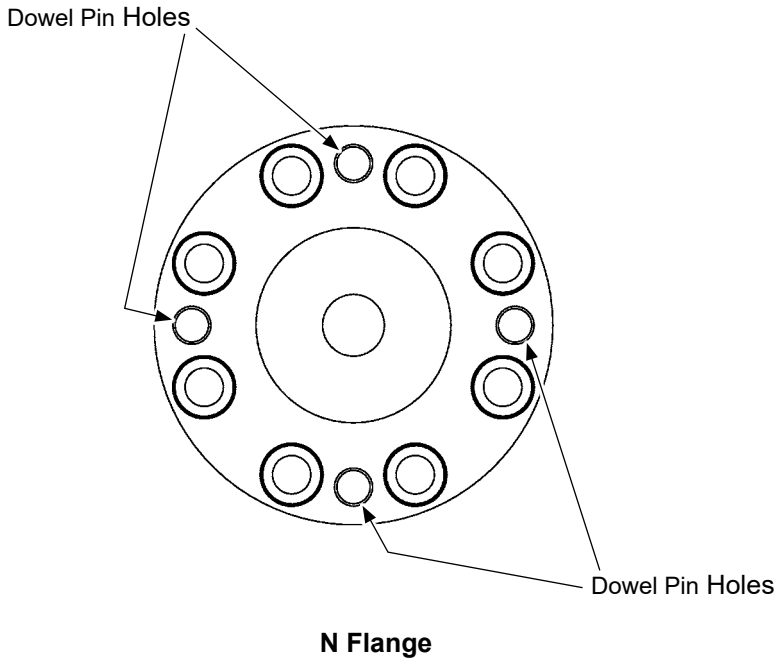
Shortly after start up with the propeller RPM above the predetermined RPM, the latch pins in the start locks will still retain the blade angle. To release the latch pins, it is necessary to manually actuate the propeller slightly toward reverse. This will move the piston, allowing the latch pins to slide freely. Centrifugal force will compress the springs and disengage the pins from the piston.

#### C. Propeller Model Designation

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



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



| Bolt Circle                                                                                        | No. of Dowels    | No. of Bolts     | Typical Engine                     |
|----------------------------------------------------------------------------------------------------|------------------|------------------|------------------------------------|
| 4.25 inch                                                                                          | 4<br>(0.50 inch) | 8<br>(9/16 inch) | Pratt & Whitney<br>(Refer to NOTE) |
| <b>NOTE:</b> An N flange propeller can be used on an engine that has 2 dowel pins or 4 dowel pins. |                  |                  |                                    |

**Propeller Flange Description**  
**Figure 2-1**

## 2. Propeller Blades

### A. Description of Composite Blades

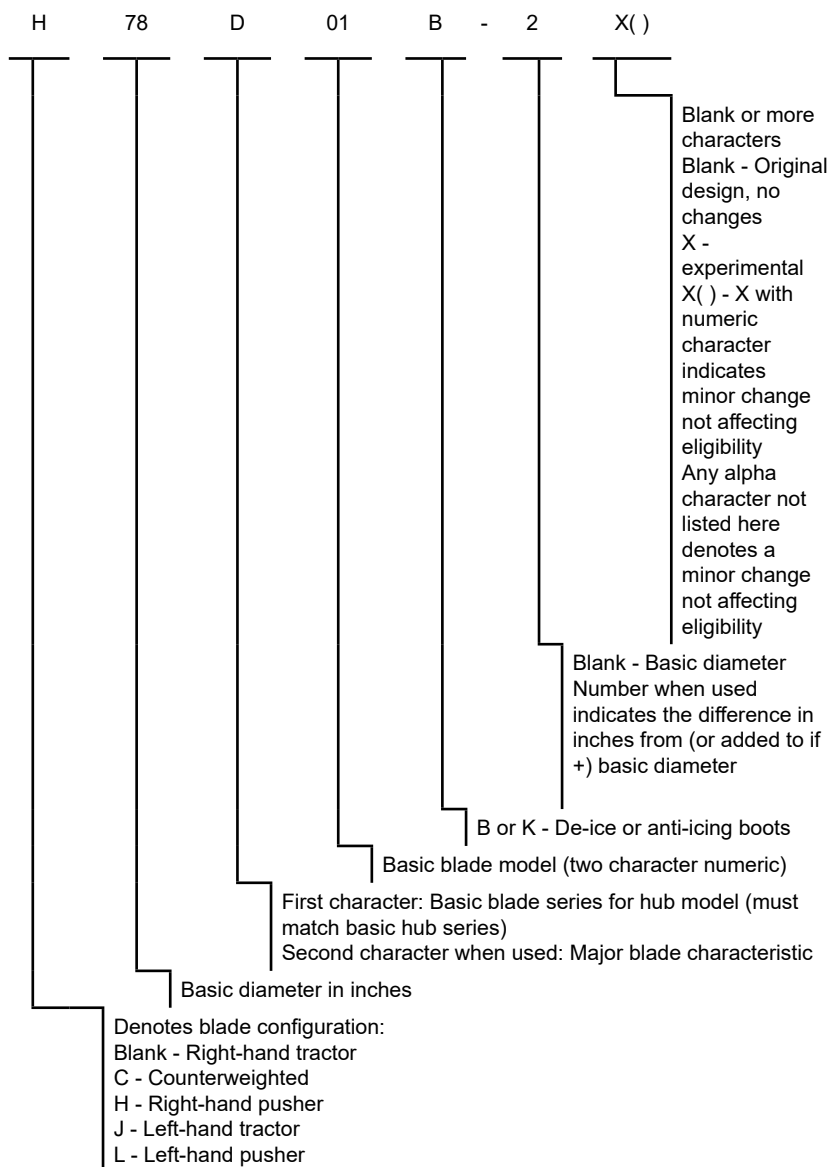
- (1) Composite blades are constructed by layering composite material over a foam core and a metal blade shank.
- (2) A metal erosion shield is bonded to the leading edge of the blade to provide protection from impact and erosion.
- (3) Composite blades are identified by direction of rotation, shank design, propeller diameter, and other blade characteristics.
  - (a) Refer to the section, "Blade Model Designation" in this chapter.

### B. Blade Model Designation

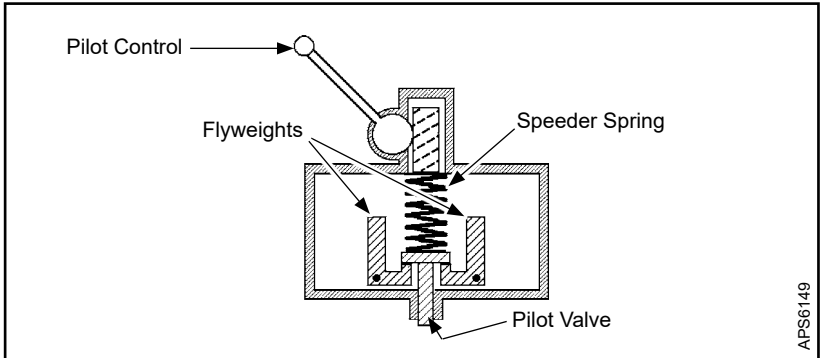
- (1) Hartzell Propeller LLC uses a model number designation system to identify specific propeller and blade assemblies. The propeller model number and blade model number are separated by a slash ( / ).
  - (a) Example: *propeller model / blade model*
- (2) The blade model number is impression stamped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

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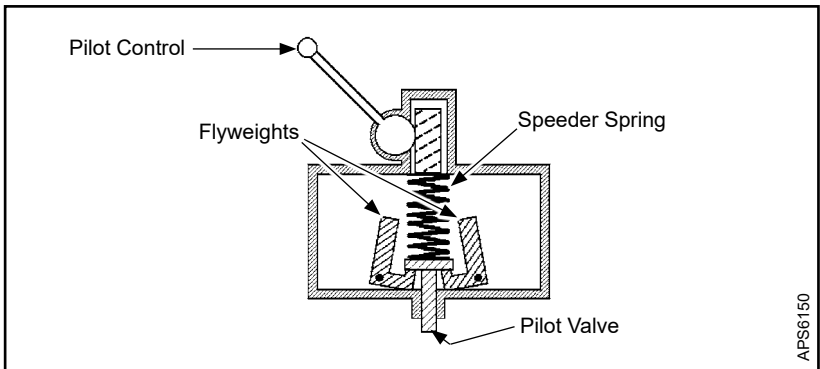
## 486



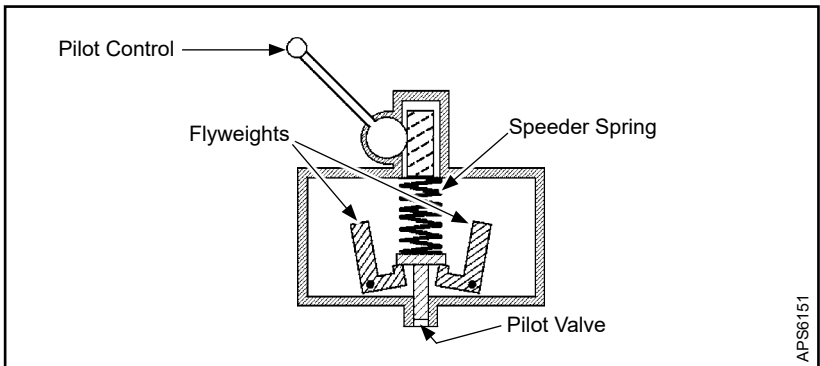
**Blade Type and Blade Model Designations**  
**Table 2-2**



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



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



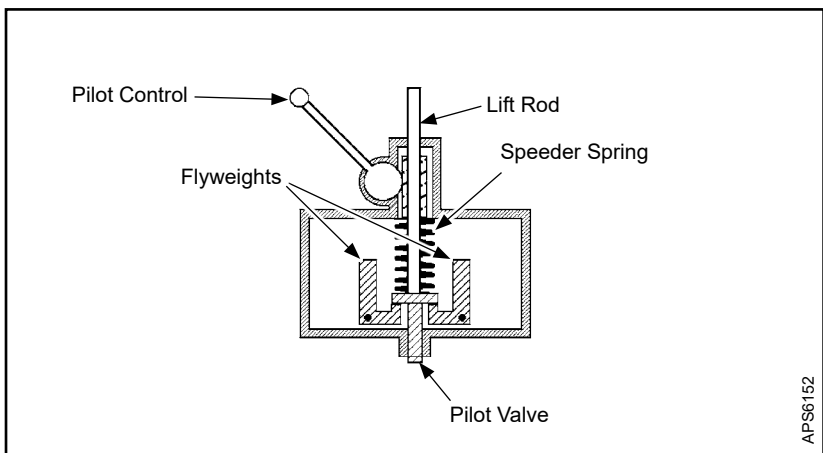
**Governor in Overspeed Condition**  
**Figure 2-4**

3. Governors (Rev. 3)

## A. Theory of Operation

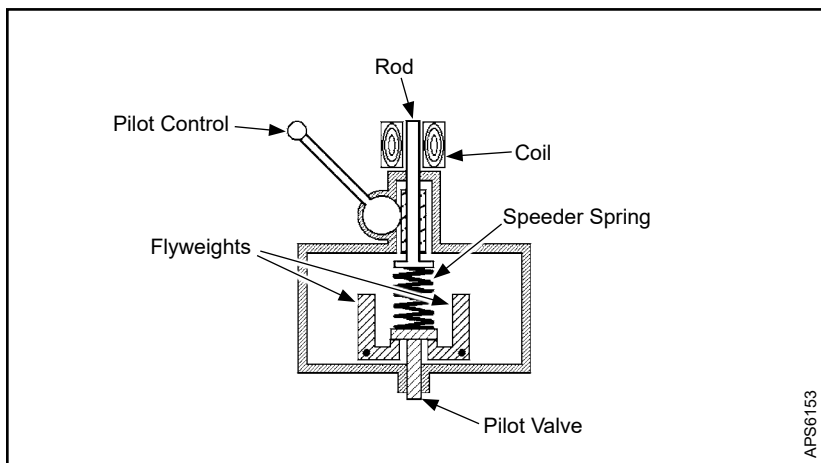
- (1) A governor is an engine RPM sensing device and high pressure oil pump. In a constant speed propeller system, the governor responds to a change in engine RPM by directing oil under pressure to the propeller hydraulic cylinder or by releasing oil from the hydraulic cylinder. The change in oil volume in the hydraulic cylinder changes the blade angle and maintains the propeller system RPM to the set value. The governor is set for a specific RPM via the cockpit propeller control, that compresses or releases the governor speeder spring.
- (2) When the engine is operating at the RPM set by the pilot using the cockpit control, the governor is operating **onspeed**. Refer to Figure 2-2. 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.

- (5) Feathering governors allow oil to be pushed from the propeller to the engine drain to increase propeller pitch to feather.
- (a) Some governors will move the propeller to feather by electrically or mechanically actuating a valve that opens to drain the oil supply between the propeller and governor to increase propeller pitch and allow the propeller to feather.
- (b) Figure 2-5 illustrates another feathering propeller governor system. When it is desired to feather the propeller, the lift rod may be moved by the cockpit control to mechanically engage the valve. The lifted valve dumps oil to increase propeller pitch until the propeller feathers.



**Feathering Governor**  
**Figure 2-5**

- (6) A synchronizing system can be employed in a multi-engine aircraft to keep the engines operating at the same RPM. A synchrophasing system not only keeps RPM of the engines consistent, but also keeps the propeller blades operating in phase with each other. Both synchronizing and synchrophasing systems serve to reduce noise and vibration. Figure 2-6 illustrates a governor as a component of a synchronizing or synchrophasing system.
- (a) Hartzell Propeller synchronizing or synchrophasing systems use one engine (the master engine) as an RPM and phase reference and adjust the RPM of the remaining engine(s) [slave engine(s)] to match it. The RPM of the master engine is monitored electronically, and this information is used to adjust the voltage applied to the electrical coil on the slave governor(s). The voltage to the coil either raises or lowers a rod which changes the force of the speeder spring. In this manner, engine RPM and phase of the propellers is synchronized or synchrophased.

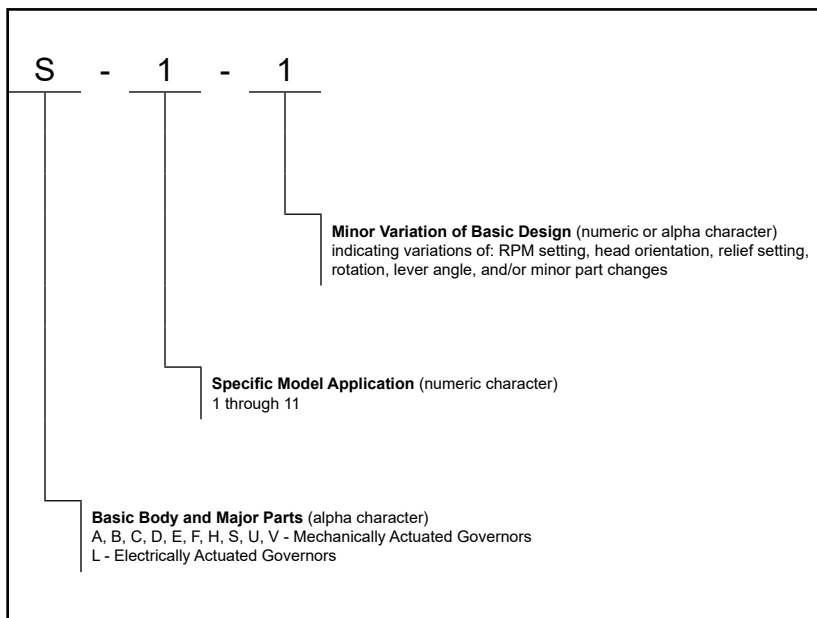


**Synchronizer/Synchrophaser Governor**  
**Figure 2-6**

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**B. Governor Model Designation**

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



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

4. Propeller Ice Protection Systems (Rev. 1)
  - A. System Description
    - (1) For detailed descriptions of propeller ice protection systems, refer to the Anti-ice and De-ice Systems chapter in this manual.

INSTALLATION AND REMOVAL - CONTENTS

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1. Tools, Consumables, and Expendables

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

**NOTE:** The flange type used on a particular Raptor propeller installation is indicated in the propeller model identification number stamped on the hub. For example, 5D3-N338-( ) indicates an N flange. Refer to the section, "Propeller Model Designation" in the Description and Operation chapter of this manual for description of each flange type.

## A. Tooling

**N Flange Propellers**

- Safety wire pliers (Alternate: Safety cable tool)
- Torque wrench
- Torque wrench adapter, TE5 or TE642
- Beta system puller, TE100

## B. Consumables

- Quick Dry Stoddard Solvent or Methyl-Ethyl-Ketone (MEK)
- Loctite 222 low strength threadlocker

## C. Expendables

- 0.032 inch (0.81 mm) stainless steel aircraft safety wire (Alternate: 0.032 inch [0.81 mm] aircraft safety cable and associated washers and ferrules)
- O-ring, Propeller-to-Engine Seal (see Table 3-1)

2. Pre-Installation (Rev. 4)

## A. Inspection of Shipping Package

- (1) Examine the exterior of the shipping container, especially the box ends around each blade, for signs of shipping damage.
  - (a) If the box is damaged, contact the freight company for a freight claim.
  - (b) A hole, tear or crushed appearance at the end of the box (blade tips) may indicate that the propeller was dropped during shipment, possibly damaging the blades.
    - 1 If the propeller is damaged, contact Hartzell Propeller LLC. Refer to the section, "Hartzell Propeller Contact Information" in the Introduction chapter of this manual.

## B. Uncrating

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

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

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

## C. Inspection after Shipment

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

## D. Reassembly of a "Knockdown" Propeller

- (1) Propellers that were disassembled for shipment must be reassembled by trained personnel in accordance with the applicable propeller maintenance manual.
- (2) For installation of ice protection systems manufactured by Hartzell, refer to Hartzell Propeller Ice Protection System Manual 180 (30-61-80).
- (3) For installation of ice protection systems not manufactured by Hartzell, refer to the applicable TC or STC holder's Instructions for Continued Airworthiness (ICA).

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

A. Propeller Mounting Hardware

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

B. Torque Information

- (1) The structural integrity of joints in the propeller that are held together with threaded fasteners is dependent upon proper torque application.
- (a) Vibration can cause an incorrectly tightened fastener to fail in a matter of minutes.
- (b) Correct tension in a fastener depends on a variety of known load factors and can influence fastener service life.
- (c) Correct tension is achieved by application of measured torque.
- (2) Use accurate wrenches and professional procedures to make sure of correct tensioning.

| <b>N-flange for:</b> | <b>O-ring</b> | <b>Bolt/Stud</b> | <b>Washer</b> | <b>Nut</b>       |
|----------------------|---------------|------------------|---------------|------------------|
| 4D3-NK338A1( )       | C-3317-230    | 109023           | A-2048-2      | 107585 or 107957 |
| 5D3-N338A( )         | C-3317-230    | B-3339-1         | A-2048-2      | n/a              |
| 5D3-NK366A1( )       | C-3317-230    | 103560           | A-2048-2      | 107585 or 107957 |
| 5D3( )-NK366B1( )    | C-3317-230    | 103560           | A-2048-2      | 107585 or 107957 |
| 5D5-NK366C1( )       | C-3317-230    | 103560           | A-2048-2      | 107585 or 107957 |
| 6D3( )-NK366B1( )    | C-3317-230    | 103560           | A-2048-2      | 107585 or 107957 |

**Propeller Mounting Hardware**  
**Table 3-1**

- (3) Refer to Table 3-2 for the torque values to use when installing a Hartzell propeller.
- (4) When an adapter is used with a torque wrench, use the equation in Figure 3-1 to determine the correct torque value.
- (5) Refer to Figure 3-2 for the proper torquing sequence of the propeller mounting bolts/nuts.

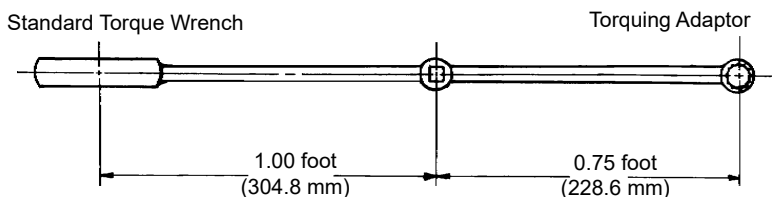
**CAUTION 1:** FOR A PROPELLER THAT DOES NOT USE A LUBRICATED (WET) TORQUE, THE MOUNTING HARDWARE MUST BE CLEAN AND DRY TO PREVENT EXCESSIVE PRELOAD OF THE MOUNTING FLANGE.

**CAUTION 2:** TORQUE VALUES WITH "WET" NOTED AFTER THEM ARE BASED ON LUBRICATED THREADS WITH APPROVED ANTI-SEIZE COMPOUND MIL-PRF-83483( ).

**CAUTION 3:** REFER TO FIGURE 3-1 FOR TORQUE READING WHEN USING A TORQUE WRENCH ADAPTER.

| Hardware                                                  | Torque                              |
|-----------------------------------------------------------|-------------------------------------|
| N-flange propeller mounting bolts<br>p/n B-3339-1         | 100-105 Ft-Lbs<br>(136-142 N•m) Wet |
| N-flange propeller mounting nuts<br>p/n 107585 and 107957 | 100-105 Ft-Lbs<br>(136-142 N•m) Wet |

**Torque Table  
Table 3-2**



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

**EXAMPLE:**

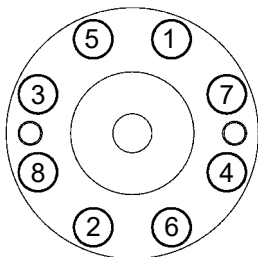
$$\frac{100 \text{ Ft-Lb (136 N}\cdot\text{m)} \times 1 \text{ ft (308.4 mm)}}{1 \text{ ft (308.4 mm)} + 0.75 \text{ ft (228.6 mm)}} = 57.1 \text{ Ft-Lb (77.4 N}\cdot\text{m)} < \begin{array}{l} \text{reading on torque} \\ \text{wrench with 9-inch} \\ \text{(228.6 mm) adapter} \\ \text{for actual torque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

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

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

**N Flange**

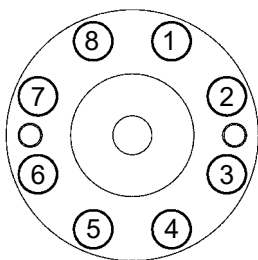


**SEQUENCE A**

Use Sequence A for steps one and two.

**Step 1** - Torque all bolts/nuts to 40 Ft-Lbs (54 N•m)

**Step 2** - Torque all bolts/nuts to 80 Ft-Lbs (108 N•m)



**SEQUENCE B**

Use Sequence B for step three.

**Step 3** - Torque all bolts/nuts to Table 3-2.

TPI-486-004

**Torquing Sequence for Propeller Mounting Bolts/Nuts**  
**Figure 3-2**

4. Propeller Installation

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

A. Precautions

WARNING 1: FOR 5D3-( ) ( ) AND (4,6)D3-NK( ) ( ) MODELS, DO NOT SAFETY WIRE THE HEX NUTS ON THE CYLINDER-END OF THE BETA RODS (FIGURE 3-3). HARTZELL ALERT SERVICE BULLETIN HC-ASB-61-407 WAS ISSUED TO ADDRESS THE UNAUTHORIZED USE OF SAFETY WIRE IN THIS LOCATION.



Do NOT Safety Wire the Cylinder-end Beta Rod Nuts  
Figure 3-3

**WARNING 2:** 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 3:** WHEN INSTALLING THE PROPELLER, FOLLOW THE AIRFRAME MANUFACTURER'S MANUALS AND PROCEDURES, AS THEY MAY CONTAIN ISSUES VITAL TO AIRCRAFT SAFETY THAT ARE NOT CONTAINED IN THIS OWNER'S MANUAL.

**CAUTION:** AVOID THE USE OF BLADE PADDLES. DO NOT PUT THE BLADE PADDLE IN THE AREA OF THE DE-ICE BOOT WHEN APPLYING TORQUE TO A BLADE ASSEMBLY. PUT THE BLADE PADDLE IN THE THICKEST AREA OF THE BLADE, JUST OUTSIDE OF THE DE-ICE BOOT. USE ONE BLADE PADDLE PER BLADE.

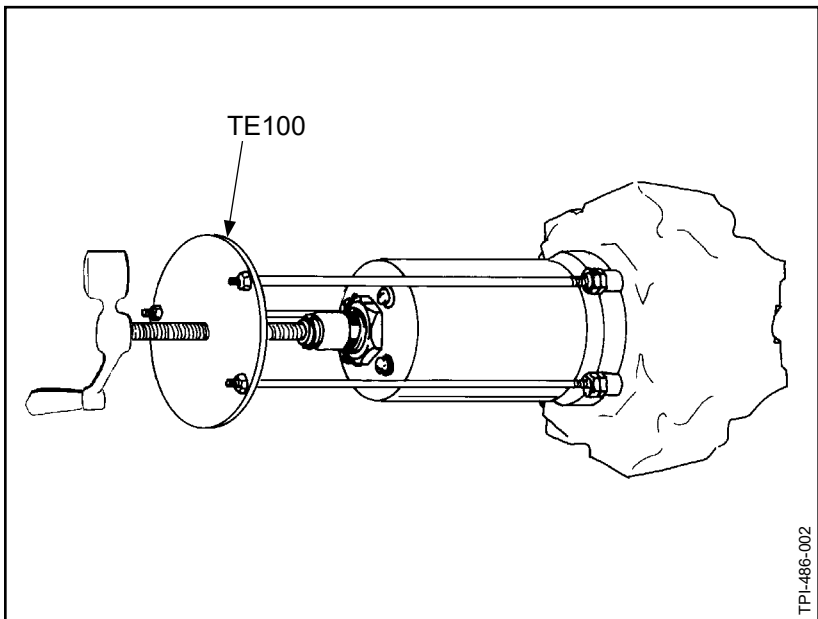
- (1) Make sure the propeller is removed before the engine is removed or installed in the airframe.
- (2) Follow the airframe manufacturer's instructions for installing the propeller.
  - (a) If such instructions are not in the airframe manufacturer's manual, then follow the instructions in this manual;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

B. 5D3-N338( ) Installation

- (1) Use a beta system puller TE100 to compress the beta system and pull the beta ring forward to permit installation of the double hex head propeller mounting bolts. Refer to Figure 3-4.

**WARNING:** MAKE SURE THE SLING IS RATED UP TO 800 LBS (363 KG) TO SUPPORT THE WEIGHT OF THE PROPELLER ASSEMBLY DURING INSTALLATION.

**CAUTION 1:** WHEN INSTALLING THE PROPELLER ON THE AIRCRAFT, DO NOT DAMAGE THE ICE PROTECTION SYSTEM COMPONENTS, IF APPLICABLE.



Compressing the Beta System  
Figure 3-4

**CAUTION 2:** INSTRUCTIONS AND PROCEDURES IN THIS SECTION MAY INVOLVE PROPELLER CRITICAL PARTS. REFER TO THE INTRODUCTION CHAPTER OF THIS MANUAL FOR INFORMATION ABOUT PROPELLER CRITICAL PARTS. REFER TO THE ILLUSTRATED PARTS LIST CHAPTER OF THE APPLICABLE OVERHAUL MANUAL(S) FOR THE IDENTIFICATION OF SPECIFIC PROPELLER CRITICAL PARTS.

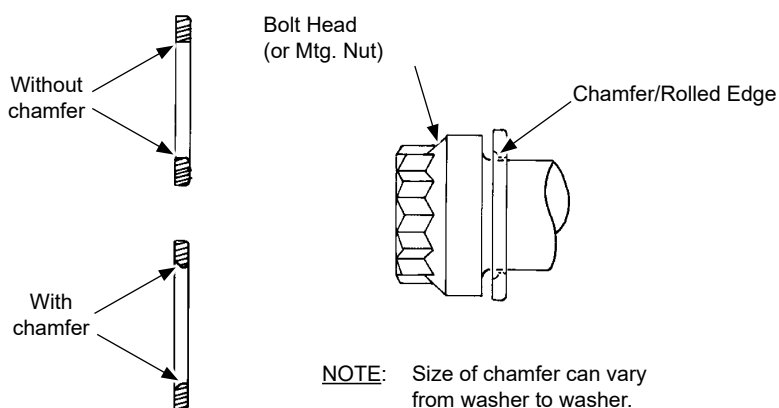
- (2) With a suitable crane hoist and sling, carefully move the propeller assembly to the aircraft engine mounting flange.
- (3) Using Quick Dry Stoddard Solvent or MEK, clean the engine flange and the propeller flange.
- (4) Remove the pitch change rod cap, if applicable.
- (5) Install the specified O-ring on the engine flange. Refer to Table 3-1.
- (6) Align the mounting and dowel pin holes in the propeller hub flange with the mounting holes and dowel pins in the engine flange.
- (7) Slide the propeller flange onto the engine flange.

**CAUTION 1:** MAKE SURE THAT COMPLETE AND TRUE SURFACE CONTACT IS ESTABLISHED BETWEEN THE PROPELLER HUB FLANGE AND THE ENGINE FLANGE.

**CAUTION 2:** NEW PROPELLER MOUNTING BOLTS MUST BE USED WHEN INITIALLY INSTALLING A NEW OR OVERHAULED PROPELLER.

- (8) Apply MIL-PRF-83483( ) (Hartzell p/n A-3338-[ ] ) anti-seize compound to the threaded surfaces of the mounting bolts. Refer to Table 3-1 for the appropriate mounting hardware.
  - (a) If the propeller is removed between overhaul intervals, mounting bolts and washers may be reused if they are not damaged or corroded.

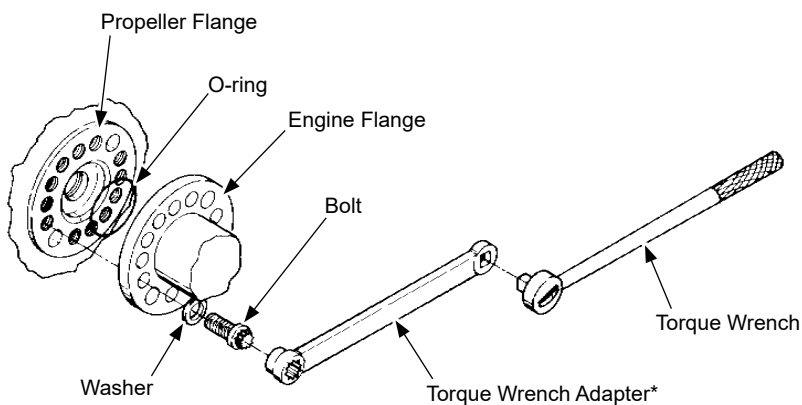
Chamfer of washer must face the bolt head (or mounting nut) at installation. Washers without chamfer must be installed with rolled edges toward bolt head (or mounting nut).



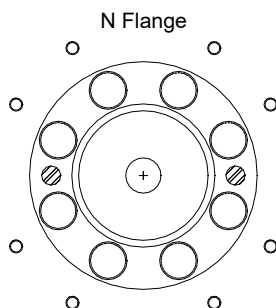
This illustration shows a mounting bolt.  
The installation of the washer is the same when used with mounting nuts.

APS0279C

**Mounting Bolt/Nut and Washer**  
**Figure 3-5**



\* **NOTE:** If torque wrench adapter is used, use the calculation in Figure 3-1 to determine correct torque wrench setting.



APS0543.W10107.W10127.W10109

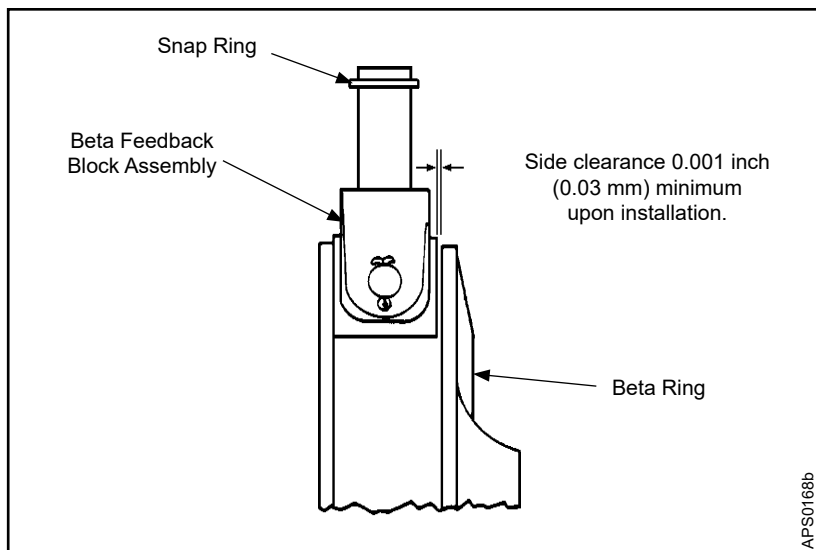
**Installing Propeller on Engine Flange**  
**Figure 3-6**

**CAUTION:** ID CHAMFER OF WASHER MUST BE FACING TOWARD THE BOLT HEAD. WASHERS WITHOUT CHAMFER MUST BE INSTALLED WITH ROLLED EDGES TOWARD THE BOLT HEAD. (REFER TO FIGURE 3-5).

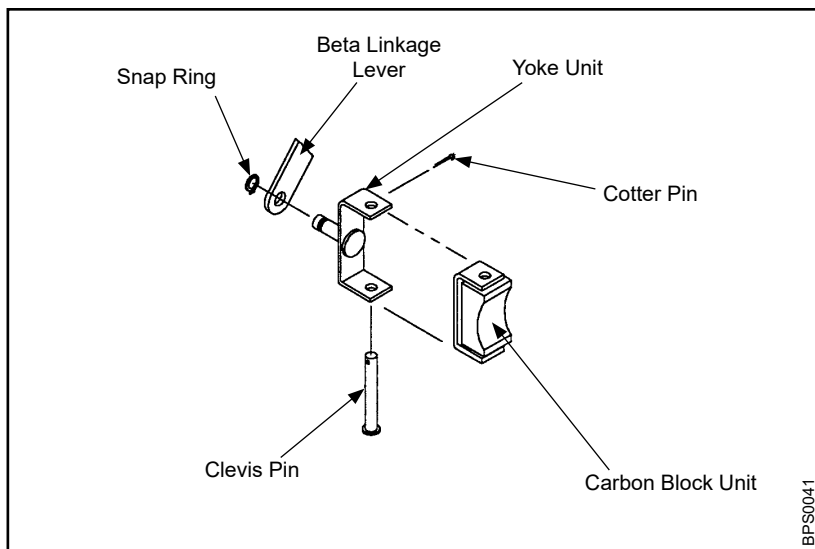
- (9) Install the mounting bolts with washers through the engine flange and into the propeller hub flange. Refer to Figure 3-6.
- (10) Using a torque wrench and a torque wrench adapter TE5, torque all mounting bolts in sequences and steps shown in Figure 3-2.
  - (a) Refer to Table 3-2 and Figure 3-1 to determine the correct torque value.
- (11) Safety all mounting bolts with 0.032 inch (0.81 mm) minimum diameter stainless steel wire or equivalent aircraft safety cable. (Two bolts per safety.)
- (12) Decompress the external beta system and remove the beta system puller.

**CAUTION:** THE BETA RING MUST NOT CONTACT ANY ENGINE COMPONENT OR MOUNTING BOLT SAFETY WIRE OR SAFETY CABLE. THE BETA MECHANISM FEEDBACK COULD BE DAMAGED IF IT CONTACTED ANY STATIC ENGINE COMPONENT WHILE ROTATING.

- (13) Examine the beta ring to make sure that it is not in contact with any engine components or mounting bolt safety wire or safety cable.
  - (a) If there is contact between the beta ring and any engine components or mounting bolt safety wire or safety cable, consult a certified propeller repair station with the appropriate rating.
- (14) Install the beta feedback block assembly into the beta linkage lever, in accordance with the airframe manufacturer's instructions.



**Beta Feedback Block Clearance**  
**Figure 3-7**



**Beta Feedback Block Assembly**  
**Figure 3-8**

**CAUTION:** FIT THE BETA FEEDBACK BLOCK ASSEMBLY IN THE BETA RING WITH A MINIMUM SIDE CLEARANCE OF 0.001 INCH (0.03 mm). REFER TO FIGURE 3-7.

- (15) Install the beta feedback block assembly into the beta ring. Refer to Figure 3-7.
- (16) Install, adjust, and safety the beta linkage in accordance with Figure 3-8 and the airframe manufacturer's instructions.
- (17) If the propeller is equipped with an ice protection system that uses components supplied by Hartzell Propeller, applicable instructions and technical information can be found in Hartzell Propeller Ice Protection System Manual 180 (30-61-80) available on the Hartzell website at [www.hartzellprop.com](http://www.hartzellprop.com).
- (18) Propeller ice protection system components not supplied by Hartzell Propeller are controlled by the applicable TC or STC holder's Instructions for Continued Airworthiness (ICA).
- (19) Install the propeller spinner dome in accordance with the section "Spinner Dome Installation" in this chapter.

C. ( )D3( )-NK( )( ) Installation

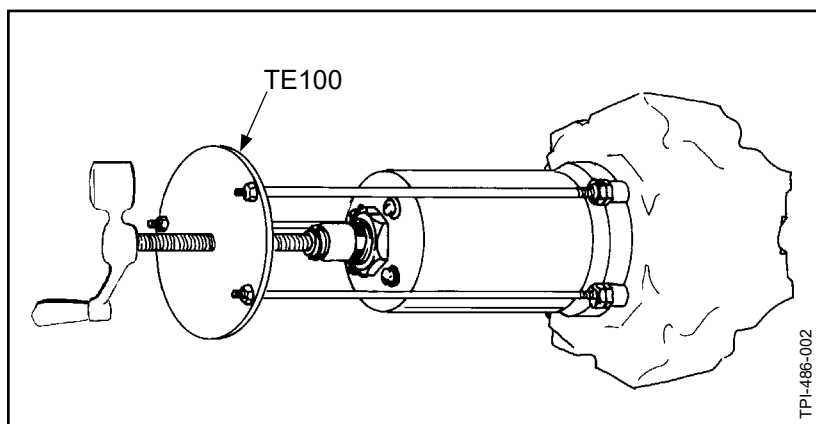
- (1) Use a beta system puller TE100 to compress the beta system and pull the beta ring forward to permit installation of the propeller mounting nuts. Refer to Figure 3-9.

**NOTE 1:** If the propeller has cylinder-mounted start locks that interfere with the beta system puller TE100, use plate kit TE615 to fit the beta system puller over the start lock housings.

**NOTE 2:** ( )D31-NK366( ) propellers ship from Hartzell with a protective cover, p/n BST-2816-8, installed on the beta ring.

**WARNING 1:** MAKE SURE THE SLING IS RATED UP TO 800 LBS (363 KG) TO SUPPORT THE WEIGHT OF THE PROPELLERASSEMBLY DURING INSTALLATION.

**WARNING 2:** THE BETA RING ON 5D31-NK366( ) PROPELLERS HAS SHARP EDGES. BE SURE THE PROTECTIVE COVER (BST-2816-8) IS INSTALLED ON THE BETA RING BEFORE INSTALLING THE PROPELLER ONTO THE ENGINE.



**Compressing the Beta System**  
**Figure 3-9**

CAUTION 1: WHEN INSTALLING 5D31-NK366( ) PROPELLERS, IT MAY BE NECESSARY TO TEMPORARILY ADJUST/REMOVE THE BETA RING SENSOR (IN ACCORDANCE WITH THE APPLICABLE AIRCRAFT MAINTENANCE MANUAL) TO PROVIDE CLEARANCE FOR THE BETA RING. FAILURE TO DO SO MAY RESULT IN DAMAGE TO THE BETA RING AND/OR THE BETA RING SENSOR.

CAUTION 2: WHEN INSTALLING THE PROPELLER ON THE AIRCRAFT, DO NOT DAMAGE THE ICE PROTECTION SYSTEM COMPONENTS, IF APPLICABLE.

CAUTION 3: INSTRUCTIONS AND PROCEDURES IN THIS SECTION MAY INVOLVE PROPELLER CRITICAL PARTS. REFER TO THE INTRODUCTION CHAPTER OF THIS MANUAL FOR INFORMATION ABOUT PROPELLER CRITICAL PARTS. REFER TO THE ILLUSTRATED PARTS LIST CHAPTER OF THE APPLICABLE OVERHAUL MANUAL(S) FOR THE IDENTIFICATION OF SPECIFIC PROPELLER CRITICAL PARTS.

- (2) With a suitable crane hoist and sling, carefully move the propeller assembly to the aircraft engine mounting flange.
- (3) Using Quick Dry Stoddard Solvent or MEK, clean the engine flange and the propeller flange.
- (4) Remove the pitch change rod cap, if applicable.
- (5) Install the specified O-ring on the engine flange. Refer to Table 3-1.
- (6) Put the propeller onto the engine flange.

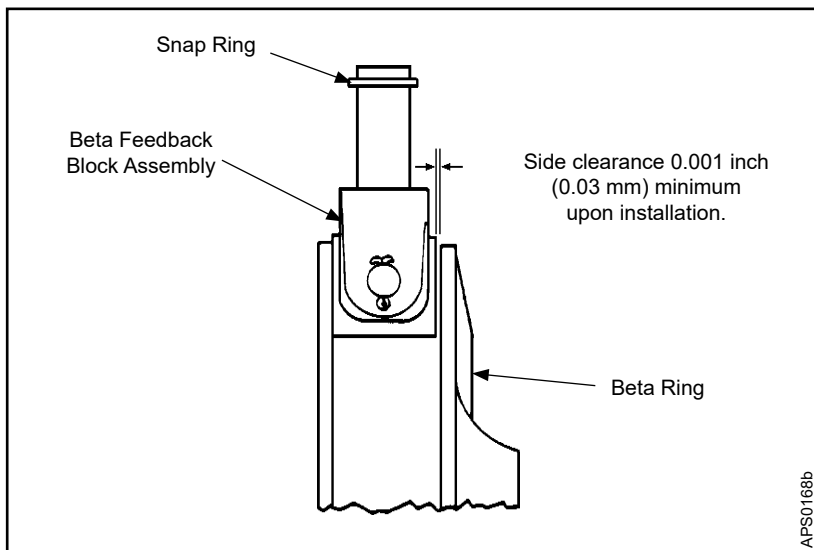
CAUTION 1: NEW PROPELLER MOUNTING NUTS MUST BE USED WHEN INITIALLY INSTALLING A NEW OR OVERHAULED PROPELLER.

CAUTION 2: ID CHAMFER OF WASHER MUST BE FACING TOWARD THE NUT. WASHERS WITHOUT CHAMFER MUST BE INSTALLED WITH ROLLED EDGES TOWARD THE NUT. (REFER TO FIGURE 3-5).

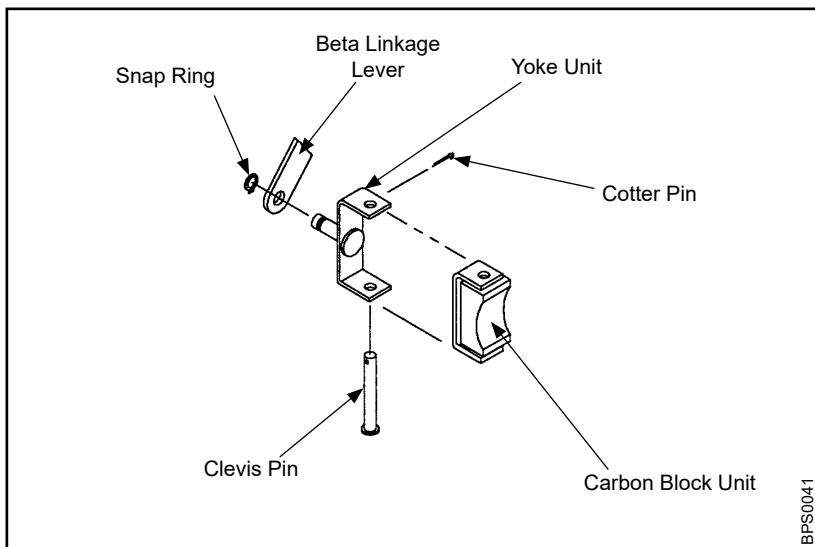
- (7) Install the applicable mounting nuts and washers onto the mounting bolts with the ID chamfer on the washer against the mounting nut. Refer to Figure 3-5.
  - (a) Refer to Table 3-1 for the applicable propeller mounting hardware.
  - (b) If the propeller is removed between overhaul intervals, the mounting nuts and washers can be reused if they are not damaged or corroded.
- (8) Using a torque wrench and a torque wrench adapter TE642, torque all mounting nuts in the sequences and steps shown in Figure 3-2.
  - (a) Refer to Table 3-2 and Figure 3-1 to determine the correct torque value.
- (9) Safety all mounting nuts with 0.032 inch (0.81 mm) minimum diameter stainless steel wire or equivalent aircraft safety cable. (Two nuts per safety.)
- (10) Decompress the external beta system and remove the beta system puller.

CAUTION: THE BETA RING MUST NOT CONTACT ANY ENGINE COMPONENT OR MOUNTING NUT SAFETY WIRE OR SAFETY CABLE. THE BETA MECHANISM FEEDBACK COULD BE DAMAGED IF IT CONTACTED ANY STATIC ENGINE COMPONENT WHILE ROTATING.

- (11) Examine the beta ring to make sure that it is not in contact with any engine components or mounting bolt safety wire or safety cable.



**Beta Feedback Block Clearance**  
**Figure 3-10**



**Beta Feedback Block Assembly**  
**Figure 3-11**

- (a) If there is contact between the beta ring and any engine components or mounting bolt safety wire or safety cable, consult a certified propeller repair station with the appropriate rating.
- (12) Steps (13) thru (15) of this procedure apply only to propeller models with beta feedback block assemblies. For propeller models with electronic beta sensors, go to step (16) of this procedure.
- (13) Install the beta feedback block assembly into the beta linkage lever, in accordance with the airframe manufacturer's instructions.

**CAUTION:** FIT THE BETA FEEDBACK BLOCK ASSEMBLY IN THE BETA RING WITH A MINIMUM SIDE CLEARANCE OF 0.001 INCH (0.03 mm). REFER TO FIGURE 3-10.

- (14) Install the beta feedback block assembly into the beta ring. Refer to Figure 3-11.
- (15) Install, adjust, and safety the beta linkage in accordance with the airframe manufacturer's instructions.
- (16) If the propeller is equipped with an ice protection system that uses components supplied by Hartzell Propeller, applicable instructions and technical information can be found in Hartzell Propeller Ice Protection System Manual 180 (30-61-80) available on the Hartzell website at [www.hartzellprop.com](http://www.hartzellprop.com).
- (17) Propeller ice protection system components not supplied by Hartzell Propeller are controlled by the applicable TC or STC holder's Instructions for Continued Airworthiness (ICA).
- (18) Install the propeller spinner dome in accordance with the section "Spinner Dome Installation" in this chapter.

**CAUTION:** USE EXTREME CARE TO AVOID SCRATCHING, NICKING, OR DAMAGING THE BETA RING.

- (19) If applicable, cut the protective cover BST-2816-8 to remove it from the beta ring.
  - (a) Retain the protective cover BST-2816-8 for use when removing the propeller.

## D. ( )D5( )-NK( ) ( ) Installation

**WARNING:** MAKE SURE THE SLING IS RATED UP TO 800 LBS (363 KG) TO SUPPORT THE WEIGHT OF THE PROPELLER ASSEMBLY DURING INSTALLATION.

**CAUTION 1:** WHEN INSTALLING THE PROPELLER ON THE AIRCRAFT, DO NOT DAMAGE THE ICE PROTECTION SYSTEM COMPONENTS, IF APPLICABLE.

**CAUTION 2:** INSTRUCTIONS AND PROCEDURES IN THIS SECTION MAY INVOLVE PROPELLER CRITICAL PARTS. REFER TO THE INTRODUCTION CHAPTER OF THIS MANUAL FOR INFORMATION ABOUT PROPELLER CRITICAL PARTS. REFER TO THE ILLUSTRATED PARTS LIST CHAPTER OF THE APPLICABLE OVERHAUL MANUAL(S) FOR THE IDENTIFICATION OF SPECIFIC PROPELLER CRITICAL PARTS.

- (1) With a suitable crane hoist and sling, carefully move the propeller assembly to the aircraft engine mounting flange.
- (2) Using Quick Dry Stoddard Solvent or MEK, clean the engine flange and the propeller flange.
- (3) Remove the pitch change rod cap, if applicable.
- (4) Install the specified O-ring on the engine flange. Refer to Table 3-1.
- (5) Put the propeller onto the engine flange.

**CAUTION 1:** NEW PROPELLER MOUNTING NUTS MUST BE USED WHEN INITIALLY INSTALLING A NEW OR OVERHAULED PROPELLER.

**CAUTION 2:** ID CHAMFER OF WASHER MUST BE FACING TOWARD THE NUT. WASHERS WITHOUT CHAMFER MUST BE INSTALLED WITH ROLLED EDGES TOWARD THE NUT. (REFER TO FIGURE 3-5).

- (6) Install the applicable mounting nuts and washers onto the mounting bolts with the ID chamfer on the washer against the mounting nut. Refer to Figure 3-5.
  - (a) Refer to Table 3-1 for the applicable propeller mounting hardware.
  - (b) If the propeller is removed between overhaul intervals, the mounting nuts and washers can be reused if they are not damaged or corroded.
- (7) Using a torque wrench and a torque wrench adapter TE642, torque all mounting nuts in the sequences and steps shown in Figure 3-2.
  - (a) Refer to Table 3-2 and Figure 3-1 to determine the correct torque value.
- (8) Safety all mounting nuts with 0.032 inch (0.81 mm) minimum diameter stainless steel wire or equivalent aircraft safety cable. (Two nuts per safety.)
- (9) Install the beta tube in accordance with the airframe/engine manufacturer's instructions.

**NOTE 1:** Follow the airframe manufacture's instructions for adjusting the beta tube to get the correct low pitch blade angle.

**NOTE 2:** Refer to the Aircraft Type Certificate Data Sheet for the low pitch blade angle.
- (10) If the propeller is equipped with an ice protection system that uses components supplied by Hartzell Propeller, applicable instructions and technical information can be found in Hartzell Propeller Ice Protection System Manual 180 (30-61-80) available on the Hartzell website at [www.hartzellprop.com](http://www.hartzellprop.com).
- (11) Propeller ice protection system components not supplied by Hartzell Propeller are controlled by the applicable TC or STC holder's Instructions for Continued Airworthiness (ICA).
- (12) Install the propeller spinner dome in accordance with the section "Spinner Dome Installation" in this chapter.

5. Spinner Dome Installation (Rev. 4)

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

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

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

NOTE 2: There are two types of spinner domes used on Hartzell Raptor-series propellers:

- Spinner Dome with a Bonded Forward Bulkhead
- Spinner Dome with a Removable Forward Bulkhead

NOTE 3: A forward bulkhead is an internal support that encircles the propeller cylinder.

NOTE 4: Refer to the applicable installation instructions for the type of dome/forward bulkhead being installed.

NOTE 5: The B-3845-8 screws supplied for spinner domes with straight mounting holes are 0.500 inch (12.70 mm) long. If correct thread engagement cannot be achieved when installing the spinner dome, B-3845-9 screws may be used. The B-3845-9 screws are 0.562 inch (14.27 mm) long.

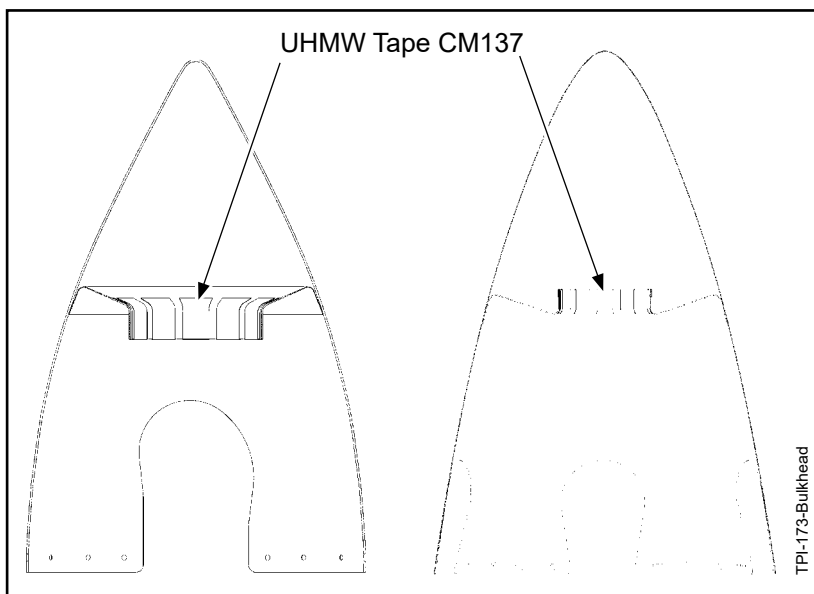
A. Spinner Dome with a Bonded Forward Bulkhead

(1) Install the spinner dome.

**CAUTION:** THE FORWARD BULKHEAD MUST FIT SNUGLY ON THE CYLINDER. AN IMPROPERLY SUPPORTED DOME COULD CAUSE CYLINDER DAMAGE OR A CRACK IN THE DOME OR BULKHEAD.

(2) Using both hands, grasp the spinner dome in the approximate location of the forward bulkhead and apply lateral force (side-to-side).

(a) If there is no lateral movement, go to step (3) of this procedure.



**UHMW Tape Location - For Bonded Forward Bulkhead**

**Figure 3-12**

- (b) If there is lateral movement, apply UHMW tape CM137 in accordance with the following steps.
- 1 Option 1: Apply UHMW tape CM137 around the cylinder.
    - a Wrap one or more layers of UHMW tape CM137 around the cylinder until the forward bulkhead fits snugly on the cylinder.
  - 2 Option 2: Apply UHMW tape CM137 to the forward bulkhead.
    - a Install 2.5 inches (63 mm) strips of UHMW tape CM137 in equally spaced locations around the ID of the forward bulkhead as shown in Figure 3-12.
    - b If necessary, install additional layers of UHMW tape CM137 until the forward bulkhead fits snugly on the cylinder.
- (c) If anti-ice travel tubes are installed:
- CAUTION: THE TRAVEL TUBES MUST NOT TOUCH THE SPINNER DOME BLADE CUTOUT.**
- 1 Make sure there is clearance between the travel tubes and the spinner dome blade cutouts.
  - 2 Make adjustments to the position of the travel tubes in accordance with Hartzell Propeller Ice Protection System Manual 180 (30-61-80).

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

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

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

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

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

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

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

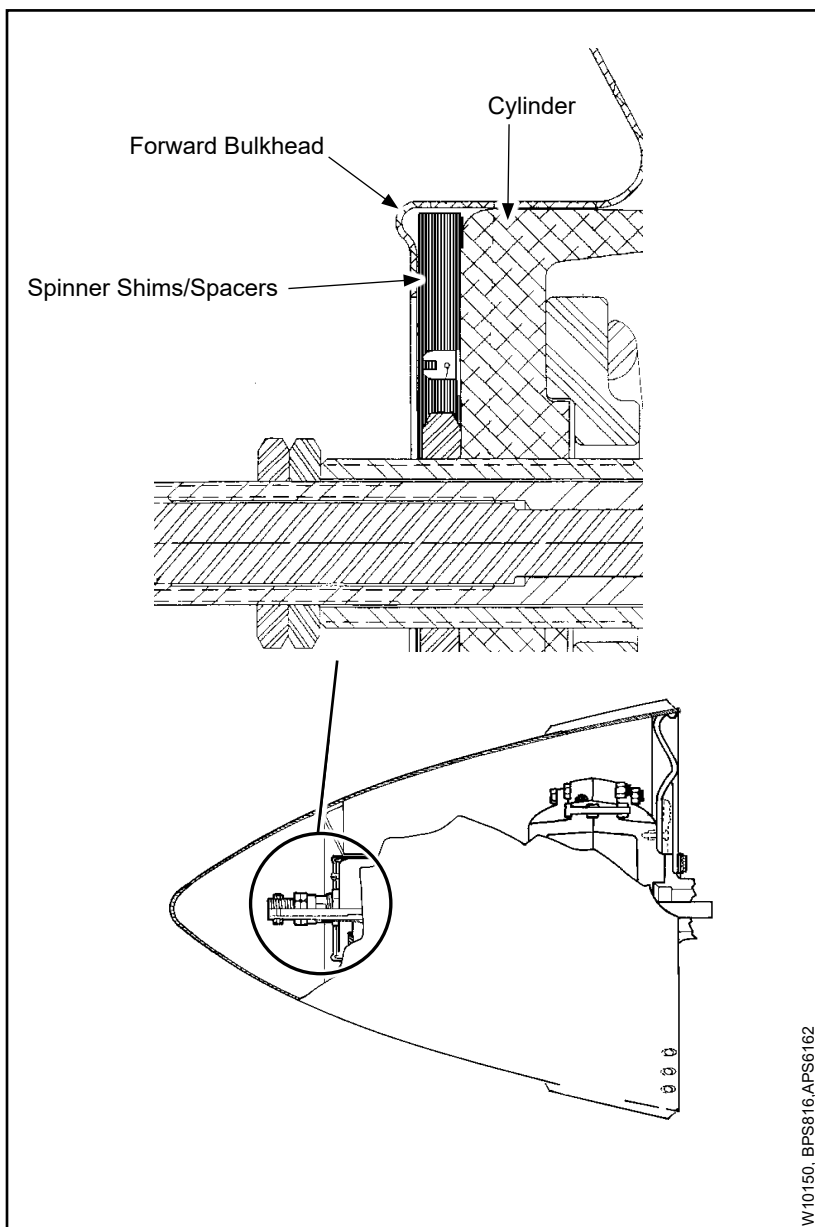
- (c) Working from the screw(s) previously installed at the centerline toward the blade cutouts, install the remaining screws one at a time.

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

- (4) If the spinner loosens in service, add one or more layers of UHMW tape to the cylinder until the spinner fits snugly.

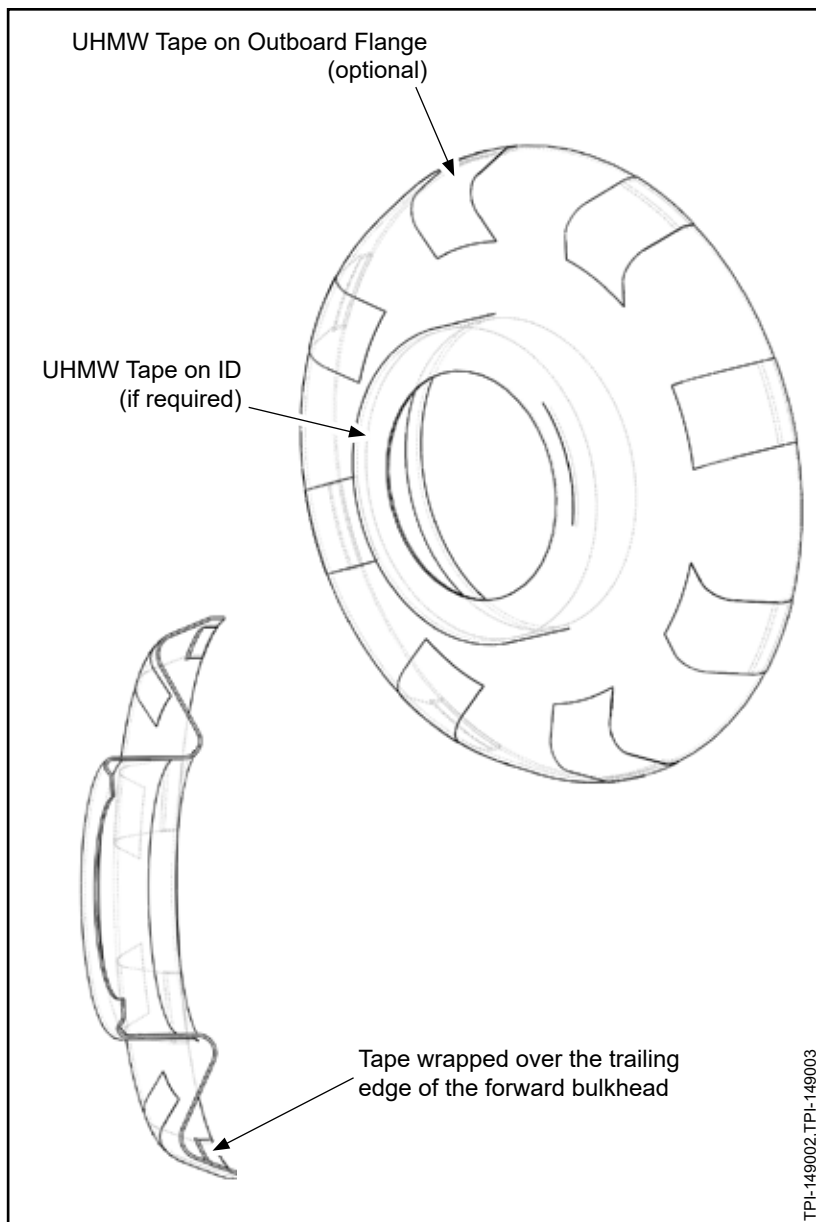
| Dome Mtg. Holes | Washer                             | Screw                                 |
|-----------------|------------------------------------|---------------------------------------|
| Straight        | A-1020<br>Washer, Fiber            | B-3845-8<br>10-32, Truss Head         |
| Countersunk     | B-3860-10L<br>Dimpled, 100°, Cres. | B-3867-272<br>10-32, 100° Head, Cres. |

**Spinner Dome Mounting Hardware**  
**Table 3-3**



W10150, BPS816, APS6162

**Spinner Dome with Removable Forward Bulkhead**  
**Figure 3-13**



**UHMW Tape on the Forward Bulkhead**  
**Figure 3-14**

**B. Spinner Dome with a Removable Forward Bulkhead**

- (1) Put five of the supplied spinner shims/spacers on top of the cylinder as shown in Figure 3-13.

**NOTE:** The spinner shims/spacers are used to adjust the spinner dome preload. Shims/spacers can be added/removed after pre-fitting the spinner dome later in this procedure.

- (2) Put the forward bulkhead over the cylinder on top of the spinner shims/spacers.

**CAUTION:** THE FORWARD BULKHEAD MUST FIT SNUGLY ON THE CYLINDER. AN IMPROPERLY SUPPORTED DOME COULD CAUSE CYLINDER DAMAGE OR A CRACK IN THE DOME OR BULKHEAD.

- (3) Using both hands, grasp the forward bulkhead and apply lateral force (side-to-side).

- (a) If there is no lateral movement, go to step (5) of this procedure.

- (b) If there is lateral movement, apply UHMW tape CM137 in accordance with the following steps.

- 1 Option 1: Apply UHMW tape CM137 around the ID of the forward bulkhead that fits over the cylinder.

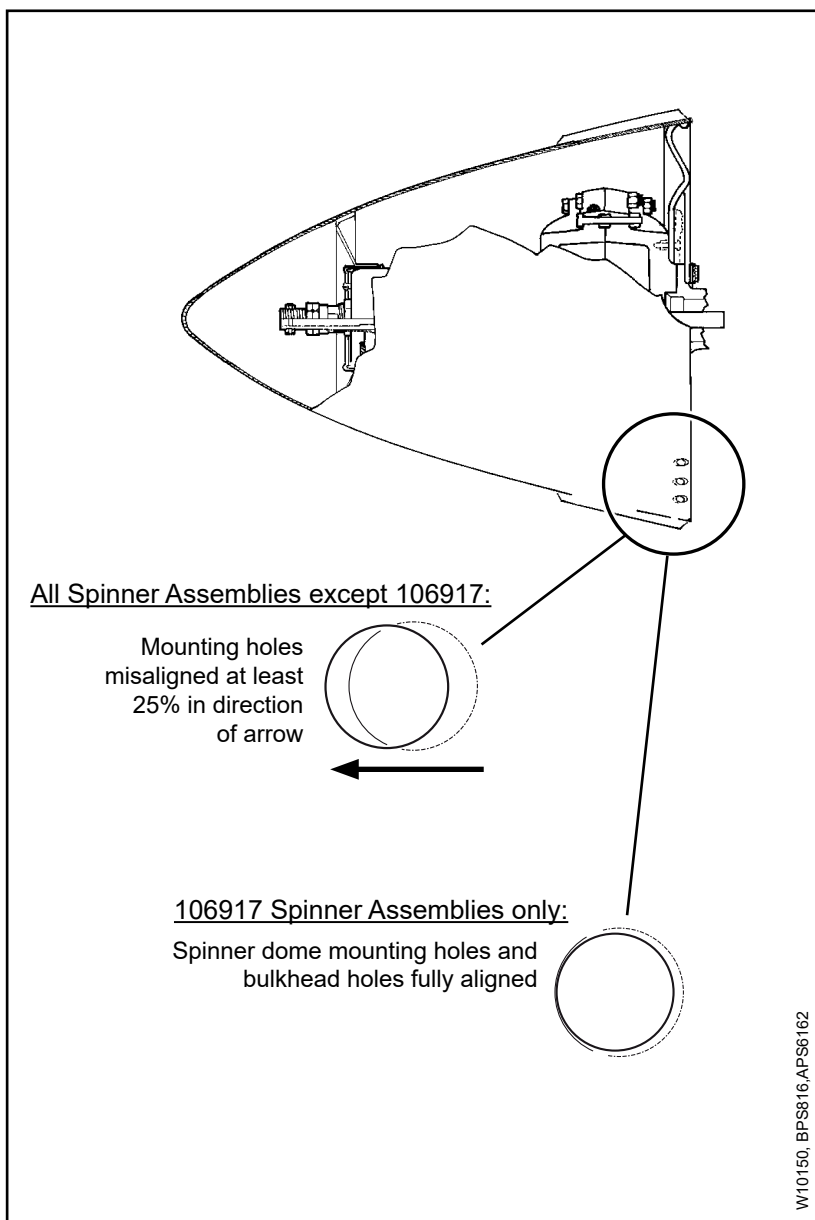
- a Install 2 inch (50 mm) strips of UHMW tape CM137 in equally spaced locations around the ID of the forward bulkhead as shown in Figure 3-14.

- b If necessary, install additional layers of UHMW tape CM137 until the forward bulkhead fits snugly on the cylinder.

- 2 Option 2: Apply UHMW tape CM137 around the cylinder.

- a Wrap one or more layers of UHMW tape CM137 around the cylinder until the forward bulkhead fits snugly on the cylinder.

- (4) OPTIONAL: To prevent contact between the forward bulkhead and the spinner dome, install eight 3 inch (76 mm) strips of UHMW tape CM137 in equally spaced locations around the outboard flange of the forward bulkhead as shown in Figure 3-14.
- (5) Install the spinner dome and gently push the dome as far as it will go onto the bulkhead.
- (a) If anti-ice travel tubes are installed:
- CAUTION: THE TRAVEL TUBES MUST NOT TOUCH THE SPINNER DOME BLADE CUTOUT.**
- 1 Make sure there is clearance between the travel tubes and the spinner dome blade cutouts.
  - 2 Make adjustments to the position of the travel tubes in accordance to Hartzell Propeller Ice Protection System Manual 180 (30-61-80).



**Mounting Hole Alignment**  
**Figure 3-15**

- (6) Examine the alignment of the mounting holes in the spinner dome and the bulkhead.

- (a) For all Hartzell Propeller spinner assemblies

**except** 106917:

- 1 The spinner dome mounting holes should stop short of full alignment with the bulkhead holes by approximately 25% of the hole diameter as shown in Figure 3-15.

**NOTE:** The temporary misalignment of the mounting holes is necessary to get the proper preload of the spinner dome.

- 2 If the mounting hole position is correct, go to step (6) of this procedure.
- 3 If the mounting hole position is incorrect, add/remove spinner shims/spacers between the cylinder and the forward bulkhead to get the correct alignment.

- (b) For 106917 spinner assembly **only**:

- 1 The spinner dome mounting holes should fully align with the bulkhead holes as shown in Figure 3-15.
- 2 If the mounting hole position is correct, go to step (7) of this procedure.

**CAUTION:** THE 106917 SPINNER ASSEMBLY REQUIRES THE 106962 SPACERS (BLACK). MAKE SURE TO USE THE CORRECT SPACERS WHEN INSTALLING ANY REMOVABLE FORWARD BULKHEAD.

- 3 Add/remove 106962 spacers between the cylinder and the forward bulkhead until the spinner dome mounting holes are fully aligned with the bulkhead holes.

**CAUTION:** MAKE SURE OF PROPER THREAD ENGAGEMENT FOR THE SCREWS IN THE NUTPLATES. APPROXIMATELY 1 TO 1 1/2 THREADS MUST EXTEND PAST THE BULKHEAD NUTPLATES. TO AVOID DAMAGING THE AIRCRAFT COWLING, THE SCREWS MUST NOT EXTEND MORE THAN 3 THREADS PAST THE BULKHEAD NUTPLATES.

- (7) Attach the spinner dome to the spinner bulkhead with the supplied screws and washers. Refer to Table 3-3.
- (a) Install a screw in the hole(s) centered between each two adjacent blade cutouts.
- 1 Push on the spinner dome to get full alignment of the mounting holes when installing screws.
  - 2 If the centerline between the adjacent blade cutouts does not align with a mounting hole, install screws in the two holes closest to the centerline.

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

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

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

- (c) Working from the screw(s) previously installed at the centerline toward the blade cutouts, install the remaining screws one at a time.
- 1 Tighten each screw until snug, then turn an additional 1/8 rotation before installing the next screw.
- (8) If the spinner loosens in service, add one or more layers of UHMW tape to the forward bulkhead or cylinder until the spinner fits snugly.

6. Post-Installation Checks

## A. Procedure

- (1) Refer to the airframe manufacturer's instructions for post-installation checks.
- (2) Perform a Maximum RPM (Static) Hydraulic Low Pitch Stop Check as outlined in the Testing and Troubleshooting chapter of this manual.

7. Spinner Dome Removal

## A. Procedure

CAUTION: TO PREVENT DAMAGING 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.

8. Propeller Removal

## A. 5D3-N338( ) Removal

WARNING: FOR SAFETY REASONS, PUT THE PROPELLER IN THE FEATHER POSITION BEFORE IT IS REMOVED FROM THE AIRCRAFT.

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

- (1) Remove the spinner dome in accordance with the section "Spinner Dome Removal" in this chapter.
- (2) If the propeller is equipped with an ice protection system that uses components supplied by Hartzell Propeller, applicable instructions and technical information for the components supplied by Hartzell can be found in Hartzell Propeller Ice Protection System Manual 180 (30-61-80) available on the Hartzell website at [www.hartzellprop.com](http://www.hartzellprop.com).
- (3) Propeller ice protection system components not supplied by Hartzell Propeller are controlled by the applicable TC or STC holder's Instructions for Continued Airworthiness (ICA).
- (4) Disconnect the engine beta linkage and beta feedback block assembly from the beta ring in accordance with the airframe manufacturer's instructions.
  - (a) Remove the snap ring that retains the beta feedback block assembly to the beta linkage. Refer to Figure 3-8.
  - (b) Remove the beta feedback block assembly. Refer to Figure 3-7.

- (5) Use the beta system puller TE100 to compress the beta system spring and pull the beta ring toward the propeller to expose the propeller mounting bolts and washers. Refer to Figure 3-4.
- (6) Cut and remove the safety wire or safety cable on the propeller mounting bolts.

**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 MANUALS AND PROCEDURES MUST BE FOLLOWED BECAUSE THEY MAY CONTAIN ISSUES VITAL TO AIRCRAFT SAFETY THAT ARE NOT CONTAINED IN THIS MANUAL OR THE HARTZELL PROPELLER OVERHAUL MANUAL 496 (61-10-96).

**WARNING 3:** MAKE SURE THE SLING IS RATED UP TO 800 LBS (363 KG) TO SUPPORT THE WEIGHT OF THE PROPELLER ASSEMBLY DURING REMOVAL.

- (7) Support the propeller assembly with a sling.
- (a) Supporting the propeller with a sling may be delayed until all but two mounting bolts and washers have been removed to permit rotating the propeller for ease of bolt removal.
  - (b) If the propeller will be reinstalled and it has been dynamically balanced, make an identifying mark on the propeller hub and a matching mark on the engine flange to make sure of proper orientation during re-installation to prevent dynamic imbalance.

**CAUTION:** DISCARD THE PROPELLER MOUNTING BOLTS IF THEY ARE DAMAGED OR CORRODED, OR WHEN THE PROPELLER IS REMOVED FOR OVERHAUL.

(8) Remove the propeller mounting bolts and washers.

(a) If the propeller is removed between overhaul intervals, mounting bolts and washers may be reused if they are not damaged or corroded.

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

(9) Using the support sling, lift the propeller from the mounting flange.

(10) Remove and discard propeller mounting O-ring.

(11) Install suitable covers on the pitch change rod opening, propeller mounting flange, and engine flange to prevent the introduction of contamination.

(12) Decompress and remove beta system puller.

(13) Put the propeller on a suitable cart for transportation.

## B. ( )D3( )-NK( ) ( ) Removal

WARNING 1: FOR SAFETY REASONS, PUT THE PROPELLER IN THE FEATHER POSITION BEFORE IT IS REMOVED FROM THE AIRCRAFT.

WARNING 2: FOR 5D31-NK366( ) PROPELLERS: HARTZELL PROPELLER RECOMMENDS INSTALLING THE PROTECTIVE COVER (BST-2816-8) ON THE BETA RING BEFORE REMOVING THE PROPELLER FROM THE AIRCRAFT. SECURE THE PROTECTIVE COVER WITH TAPE IF NECESSARY.

CAUTION 1: WHEN REMOVING 5D31-NK366( ) PROPELLERS, IT MAY BE NECESSARY TO TEMPORARILY ADJUST/REMOVE THE BETA RING SENSOR (IN ACCORDANCE WITH THE APPLICABLE AIRCRAFT MAINTENANCE MANUAL) TO PROVIDE CLEARANCE FOR THE BETA RING. FAILURE TO DO SO MAY RESULT IN DAMAGE TO THE BETA RING AND/OR THE BETA RING SENSOR.

CAUTION 2: INSTRUCTIONS AND PROCEDURES IN THIS SECTION MAY INVOLVE PROPELLER CRITICAL PARTS. REFER TO THE INTRODUCTION CHAPTER OF THIS MANUAL FOR INFORMATION ABOUT PROPELLER CRITICAL PARTS. REFER TO THE ILLUSTRATED PARTS LIST CHAPTER OF THE APPLICABLE OVERHAUL MANUAL(S) FOR THE IDENTIFICATION OF SPECIFIC PROPELLER CRITICAL PARTS.

- (1) Remove the spinner dome in accordance with the section "Spinner Dome Removal" in this chapter.

- (2) If the propeller is equipped with an ice protection system that uses components supplied by Hartzell Propeller, applicable instructions and technical information for the components supplied by Hartzell can be found in Hartzell Propeller Ice Protection System Manual 180 (30-61-80) available on the Hartzell website at [www.hartzellprop.com](http://www.hartzellprop.com).
- (3) Propeller ice protection system components not supplied by Hartzell Propeller are controlled by the applicable TC or STC holder's Instructions for Continued Airworthiness (ICA).
- (4) Disconnect the engine beta linkage and beta feedback block assembly from the beta ring in accordance with the airframe manufacturer's instructions.
  - (a) Remove the snap ring that retains the beta feedback block assembly to the beta linkage. Refer to Figure 3-10.
  - (b) Remove the beta feedback block assembly. Refer to Figure 3-11.
- (5) Use the beta system puller TE100 to compress the beta system spring and pull the beta ring toward the propeller to expose the propeller mounting nuts and washers. Refer to Figure 3-9.
- (6) Cut and remove the safety wire or safety cable on the propeller mounting nuts.

**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 MANUALS AND PROCEDURES MUST BE FOLLOWED BECAUSE THEY MAY CONTAIN ISSUES VITAL TO AIRCRAFT SAFETY THAT ARE NOT CONTAINED IN THIS MANUAL OR THE HARTZELL PROPELLER OVERHAUL MANUAL 496 (61-10-96).

**WARNING 3:** MAKE SURE THE SLING IS RATED UP TO 800 LBS (363 KG) TO SUPPORT THE WEIGHT OF THE PROPELLER ASSEMBLY DURING REMOVAL.

- (7) Support the propeller assembly with a sling.
- (a) Supporting the propeller with a sling may be delayed until all but two mounting nuts and washers have been removed to permit rotating the propeller for ease of nut removal.
  - (b) If the propeller will be reinstalled and it has been dynamically balanced, make an identifying mark on the propeller hub and a matching mark on the engine flange to make sure of proper orientation during re-installation to prevent dynamic imbalance.

**CAUTION:** DISCARD THE PROPELLER MOUNTING NUTS IF THEY ARE DAMAGED OR CORRODED, OR WHEN THE PROPELLER IS REMOVED FOR OVERHAUL.

- (8) Remove the propeller mounting nuts and washers.
- (a) If the propeller is removed between overhaul intervals, mounting nuts and washers may be reused if they are not damaged or corroded.

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

- (9) Using the support sling, lift the propeller from the mounting flange.
- (10) Remove and discard propeller mounting O-ring.
- (11) Install suitable covers on the pitch change rod opening, propeller mounting flange, and engine flange to prevent the introduction of contamination.
- (12) Decompress and remove beta system puller.
- (13) Put the propeller on a suitable cart for transportation.

## C. ( )D5( )-NK( )( ) Removal

**WARNING:** FOR SAFETY REASONS, PUT THE PROPELLER IN THE FEATHER POSITION BEFORE IT IS REMOVED FROM THE AIRCRAFT.

**CAUTION 2:** INSTRUCTIONS AND PROCEDURES IN THIS SECTION MAY INVOLVE PROPELLER CRITICAL PARTS. REFER TO THE INTRODUCTION CHAPTER OF THIS MANUAL FOR INFORMATION ABOUT PROPELLER CRITICAL PARTS. REFER TO THE ILLUSTRATED PARTS LIST CHAPTER OF THE APPLICABLE OVERHAUL MANUAL(S) FOR THE IDENTIFICATION OF SPECIFIC PROPELLER CRITICAL PARTS.

- (1) Remove the spinner dome in accordance with the section "Spinner Dome Removal" in this chapter.
- (2) If the propeller is equipped with an ice protection system that uses components supplied by Hartzell Propeller, applicable instructions and technical information for the components supplied by Hartzell can be found in Hartzell Propeller Ice Protection System Manual 180 (30-61-80) available on the Hartzell website at [www.hartzellprop.com](http://www.hartzellprop.com).
- (3) Propeller ice protection system components not supplied by Hartzell Propeller are controlled by the applicable TC or STC holder's Instructions for Continued Airworthiness (ICA).

**CAUTION:** REMOVE THE BETA TUBE IN ACCORDANCE WITH THE AIRCRAFT MAINTENANCE MANUAL BEFORE REMOVING THE PROPELLER ASSEMBLY FROM THE AIRCRAFT.

- (4) Remove the beta adjust anti-rotation hardware.
- (5) Remove the beta adjust screw and beta tube.

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1. Operational Checks (Rev. 1)

A. Operational Checks

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

2. Propeller Ice Protection Systems (Rev. 2)

**WARNING:** CONSULT THE PILOT OPERATING HANDBOOK (INCLUDING ALL SUPPLEMENTS) REGARDING FLIGHT INTO CONDITIONS OF KNOWN ICING. THE AIRCRAFT MAY NOT BE CERTIFICATED FOR FLIGHT INTO KNOWN ICING CONDITIONS, EVEN THOUGH AN ICE PROTECTION SYSTEM IS INSTALLED.

A. Operational Checks and Troubleshooting

- (1) Refer to the Anti-ice and De-ice Systems chapter of this manual for operational checks and troubleshooting information for Hartzell Propeller ice protection systems.

### 3. Troubleshooting

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

#### A. Hunting and Surging (Rev. 2)

##### (1) General

- (a) Hunting is characterized by a cyclic variation in engine speed above and below desired speed. Surging is characterized by a large increase/decrease in engine speed, followed by a return to set speed after one or two occurrences.
- (b) If the propeller is hunting, a certified airframe and powerplant mechanic with the appropriate rating or a certified propeller repair station with the appropriate rating should check:

- 1 Governor
- 2 Fuel control
- 3 Synchrophaser, or synchronizer (if applicable)

##### (2) If the propeller is surging:

- (a) Perform the "Initial Run-Up" in accordance with the Inspection and Check chapter of this manual to release trapped air from the propeller.
  - 1 If surging reoccurs it is most likely due to a faulty governor.
    - a Have the governor tested by a certified propeller repair station with the appropriate rating.

- (b) Hunting and/or surging may also be caused by friction or binding within the governor control, or internal propeller corrosion, which causes the propeller to react slower to governor commands.

1 To isolate these faults, the propeller must be tested on a test bench at a certified propeller repair station with the appropriate rating.

**B. 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.
  - (b) Friction in propeller.
- (3) Decrease in engine speed while increasing airspeed:
  - (a) Governor pilot valve is stuck and is excessively decreasing oil volume.
  - (b) Feathering command engaged on propeller pitch control.
- (4) Increase in engine speed while decreasing airspeed:
  - (a) Governor pilot valve is stuck and is excessively increasing oil volume.
- (5) Decrease in engine speed while decreasing airspeed:
  - (a) Governor is not increasing oil volume in the propeller.
  - (b) Engine oil transfer system leaking excessively.
  - (c) Friction in propeller.

## C. Loss of Propeller Control

- (1) Propeller goes to uncommanded high pitch (or feather).
  - (a) Loss of propeller oil pressure - check:
    - 1 Governor pressure relief valve.
    - 2 Governor drive.
    - 3 Engine oil supply.
  - (b) Start lock(s) not engaging (applicable models only)
- (2) Propeller goes to uncommanded low pitch (High RPM).
  - (a) Governor pilot valve sticking.
- (3) RPM increases with power and airspeed, propeller RPM control has little or no effect.
  - (a) Excessive friction in blade bearings or pitch changing mechanism.
  - (b) Broken feathering spring.
- (4) RPM control sluggish (especially on reducing RPM)
  - (a) Broken feathering spring.

## D. Failure to Feather (or feathers slowly) (Rev. 1)

- (1) Broken feathering spring (if applicable).
- (2) Check for proper function and rigging of propeller/governor control linkage.
- (3) Check the governor function.
- (4) The propeller must be inspected for misadjustment or internal corrosion (usually in blade bearings or pitch changing mechanism) that results in excessive friction.
  - (a) This inspection must be performed by a certified propeller repair station with the appropriate rating.

## E. Failure to Unfeather (Rev. 1)

- (1) Check for proper function and rigging of propeller control linkage.
- (2) Check the governor function.
- (3) The propeller must be inspected for misadjustment or internal corrosion (usually in blade bearings or pitch change mechanism) that results in excessive friction.
  - (a) This inspection must be accomplished by a certified propeller repair station with the appropriate rating.

## F. Start Locks Fail to Latch (applicable models only)

- (1) Propeller was feathered before shutdown.
- (2) Shutdown occurred at high RPM with propeller control off the low pitch stop.

NOTE: Problems F.(1) and F.(2) can be resolved by restarting the engine, placing the propeller control in the proper shutdown position, then shutting down the engine.

- (3) Excessive governor pump leakage
- (4) Broken start locks

NOTE: Problems F.(3) and F.(4) should be referred to a certified propeller repair station with the appropriate rating.

## G. Vibration (Rev. 1)

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

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

## (1) Check:

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

- (h) Spinner for cracks, improper installation, or “wobble” during operation
  - (i) Static balance
  - (j) Hub damage or cracking
  - (k) Grease or oil leakage
  - (l) Blade deformation
- (2) Dynamic Balance
- (a) Dynamic balancing is recommended after installing or performing maintenance on a propeller. While this is normally an optional task, it may be required by the engine or airframe manufacturer to make certain the propeller/engine combination is balanced properly before operation.
    - 1 Refer to the engine or airframe manuals, and the Maintenance Practices chapter of this manual.

#### H. Propeller Overspeed

- (1) Check:
- (a) Low pitch stop adjustment.
  - (b) Governor Maximum RPM set too high.
  - (c) Broken feathering spring.
  - (d) Governor pilot valve jammed, supplying high pressure only.
  - (e) Tachometer error.

#### I. Propeller Underspeed

- (1) Check:
- (a) Governor oil pressure low.
  - (b) Governor oil passage clogged.
  - (c) Tachometer error.

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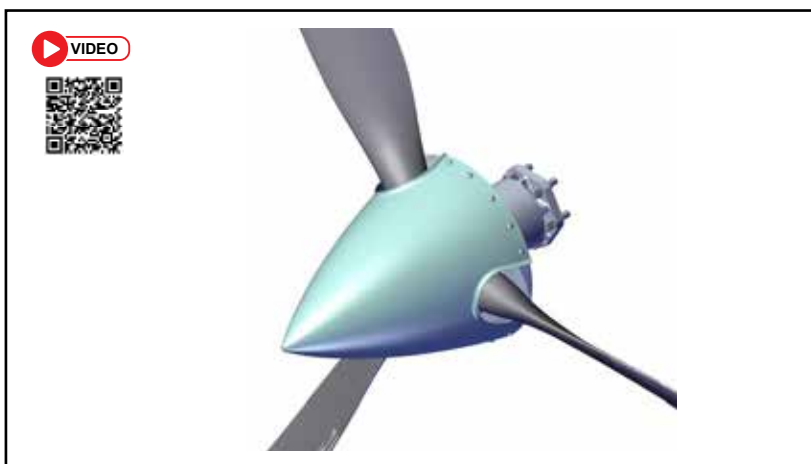
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1. Pre-Flight Checks (Rev. 5)

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

A. Important Information

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



**Pre-Flight Inspection  
Figure 5-1**

**B. Propeller Blades**

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

**C. Spinner Assembly and Blade Retention Components**

- (1) Inspect the spinner and the visible blade retention components for damage and/or cracks.
  - (a) Repair or replace components as required before further flight.

## D. Hardware

- (1) Check for loose or missing hardware.
  - (a) Retighten or reinstall as necessary.

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

## E. Grease/Oil Leakage

- (1) Examine the face and camber-sides of the blades for evidence of grease/oil leakage.
- (2) Using an appropriate light source, examine the propeller through the blade cut-outs in the spinner for signs of grease/oil leakage.
  - (a) Spinner removal is not required for this inspection.
  - (b) If grease/oil leakage is found, refer to the section, "Inspection Procedures" in this chapter.

## F. Initial Run-Up

- (1) Perform the Initial Run-Up procedure in accordance with the section, "Operational Checks" in this chapter.

## G. Additional Information

- (1) Refer to the airframe manufacturer's manual for additional pre-flight checks.
- (2) Refer to the section, "Inspection Procedures" in this chapter for additional inspection/repair information.

2. Operational Checks (Rev. 5)

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

A. Initial Run-Up

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

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

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

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

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

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

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

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

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

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

## B. Propeller Ground Idle RPM Check

**WARNING:** STABILIZED GROUND OPERATION WITHIN THE PROPELLER RESTRICTED RPM RANGE CAN GENERATE HIGH PROPELLER STRESSES AND RESULT IN FATIGUE DAMAGE TO THE PROPELLER. THIS DAMAGE CAN LEAD TO A REDUCED PROPELLER FATIGUE LIFE, PROPELLER FAILURE, AND LOSS OF CONTROL OF THE AIRCRAFT. THE PROPELLER RESTRICTED RPM RANGE IS DEFINED IN THE AIRPLANE FLIGHT MANUAL.

## (1) General

- (a) Propellers with four or more blades operating on turbine engines can be sensitive to operation within restricted RPM ranges. These restricted ranges are usually in the lower RPM ranges, requiring that ground idle RPM be set above a critical minimum value.
- (b) This minimum propeller idle RPM operating restriction is the result of a specific vibratory resonant condition known as “reactionless mode”. During operation in these conditions the flight crew cannot feel the resulting high propeller vibration. Ground operation at or near an RPM that can create a reactionless mode vibratory resonance can cause very high stresses in the propeller blades and the hub. These high stresses are more severe when operating in a quartering tail wind condition.
- (c) If the propeller is operated within a restricted RPM range or below a minimum idle RPM restriction for an extended period of time, the propeller blades and hub can become unairworthy because of fatigue. A failed blade or hub has the potential to cause a catastrophic blade separation.
- (d) Use the “Periodic Ground Idle RPM Check” steps in this section to determine if the propeller is operating within the specified RPM limits.
- (e) Refer to the “Corrective Action” steps in this section for maintenance information about propellers operating outside of the specified RPM range.

## (2) Periodic Ground Idle RPM Check

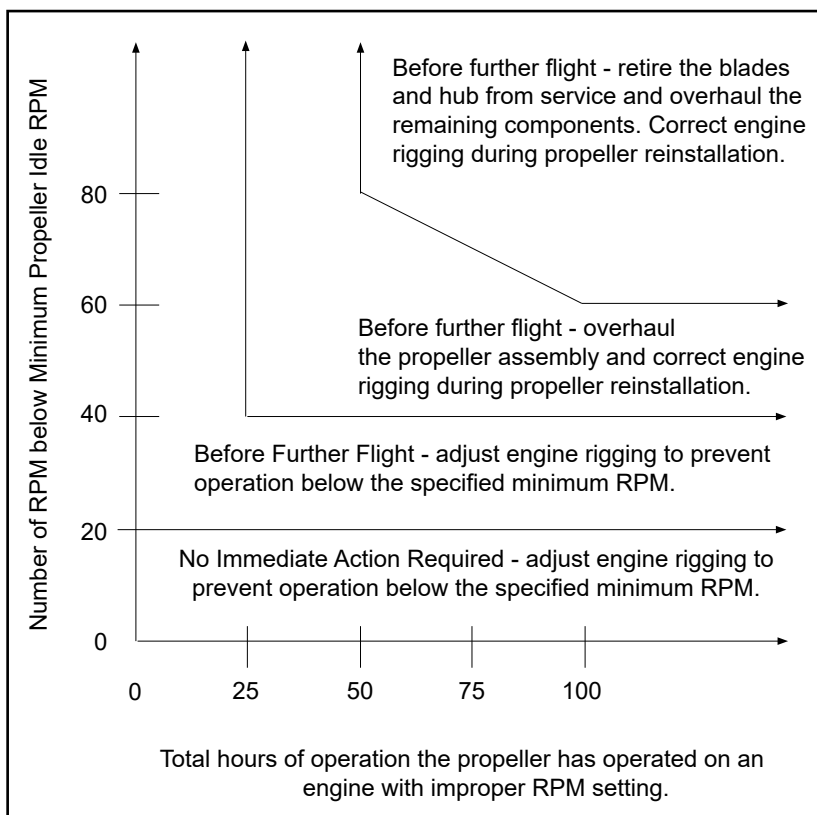
**NOTE:** The accuracy of the tachometer is critical to the safe operation of the aircraft. Refer to the section, "Tachometer Calibration" in the Maintenance Practices chapter of this manual for important information.

- (a) Perform the RPM check in accordance with the Airplane Flight Manual or Airplane Flight Manual Supplement.
  - 1 Refer to the Airplane Flight Manual or Airplane Flight Manual Supplement to determine if there are any propeller RPM restrictions or limitations.
- (b) Perform an engine run up and determine if the engine and/or propeller rigging permits operation of the propeller below the minimum specified propeller idle RPM.
- (c) If the propeller cannot be operated below the minimum specified propeller idle RPM, no further action is required.
- (d) If the propeller can be operated below the minimum specified propeller idle RPM:
  - 1 Refer to Figure 5-2 for corrective action requirements, and Figure 5-3 for an example of a ground idle RPM check evaluation.
  - 2 The corrective action is based on the amount the RPM is below the minimum propeller idle RPM and the total hours of operation the propeller has accumulated.
    - a Figure 5-2 applies to an aircraft that is operated in conventional service. "Hours of Operation" refers to the total number of hours the propeller is operated on an engine that has an improper RPM setting. It is not the number of hours the propeller is operated in a restricted range, which will be less than the total hours of operation.

## (3) Corrective Action

(a) The required corrective action is determined by both the amount and duration of RPM deviation.

- 1 A turboprop propeller with four or more blades may have a variety of operating restrictions and these different restrictions may have different operating margins.
- 2 The greater the amount of the RPM deviation and the longer it is permitted to exist, the more severe the required corrective action.



**Corrective Action Required**

**Figure 5-2**

- 3 The corrective action may vary from no action required, to retirement of the blades and the hub.
- 4 The chart in Figure 5-2 specifies the required corrective action for operation below the minimum idle RPM.
  - a The chart in Figure 5-2 does not apply to other propeller restrictions that are above the minimum idle RPM.
- 5 If the corrective action requires a propeller overhaul, overhaul the propeller in accordance with the applicable propeller overhaul manuals.
- 6 If the corrective action requires that the blades and the hub be retired from service, retire these components in accordance with the Part Retirement Procedures chapter of Hartzell Propeller Standard Practices Manual 202A (61-01-02) before further flight.

**Example:**

Minimum propeller idle RPM listed in the AMM is 1180 RPM

Propeller idle is set at 1120 RPM

Propeller has operated with a RPM deviation of **60 RPM**

Engine was rigged 2 months ago and has operated **75 hours** since it was rigged

Figure 5-1 shows that with an RPM deviation of 60 RPM for 75 hours - the propeller assembly must be overhauled and engine rigging corrected before further flight.

**Example of a Ground Idle RPM Check Evaluation**  
**Figure 5-3**

a A propeller hub or blade that has been retired from service because of a violation of the operating restrictions as specified in this section must not be reused on another aircraft application.

7 If the corrective action requires the correction of the propeller RPM setting, refer to the applicable installation and rigging instructions for the adjustment of engine torque, engine idle speed, and propeller RPM setting.

(b) Contact the Hartzell Propeller Product Support Department to report the findings, or if a propeller restriction other than those described in Figure 5-2 has been violated.

1 Refer to the section, "Hartzell Propeller Contact Information" in the Introduction chapter of this manual.

C. Post-Run Check

(1) After engine shutdown, check propeller for signs of grease/oil leakage.

D. Propeller Ice Protection System

(1) Refer to the Anti-ice and De-ice Systems chapter in this manual for operational checks and troubleshooting information for Hartzell Propeller ice protection systems.

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

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

## A. Periodic Inspection

- (1) Perform the following inspection procedures at 400 hour intervals, not to exceed twelve (12) calendar months. Procedures involved in these inspections are detailed below.
  - (a) Inspection and maintenance specified by an airframe manufacturer's maintenance program and approved by the applicable airworthiness agency may not coincide with the inspection time intervals specified.
    - 1 In this situation, the airframe manufacturer's schedule may be applied as long as the calendar limit for the inspection interval does not exceed twelve (12) months.
  - (b) For additional inspection information (including possible corrections), refer to the section, "Inspection Procedures" in this chapter, and/or the Testing and Troubleshooting chapter of this manual.
- (2) Remove the spinner dome.
- (3) Visually examine the propeller blades (lead edge, trail edge, face, and camber sides) for nicks, gouges, erosion, cracks, etc.
  - (a) Refer to the section, "Composite Blades" in the Maintenance Practices chapter of this manual for damage evaluation and repair information.

- (4) Examine the propeller for grease/oil leakage in accordance with the section, "Grease/Oil Leakage" in this chapter.
- (5) If a blade track problem is suspected, check the blade track in accordance with the section, "Blade Track" in this chapter.
- (6) Make an entry in the propeller logbook about completion of these inspections.

**B. Periodic Maintenance**

- (1) Lubricate the propeller assembly.
  - (a) Refer to the section, "Lubrication" in the Maintenance Practices chapter of this manual for intervals and procedures.

**C. Periodic Coin-Tap Inspections for Composite Blades**

- (1) Perform a coin-tap inspection of the exposed section of the blade at intervals not to exceed 1200 flight hours.
- (2) Perform a coin-tap inspection of the erosion shield surface at 600 hour intervals, not to exceed 12 months.
- (3) Refer to Hartzell Propeller Composite Blade Field Maintenance and Minor Repair Manual 170 (61-13-70) for the coin-tap inspection procedure.

**D. 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 included in this manual. Refer to the Airworthiness Limitations chapter of this manual.
- (3) Operators are urged to keep informed of airworthiness information via Hartzell Propeller Service Bulletins and Service Letters, which are available from Hartzell distributors or from Hartzell by subscription. Selected information is also available on the Hartzell Propeller website at [www.hartzellprop.com](http://www.hartzellprop.com).

## E. Overhaul Periods

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

#### 4. Inspection Procedures

##### A. Blade Damage (Rev. 1)

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

##### B. Grease/Oil Leakage (Rev. 2)

**WARNING:** UNUSUAL OR ABNORMAL GREASE LEAKAGE OR VIBRATION, WHERE THE CONDITION STARTED SUDDENLY, CAN BE AN INDICATION OF A FAILING PROPELLER BLADE OR BLADE RETENTION COMPONENT. AN INFLIGHT BLADE SEPARATION CAN RESULT IN DEATH, SERIOUS BODILY INJURY, AND/OR SUBSTANTIAL PROPERTY DAMAGE. UNUSUAL OR ABNORMAL GREASE LEAKAGE OR VIBRATION DEMANDS IMMEDIATE INSPECTION.

##### (1) Important Information

- (a) 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. Leakage should cease within the first ten hours of operation.
- (b) 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.
  - 1 A determination should be made as to the source of the leak. If the source of the leak is the O-ring seal between the engine and the propeller flange or a lubrication fitting, field repair is permitted.
  - 2 All other leakage repairs should be referred to a certified propeller repair station with the appropriate rating.

- 3 If abnormal leakage is detected, inspect the propeller assembly using the Inspection Procedure steps in this section.
- (c) Grease Leakage - probable causes:
  - 1 Loose/defective lubrication fitting
  - 2 Faulty seal at the blade socket between the blade and the hub
    - a Refer to a certified propeller repair station with the appropriate rating for seal replacement.
  - 3 Leakage from the hub and beta rod interface (if applicable)
    - a Over-greased hub
      - (1) Refer to a certified propeller repair station with the appropriate rating for grease removal.
    - b Faulty seal
      - (1) Refer to a certified propeller repair station with the appropriate rating for seal replacement.
  - 4 Cracked hub
- (d) Oil Leakage - probable causes:
  - 1 Leaks between the hub and cylinder
    - a Faulty or missing seal between the hub and the cylinder
      - (1) Refer to a certified propeller repair station with the appropriate rating for seal replacement.
  - 2 Leaks between the hub halves, beta rods and hub
    - a Faulty seal(s) between the hub and the pitch change rod
      - (1) Refer to a certified propeller repair station with the appropriate rating for seal replacement.

- 3 Leaks from the front of the cylinder or through the start lock units
    - a Faulty seal(s) between the piston and cylinder, or piston and pitch change rod
      - (1) Refer to a certified propeller repair station with the appropriate rating for seal replacement.
  - 4 Leaks between the hub and the engine
    - a Faulty or missing seal between the propeller hub and the engine flange
- (2) Inspection Procedure

(a) 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.

- (b) Perform a visual inspection of the hub, blades, and blade retention areas to locate the source of the grease leak.
- 1 If the source of the grease leak is a lubrication fitting, blade O-ring, or the hub parting line, repairs can be accomplished during scheduled maintenance as long as flight safety is not compromised.
    - a To repair a grease leak from a lubrication fitting, blade O-ring, or hub parting line, the propeller must be disassembled and inspected at a certified propeller repair station with the appropriate rating.
  - 2 If the source of the grease leak is a component or location other than a lubrication fitting, blade O-ring, or the hub parting line, the propeller must be disassembled and inspected at a certified propeller repair station with the appropriate rating before further flight.

- (c) Perform a visual inspection for cracks in the hub.
  - 1 Extra attention should be given to the blade retention area of the hub.
  - 2 A crack may be visible or may be indicated by grease leaking from a seemingly solid surface.
- (d) If cracks are suspected, additional inspections to verify the condition must be performed before further flight.
  - 1 Inspections typically include disassembly of the propeller followed by inspection of parts, using nondestructive methods in accordance with published procedures.
    - a These inspections must be performed by a certified propeller repair station with the appropriate rating.
- (e) If cracks or failing components are found, these parts must be replaced before further flight.
  - 1 Report such occurrences to the appropriate airworthiness authorities and to Hartzell Propeller Product Support.

## C. Vibration (Rev. 3)

**NOTE:** Vibration may originate in the engine, propeller, or airframe. Troubleshooting procedures typically begin with an investigation of the engine. Airframe components, such as engine mounts or loose landing gear doors, can also be the source of vibration. When investigating an abnormal vibration, the blades and the blade retention components should be considered as potential sources of the vibration.

## (1) Important Information

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

## (2) Inspection

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

- (c) If cracks are suspected, additional inspections must be performed to evaluate the condition before further flight.

- 1 These inspections typically include disassembly of the propeller, followed by inspection of parts, using nondestructive methods in accordance with published procedures.
- 2 These inspections must be performed at a certified propeller repair station with the appropriate rating.

- (d) Inspect the play of the propeller blades in accordance with the section, "Blade Tolerances" in this chapter.

- (e) Inspect blade track in accordance with the section, "Blade Track" in this chapter.

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

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

## D. Blade Track

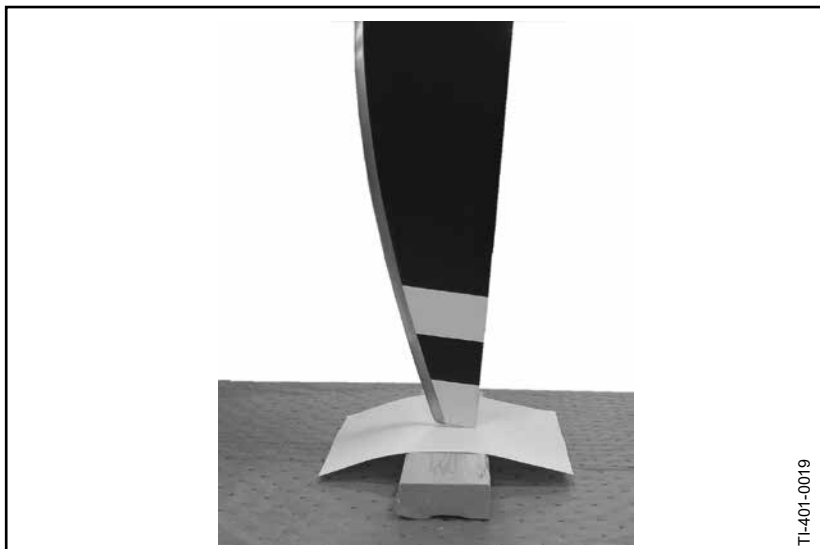
- (1) If a blade track problem is suspected, examine the blade track as follows.
- (2) Move the propeller to low pitch.
  - (a) Remove the screws and washers that attach the spinner dome to the engine side bulkhead.
  - (b) Remove the spinner dome and set it aside.
  - (c) Remove the forward bulkhead and spacers from the forward end of the cylinder, if applicable.
  - (d) Remove the bolt, nut, and washer from the pitch change rod, if applicable.
    - 1 Removal of the plug and O-ring is not required unless an early style propeller unfeathering tool that threads internally is used.

**CAUTION 1:** DO NOT ATTEMPT TO INSTALL AND USE THE PROPELLER UNFEATHERING TOOL WITHOUT REMOVING THE PITCH CHANGE ROD SAFETY BOLT. BOLT REMOVAL IS NECESSARY TO MAKE SURE OF ADEQUATE THREAD ENGAGEMENT OF THE TOOL.

**CAUTION 2:** DO NOT ATTEMPT TO MOVE THE PROPELLER BLADES BEYOND THE LOW PITCH MECHANICAL STOPS, IF APPLICABLE.

- (e) Install propeller unfeathering tool part number 9943HART-001 or equivalent.
  - 1 Attach the threaded rod of the tool onto the end of the pitch change rod as far as possible, hand tight.
  - 2 Move the cylindrical portion of the tool over the threaded rod and against the propeller cylinder.
  - 3 Apply a small amount of lubricant or anti-seize compound to the threads of the 1-1/2 inch nut of the unfeathering tool.
  - 4 Install the 1-1/2 inch nut onto the threaded rod of the unfeathering tool.

- 5 Turn the 1-1/2 inch nut down until it contacts the thrust bearing.
  - 6 Continue turning the nut until the blades move to low pitch.
- (3) Check blade track as follows:
- NOTE:** An accurate blade track inspection cannot be accomplished with the propeller in feather position.
- (a) Chock the aircraft wheels securely.
  - (b) Put a fixed reference point beneath the propeller, within 0.25 inch (6.4 mm) of the lowest point of the propeller arc as shown in Figure 5-4.
- 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 (6.4 mm) of the propeller arc.
- (c) Rotate the propeller by hand in the direction of normal rotation until a blade points directly at the paper.



**Checking Blade Track**  
**Figure 5-4**

- (d) Mark the position of the blade tip in relation to the paper.
  - (e) Repeat this procedure with the remaining blades.
  - (f) Tracking tolerance is  $\pm 0.125$  inch (3.18 mm) or 0.25 inch (6.4 mm) total.
- (4) Possible Correction
- (a) Remove foreign matter from the propeller mounting flange.
    - 1 Examine the engine and propeller flanges for damage.
    - 2 Repair any damage to the engine or propeller flange. If necessary, refer to an appropriately rated propeller repair station that is certified by the Federal Aviation Administration (FAA) or international equivalent.
  - (b) If no foreign matter is present, refer to a certified propeller repair station with the appropriate rating.

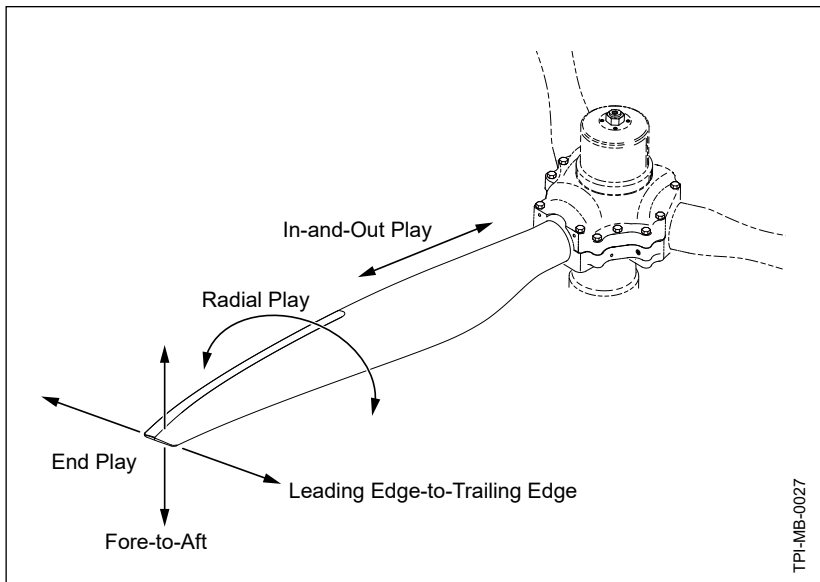
E. Blade Tolerances (Rev. 4)

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

(a) End Play:

- 1 Check the blade end play, Leading Edge-to-Trailing Edge and Face-to-Camber (Fore-to-Aft) in accordance with the following steps:

**NOTE 1:** Hartzell Raptor-series propellers use specially designed spacers within the propeller to achieve the required blade fit. The blades may feel loose in the hub when compared to Hartzell Compact-series propellers. During propeller rotation, the blade fit within the propeller is the same as other Hartzell propeller models.



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

NOTE 2: Blade tip play is affected by the fit of the blade within the propeller, and also by movement of components within the engine and the aircraft. The following check will evaluate only the fit of the blade within the propeller.

- a Using one finger and thumb, apply a light load of approximately 5 lbs. (2.2 kg) to the blade in the direction of the check being performed.

(1) Apply the load at the mid-span of the blade approximately in line with the blade decal.

- b Measure blade play at the tip of the blade.

(1) The maximum permitted blade play is  $\pm 0.125$  inch (3.17 mm),  
0.250 inch (6.35 mm) total.

- 2 If blade play is greater than the permitted limit, contact the Hartzell Propeller Product Support Department.

(b) In-and-Out Play 0.020 inch (0.50 mm)

(c) Radial Play  $\pm 0.5$  degree (1 degree total)  
measured at reference station

- (2) Limits for Blade Track are specified below:

(a) Composite Blades  $\pm 0.125$  inch (3.17 mm)  
Total: 0.250 inch (6.35 mm)

F. Corrosion (Rev. 1)

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

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

## G. Spinner Damage (Rev. 3)

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

- (a) Metal Spinners

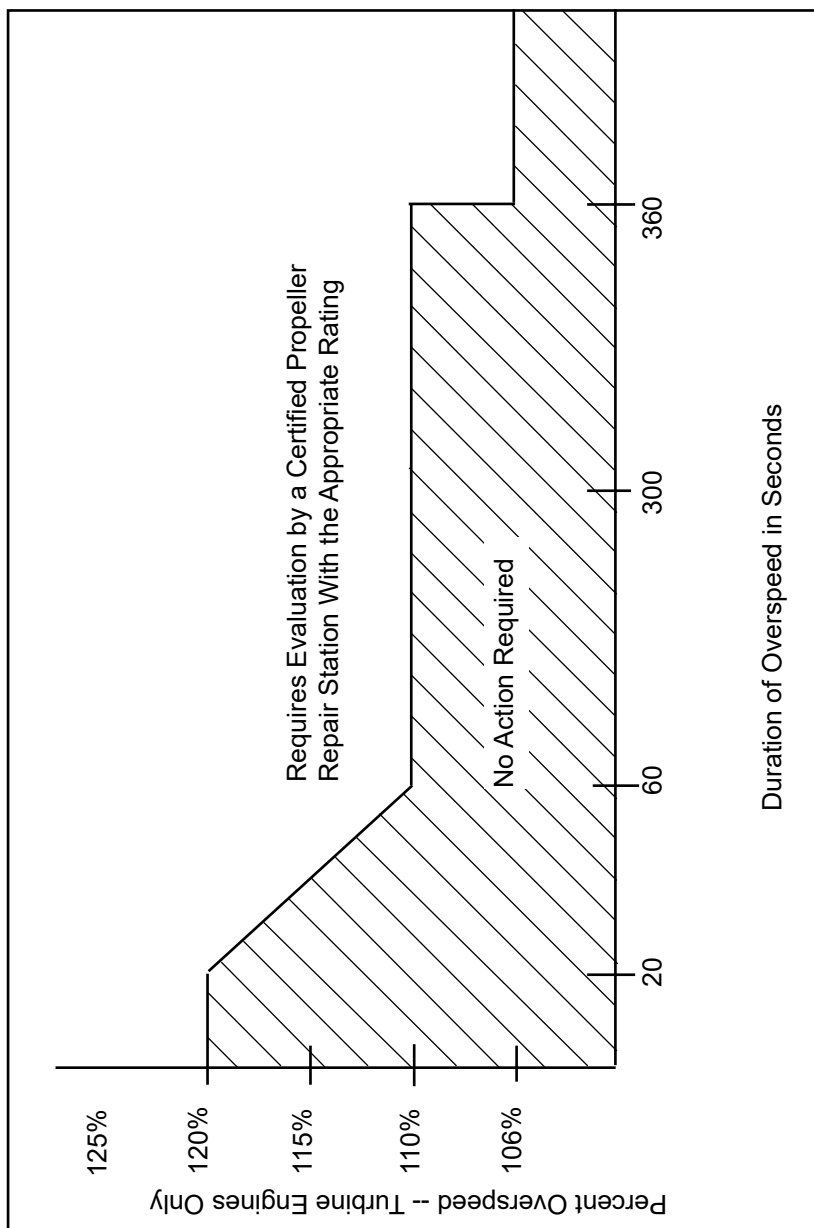
- 1 For damage evaluation and repair information, refer to Hartzell Propeller Manual 127 (61-16-27) or a certified propeller repair station with the appropriate rating.
  - 2 Contact the local airworthiness authority for repair approval.

- (b) Composite Spinners

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

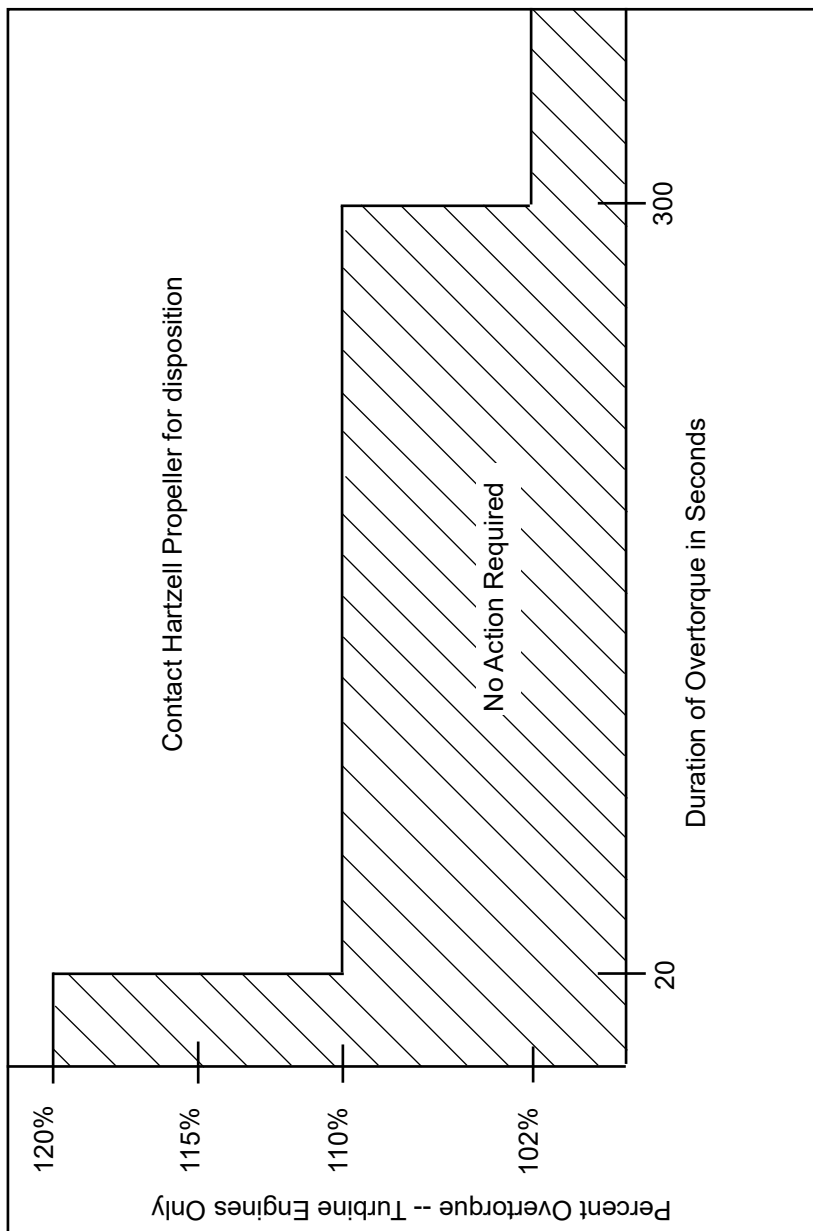
## H. Propeller Ice Protection Systems (Rev. 1)

- (1) Refer to the Anti-ice and De-ice Systems chapter of this manual for operational checks and troubleshooting information.



**Turbine Engine Overspeed Limits**

**Figure 5-6**



**Turbine Engine Overtorque Limits**

**Figure 5-7**

5. Special Inspections (Rev. 2)

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

## A. Overspeed/Overtorque

- (1) An overspeed has occurred when the propeller RPM has exceeded the maximum RPM stated in the applicable Aircraft Type Certificate Data Sheet. An overtorque condition occurs when the engine load exceeds the limits established by the engine, propeller, or airframe manufacturer. The duration of time at overspeed/overtorque for a single event determines the corrective action that must be taken to make sure no damage to the propeller has occurred.
- (2) The criteria for determining the required action after an overspeed are based on many factors. The additional centrifugal forces that occur during overspeed are not the only concern. Some applications have sharp increases in vibratory stresses at RPMs above the maximum rated for the airframe/engine/propeller combination.
  - (a) When a propeller installed on a turbine engine has an overspeed event, refer to the Turbine Engine Overspeed Limits (Refer to Figure 5-6) to determine the corrective action to be taken.
  - (b) When a propeller installed on a turbine engine has an overtorque event, refer to the Turbine Engine Overtorque Limits (Refer to Figure 5-7) to determine the corrective action to be taken.

- (c) Make a record of the overspeed/overtorque event in the propeller logbook, indicating any corrective action(s) taken.

**NOTE:** Some aircraft installations have torque indicator values indicating 100% torque that are less than the maximum certified torque for the specific propeller model as listed in the propeller type certificate data sheet. If an overtorque occurs that requires propeller repair station evaluation, contact Hartzell Propeller Product Support to confirm actual overtorque percentage.

B. Lightning Strike - Propeller Assembly (Rev. 2)

**CAUTION 1:** REFER TO THE ENGINE AND AIRFRAME MANUFACTURER'S MANUALS FOR ADDITIONAL INSPECTIONS TO PERFORM AFTER A PROPELLER LIGHTNING STRIKE.

**CAUTION 2:** A COMPOSITE BLADE SUSPECTED OF OF LIGHTNING STRIKE MUST BE INSPECTED AND MAY REQUIRE OVERHAUL.

**NOTE:** Lightning usually enters the propeller through the metal erosion shield or the stainless steel mesh (if applicable) of a blade. The charge typically enters at the tip of the blade and travels through the erosion shield toward the hub. The charge exits the erosion shield at the inboard end and enters the next conductive element in the path.

(1) General

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

- (2) Temporary Operation Inspection
- (a) Remove the spinner dome and perform a visual inspection of the propeller, blades, spinner, and ice protection system for evidence of damage that would require repair before flight (such as broken wires or arcing damage to propeller hub).
    - 1 A lightning strike indication may appear as a darkened area in proximity of the tip and at the most inboard end of the metal erosion shield.
    - 2 Other indications include: debonding, lifting or buckling of the erosion shield, and splitting or delamination of the composite material.
  - (b) Perform visual and coin-tap inspections of the blades that have lightning strike indications in accordance with Hartzell Propeller Composite Blade Field Maintenance and Minor Repair Manual 170 (61-13-70).
    - 1 If the damage is within the airworthy damage limits specified in Manual 170, temporary operation for up to 10 flight hours is permitted before propeller disassembly and inspection.
    - 2 If the damage is not within the airworthy damage limits specified in Manual 170, temporary operation is not permitted. The propeller must be removed from the aircraft, disassembled, evaluated, and/or repaired by a certified propeller repair station with the appropriate rating before further flight.
  - (c) Perform an operational check of the propeller ice protection system (if installed) in accordance with the Anti-ice and De-ice Systems chapter of this manual.
  - (d) Make a record of the lightning strike in the propeller logbook, indicating any corrective action(s) taken.
- (3) For flight beyond the 10-hour temporary operation limit:
- (a) The propeller must be removed from the aircraft, disassembled, evaluated, and/or repaired by a certified propeller repair station with the appropriate rating.

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

## (1) General

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

## (2) Inspection Procedure

- (a) Examine the propeller assembly for damage related to the foreign object/ground strike.
- (b) If any of the following indications are found, the propeller must be removed from the aircraft, disassembled, and overhauled by a certified propeller repair station with the appropriate rating.
  - 1 Blade(s) damaged, bent, or out of track/angle
  - 2 Blade(s) loose in the hub (if applicable)
    - a Refer to the section, "Blade Tolerances" in this chapter for the permitted limits of blade play.
  - 3 Blade(s) rotated in the clamp (if applicable)
  - 4 Any noticeable or **suspected** damage to the pitch change mechanism
  - 5 Any blade diameter reduction
  - 6 Bent, cracked, or failed engine shaft
  - 7 Vibration during operation (that was not present before the event)
- (c) Aluminum Blades: Nicks, gouges, and scratches on blade surfaces or the leading and trailing edges must be removed before flight.
  - 1 Refer to the section, "Aluminum Blades" in the Maintenance Practices chapter of this manual (if applicable) for damage evaluation and repair information.
- (d) Composite Blades: Perform a thorough visual inspection and a coin-tap inspection of each blade (including the metal erosion shield) in accordance with Hartzell Propeller Composite Blade Field Maintenance and Minor Repair Manual 170 (61-13-70).
  - 1 If the blade damage is not within the airworthy damage limits, the blade(s) must be repaired before further flight.
    - NOTE: It is not necessary to remove the de-ice/anti-icing boot for this inspection.

- (e) Engine mounted components - such as governors, pumps, etc. may be damaged by a foreign object strike, especially if the strike resulted in a sudden stoppage of the engine.
  - 1 These components should be inspected, repaired, or overhauled as recommended by the applicable component maintenance manual.
- (f) Make a record of the foreign object/ground strike event in the propeller logbook, indicating any corrective action(s) taken.

D. Fire/Heat Damage (Rev. 1)

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

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

E. Sudden Stoppage (Rev. 1)

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

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

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

6. Long Term Storage (Rev. 1)

## A. Important Information

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

## B. Composite Blades

- (1) In addition to the long term storage requirements specified in Hartzell Propeller Standard Practices Manual 202A (61-01-02), the maximum permitted storage temperature for Hartzell Propeller composite blades is 180°F (82°C).

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1. Cleaning (Rev. 2)

CAUTION 1: INSTRUCTIONS AND PROCEDURES IN THIS SECTION MAY INVOLVE PROPELLER CRITICAL PARTS. REFER TO THE INTRODUCTION CHAPTER OF THIS MANUAL FOR INFORMATION ABOUT PROPELLER CRITICAL PARTS. REFER TO THE ILLUSTRATED PARTS LIST CHAPTER OF THE APPLICABLE OVERHAUL MANUAL(S) FOR THE IDENTIFICATION OF SPECIFIC PROPELLER CRITICAL PARTS.

CAUTION 2: BEFORE CLEANING THE PROPELLER, BE SURE THE PROPELLER HAS BEEN INSPECTED IN ACCORDANCE WITH THE REQUIRED PERIODIC INSPECTIONS SPECIFIED IN THIS MANUAL. CLEANING THE PROPELLER PRIOR TO INSPECTION MAY REMOVE EVIDENCE OF A CONDITION THAT REQUIRES CORRECTIVE ACTION.

CAUTION 3: DO NOT USE PRESSURE WASHING EQUIPMENT TO CLEAN THE PROPELLER OR CONTROL COMPONENTS. PRESSURE WASHING CAN FORCE WATER AND/OR CLEANING SOLVENTS PAST SEALS, AND CAN LEAD TO INTERNAL CORROSION OF PROPELLER COMPONENTS.

## A. General Cleaning

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

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

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

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

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

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

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

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

- (5) Using the tank sprayer, apply a fine mist of the soap solution to the surfaces of the downward facing blades, and the hub, bulkhead, and slip ring around the downward facing blades.
  - (a) Use a cloth or soft nylon brush to loosen dirt and unwanted material on the surfaces where the soap solution was applied, particularly on the inboard surface of the counterweight clamp.

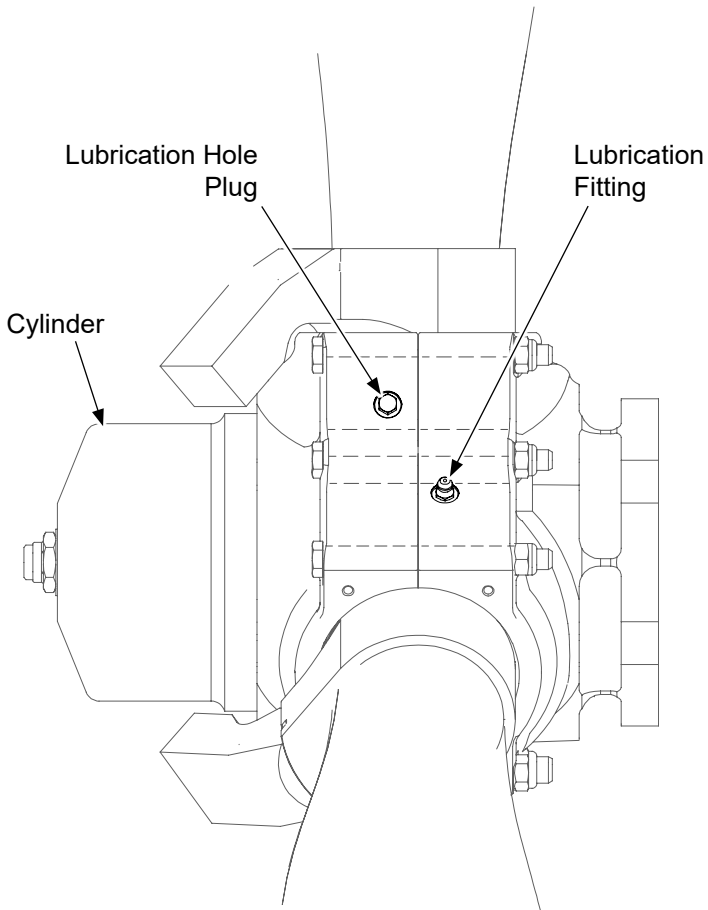
- (6) Using clean potable water at low pressure, rinse the surfaces where the soap solution was applied to remove dirt, unwanted material, and soap residue.
  - (7) Use a clean dry cloth to dry the surfaces cleaned in the previous steps.
  - (8) Rotate the propeller so that the next blade(s) to be cleaned are pointing downward, then repeat steps 5 thru 7.
    - (a) Repeat steps 5 thru 8 until all blades have been cleaned and dried.
  - (9) Let the propeller dry.
  - (10) Install the spinner dome in accordance with the Installation and Removal chapter in this manual.
- B. Spinner Cleaning and Polishing
- (1) Clean the spinner using the General Cleaning procedures in this section.
  - (2) If an aluminum spinner is dome is installed, polish the dome (if required) with an automotive-type aluminum polish.

2. Lubrication (Rev. 7)

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

A. Lubrication Intervals

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



TPH-MB-0335

**NOTE:** A tractor/pusher propeller with clockwise (standard) rotation is shown in this illustration.

**Lubrication Fittings/Hole Plugs**  
**Figure 6-1**

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

**B. Lubrication Procedure**

**WARNING 1:** FOLLOW LUBRICATION PROCEDURES CORRECTLY TO MAINTAIN ACCURATE BALANCE OF THE PROPELLER ASSEMBLY.

**WARNING 2:** PITCH CONTROL DIFFICULTY COULD RESULT IF THE PROPELLER IS NOT CORRECTLY LUBRICATED.

- (1) Remove the propeller spinner.
- (2) Each blade socket has two lubrication fittings or one lubrication fitting and one lubrication hole plug. Refer to Figure 6-1.
- (3) Remove the lubrication fitting caps from the lubrication fittings.
- (4) Remove the lubrication fittings or hole plugs as applicable.
  - (a) For all tractor or pusher propellers with clockwise (standard) rotation when viewed from BEHIND the aircraft, remove the lubrication fittings (p/n A-279 or C-6349) or lubrication hole plugs (p/n 106545) from the CYLINDER-SIDE hub half.
  - (b) For all tractor or pusher propellers with counter-clockwise (backward) rotation when viewed from BEHIND the aircraft, remove the lubrication fittings (p/n A-279 or C-6349) or lubrication hole plugs (p/n 106545) from the ENGINE-SIDE hub half.

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

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

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

- (6) A label is normally applied to the propeller to indicate the type of grease previously used. Refer to Figure 6-2.
- (a) The same grease type should be used during re-lubrication unless the propeller has been disassembled and the old grease removed.
- 1 It is not possible to purge old grease through lubrication fittings.



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

- 2 To completely replace one grease with another, the propeller must be disassembled and cleaned in accordance with the applicable overhaul manual.
- (7) If different grease types are accidentally mixed, the propeller must be disassembled and cleaned in accordance with the applicable overhaul/maintenance manual within three months or 30 flights whichever occurs first.
- (a) EXCEPTION: Aeroshell 5 and Aeroshell 6 greases both have a mineral oil base and the same thickening agent; therefore, mixing of these two greases is permitted in Hartzell propellers.

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

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

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

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

**CAUTION 4:** OVER LUBRICATING AN ALUMINUM HUB PROPELLER MAY CAUSE THE GREASE TO ENTER THE HUB CAVITY, LEADING TO EXCESSIVE VIBRATION AND/OR SLUGGISH OPERATION. THE PROPELLER MUST THEN BE DISASSEMBLED TO REMOVE THIS GREASE.

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

**NOTE:** It may be necessary to use a right angle coupler such as TE559 or equivalent, on the grease gun to access the lubrication fittings. Refer to Figure 6-3.

- (a) For all tractor or pusher propellers with clockwise (standard) rotation when viewed from BEHIND the aircraft, the lubrication fitting is in the ENGINE-SIDE hub half.
- (b) For all tractor or pusher propellers with counter-clockwise (backward) rotation when viewed from BEHIND the aircraft, the lubrication fitting is in the CYLINDER-SIDE hub half.



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**Right Angle Coupler for Grease Gun**  
**Figure 6-3**

(9) If a lubrication fitting (p/n A-279 or C-6349) was removed at the beginning of this procedure, it may be reinstalled or replaced with a lubrication hole plug (p/n 106545).

(a) Reinstall the lubrication fitting or hole plug that was removed at the beginning of this procedure.

(b) Tighten until finger-tight, then tighten one additional 360 degree turn.

(10) Make sure that the ball of each lubrication fitting is correctly seated.

(11) Reinstall a lubrication fitting cap on each lubrication fitting.

**C. Approved Lubricants**

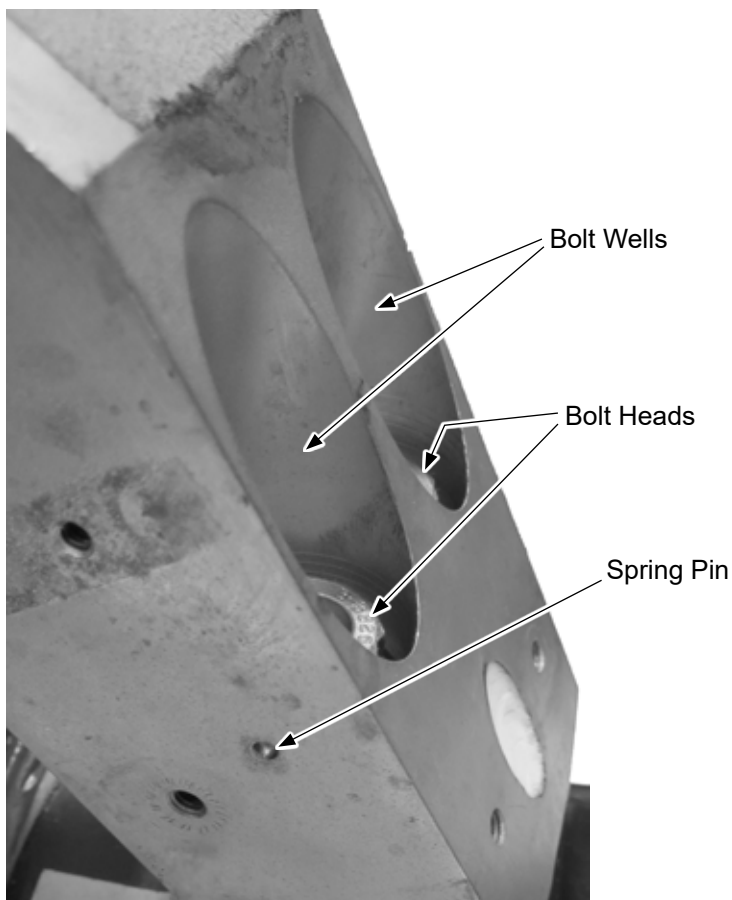
(1) For a list of lubricants approved for use in Hartzell propellers, refer to the Consumable Materials chapter of Hartzell Propeller Standard Practices Manual 202A (61-01-02).

3. Corrosion Inhibitor (Rev. 2)

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

A. Application Intervals

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



TPH-JM-000147

**Applying Corrosion Inhibitor CM352**  
**Figure 6-4**

## B. Application Procedure

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

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

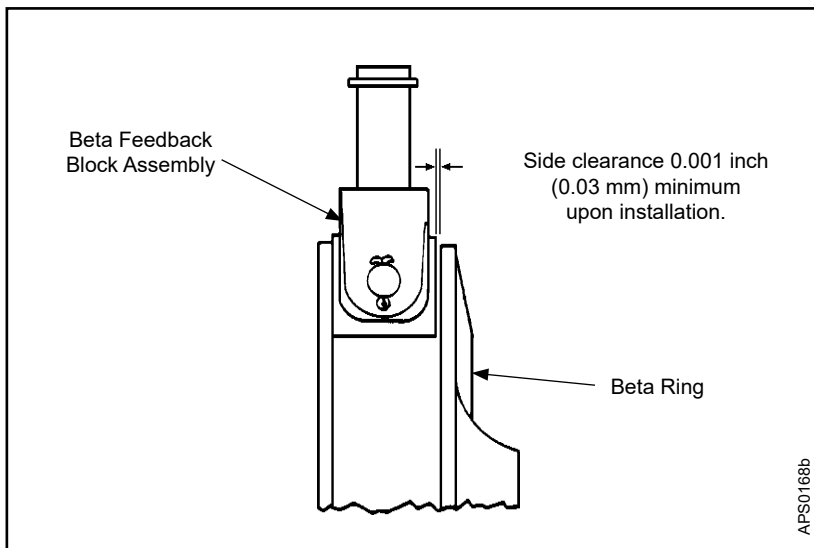
- (2) Spray the corrosion inhibitor CM352 into a cup or container, then use a soft bristled brush to apply the corrosion inhibitor CM352 to the bolt heads, spring pins, and bolt wells of the counterweight. Refer to Figure 6-4.
  - (a) Use caution when applying the corrosion inhibitor CM352 around ice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

4. Beta Feedback Block Assemblies (if applicable) (Rev. 1)

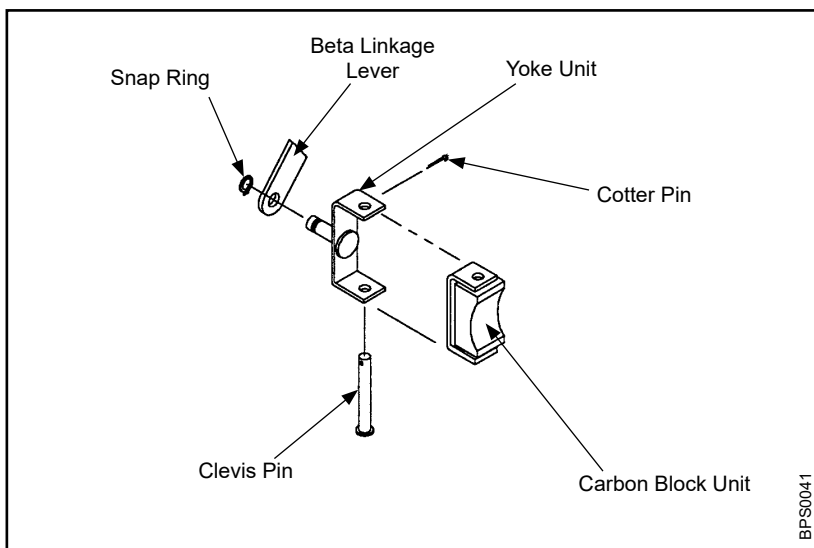
CAUTION: INSTRUCTIONS AND PROCEDURES IN THIS SECTION MAY INVOLVE PROPELLER CRITICAL PARTS. REFER TO THE INTRODUCTION CHAPTER OF THIS MANUAL FOR INFORMATION ABOUT PROPELLER CRITICAL PARTS. REFER TO THE ILLUSTRATED PARTS LIST CHAPTER OF THE APPLICABLE OVERHAUL MANUAL(S) FOR THE IDENTIFICATION OF SPECIFIC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

## A. Inspection

- (1) The clearance between the yoke pin and the corresponding linkage (beta lever bushing) can become too close due to a buildup of plating and foreign particles between the two pieces. This can cause a binding action, resulting in excessive wear to the carbon block unit, low stop collar, beta ring, and/or beta linkage.
- (2) Inspect the beta lever and beta feedback block assembly interface for free movement. If there is binding, do the following:
  - (a) Disconnect the beta linkage and remove the beta feedback block assemblies from the beta ring.
  - (b) Using an abrasive pad, lightly polish the yoke pin to provide adequate clearance and eliminate binding.
  - (c) Reinstall the beta feedback block assembly into the beta ring.
  - (d) Install, adjust and safety the beta linkage in accordance with the airframe manufacturer's instructions.



**Beta Feedback Block Assembly and Beta Ring Clearance**  
**Figure 6-5**



**Beta Feedback Block Assembly**  
**Figure 6-6**

- B. Replacement of the A-3026 Carbon Block Unit in the A-3044 Beta Feedback Block Assembly
- (1) If the side clearance between the beta ring and the beta feedback block unit exceeds 0.010 inch (0.25 mm) - refer to Figure 6-5, replace the A-3026 carbon block unit in accordance with Figure 6-6 and the following steps:
    - (a) Remove the cotter pin from the end of the clevis pin.
    - (b) Slide the pin from the assembly and remove and discard the carbon block unit.
    - (c) Inspect the yoke for wear or cracks.
      - 1 Replace the yoke, if necessary.
    - (d) Install a new carbon block unit and slide a new clevis pin into position.
    - (e) Secure the clevis pin with a T-head cotter pin.
    - (f) Refit the carbon block in accordance with Figure 6-5.
      - 1 Establish the required clearance by sanding the sides of the carbon block as needed.
- C. Installation of the A-3044 Beta Feedback Block Assembly
- (1) Refer to Installation and Removal chapter of this manual for installation instructions.

5. Composite Blades (Rev. 2)

## A. Inspection Requirements

- (1) Perform inspections (pre-flight, periodic, lightning strike, etc.) in accordance with the Inspection and Check chapter of this manual.

## B. Damage Evaluation and Repair Limits

- (1) Any defects or damage to a composite blade must be evaluated in accordance with Hartzell Propeller Composite Propeller Blade Field Maintenance and Minor Repair Manual 170 (61-13-70) to determine if repairs are required before further flight.
  - (a) Airworthy damage does not require repair before further flight, but should be repaired as soon as possible to prevent degradation of the damage.
  - (b) Unairworthy damage must be repaired before further flight.

## C. Blade Repairs

- (1) For personnel requirements and procedures for composite blade repairs, refer to Hartzell Propeller Composite Propeller Blade Field Maintenance and Minor Repair Manual 170 (61-13-70).

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

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

## A. Important Information

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

(a) Composite Blades Only:

- 1 If the area to be painted is less than 10 sq.inches (6451.6 sq. mm), blade paint touch-up is permitted.
- 2 If the area to be painted is greater than 10 sq. inches (6451.6 sq. mm), blade paint touch-up is not permitted.
  - a Areas greater than 10 sq. inches (6451.6 sq. mm) require the entire blade to be repainted by a certified propeller repair station with the appropriate rating.

(b) Aluminum Blades Only:

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

## B. Paint

- (1) The paints listed in Table 6-1 have been tested by Hartzell Propeller and are recommended for blade touch-up.
- (a) Alternate paints may be used for blade touch-up, but Hartzell Propeller accepts no responsibility for wear or adhesion-related issues.

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

(a) **Tempo Products Company**

A Plasti-kote Company

1000 Lake Road

Medina, OH 44256

Tel: 800.321.6300

Fax: 216.349.4241

Cage Code: 07708

(b) **Sherwin-Williams Company**

Refer to the Sherwin-Williams

Product Finishes Global Finishes Group website at:

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

| Vendor           | Color/Type                | Vendor P/N                     | Hartzell Propeller LLC P/N |
|------------------|---------------------------|--------------------------------|----------------------------|
| Tempo            | Epoxy Black               | A-150                          | A-6741-145-2               |
| Tempo            | Epoxy Gray                | A-151                          | A-6741-146-2               |
| Tempo            | Epoxy White (tip stripe)  | A-152                          | A-6741-147-2               |
| Tempo            | Epoxy Red (tip stripe)    | A-153                          | A-6741-149-2               |
| Tempo            | Epoxy Yellow (tip stripe) | A-154                          | A-6741-150-2               |
| Sherwin-Williams | Black                     | F75KXB9958-4311                | A-6741-145-1               |
| Sherwin-Williams | Gray                      | F75KXA10445-4311               | A-6741-146-1               |
| Sherwin-Williams | Gray Metallic             | F75KXM9754-4311                | A-6741-148-1               |
| Sherwin-Williams | White (tip stripe)        | F75KXW10309-4311               | A-6741-147-1               |
| Sherwin-Williams | Red (tip stripe)          | F75KXR12320-4311               | A-6741-149-1               |
| Sherwin-Williams | Yellow (tip stripe)       | F75KXY11841-4311               | A-6741-150-1               |
| Sherwin-Williams | Silver Metallic           | F63TXS30880-4311               | A-6741-163-1               |
| Sherwin-Williams | Silver                    | F75KXS13564-4311               | A-6741-190-1               |
| Sherwin-Williams | Bright Red                | 1326305 or<br>F63TXR16285-4311 | A-6741-200-5               |
| Sherwin-Williams | Bright Yellow             | 1326313 or<br>F63TXY16286-4311 | A-6741-201-5               |
| Sherwin-Williams | Bright Silver             | 1334259                        | A-6741-203-5               |
| Sherwin-Williams | Prop Gold                 | F63TXS17221-4311               | A-6741-204-5               |

**Touch-up Paints**

**Table 6-1**

## C. Procedure

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

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

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

(2) Permit the solvent to evaporate.

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

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

(3) Using 120 to 180 grit sandpaper, sand to feather the existing coatings away from the eroded or repaired area.

(a) Erosion damage is typically very similar on all blades in a propeller assembly. If one blade has more extensive damage, e.g. in the tip area, sand all the blades in the tip area to replicate the repair of the most severely damaged blade tip. This practice is essential in maintaining balance after refinishing.

(4) Using acetone, #700 lacquer thinner, or MEK, wipe the surface of the blade.

- (5) Permit the solvent to evaporate.
- (6) Aluminum Blades Only:
  - (a) Apply an approved corrosion preventative coating to the bare aluminum surface of the blade in accordance with the manufacturer's instructions.
    - 1 Oakite 31, Chromicote L-25, or Alodine 1201 are approved chemical conversion coatings.
- (7) Apply masking material to the erosion shield, anti-icing or de-ice boot, and tip stripes, as needed.

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

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

- (8) Apply a sufficient amount of finish coating to achieve 2 to 4 mils thickness when dry.
  - (a) Re-coat before 30 minutes, or after 48 hours.
  - (b) If the paint is permitted to dry longer than four hours, it must be lightly sanded before another coat is applied.
- (9) Remove masking material from the tip stripes and re-apply masking material for the tip stripe refinishing if required.
- (10) Apply sufficient tip stripe coating to achieve 2 to 4 mils thickness when dry.
  - (a) Re-coat before 30 minutes, or after 48 hours.
  - (b) If the paint is permitted to dry longer than four hours, it must be lightly sanded before another coat is applied.

- (11) Remove the masking material immediately from the anti-icing or de-ice boot and tip stripes, if applicable.
- (12) Optionally, perform dynamic balancing in accordance with the procedures and limitations specified in the Dynamic Balance section of this chapter.

## 7. Dynamic Balance

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

### A. Overview

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

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

**NOTE:** Some engine manufacturers' instructions also contain information about dynamic balance limits.

**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 examine each propeller blade assembly for evidence of grease leakage.
  - (c) Visually examine the inner surface of the spinner dome for evidence of grease leakage.
- (2) If there is no evidence of grease leakage, lubricate the propeller in accordance with the Maintenance Practices chapter in this manual. If grease leakage is evident, determine the location of the leak and correct before re-lubricating the propeller and dynamic balancing.
- (3) Before dynamic balancing, record the number and location of all balance weights.
- (4) Static balance is accomplished at an appropriately rated propeller repair station that is certified by the Federal Aviation Administration (FAA) or international equivalent 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 it may not be possible to achieve dynamic balance.

C. Modifying Spinner Bulkhead to Accommodate Dynamic Balance Weights

**CAUTION 1:** DO NOT MODIFY A COMPOSITE SPINNER BULKHEAD TO ACCOMMODATE DYNAMIC BALANCE WEIGHTS.

**CAUTION 2:** ALL HOLE/BALANCE WEIGHT LOCATIONS MUST TAKE INTO CONSIDERATION AND MUST AVOID, ANY POSSIBILITY OF INTERFERING WITH THE ADJACENT AIRFRAME, ICE PROTECTION SYSTEM, AND ENGINE COMPONENTS.

- (1) It is recommended that the placement of balance weights be in a radial location on the aluminum spinner bulkheads that have not been previously drilled.
- (2) The radial location should be outboard of the de-ice slip ring or bulkhead doubler and inboard of the bend where the bulkhead creates the flange surface to attach the spinner dome.
- (3) Equally spaced locations for weight attachment are recommended.
- (4) Installing nut plates (10-32 thread) of the type used to attach the spinner dome will permit convenient balance weight attachment on the engine side of the bulkhead.
- (5) Alternatively, drilling holes for use with the AN3-( ) type bolts with self-locking nuts is permitted.
- (6) Chadwick-Helmuth Manual AW-9511-2, "The Smooth Propeller", specifies several generic bulkhead rework procedures. These are permitted if they comply with the conditions specified herein.

## D. Placement of Balance Weights for Dynamic Balance

- (1) The preferred method of attachment of dynamic balance weights is to add the weights to the spinner bulkhead.

NOTE: Many spinner bulkheads have factory installed self-locking nut plates provided for this purpose.

- (2) If the location of static balance weights has not been altered, subsequent removal of the dynamic balance weights will return the propeller to its original static balance condition.
- (3) Use only stainless or plated steel washers as dynamic balance weights on the spinner bulkhead.
- (4) A maximum of six AN970 style washers weighing up to approximately 1.0 oz (28.0 g) maybe installed at any one location.

NOTE: The dimensions of an AN970 washer are: ID 0.203 inch (5.16 mm), OD 0.875 inch (22.23 mm), and thickness 0.063 inch (1.59 mm).

- (5) Install weights using aircraft quality #10-32 or AN-3( ) type screws or bolts.
- (6) Torque the screws or bolts in accordance with Torque Table 3-2.
- (7) Balance weight screws attached to the spinner bulkhead must protrude through the self-locking nuts or nut plates a minimum of one thread and a maximum of four threads.
  - (a) Make sure that the screw or bolt grip length is short enough to prevent interference with the nut or nut plate when the correct torque is applied.
  - (b) It may be necessary to alter the number and/or location of static balance weights in order to achieve dynamic balance.

- (8) Unless otherwise specified by the engine or airframe manufacturer, Hartzell Propeller recommends that the propeller be dynamically balanced to a reading of 0.2 IPS, or less.
- (9) 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.

8. Hydraulic Low Pitch Stop Setting (Rev. 2)

A. Hydraulic Low Pitch Stop Adjustment

- (1) The hydraulic low pitch stop is normally set by Hartzell Propeller LLC in accordance with the aircraft manufacturer's requirements, and should not require any additional adjustment.
  - (a) Adjustments may be required after maintenance or because of aircraft variances.
    - 1 Adjustments must be done in accordance with the specifications found in the airframe manufacturer's manual.

9. Feathering Pitch Stop Settings (Rev. 2)

A. Feathering Pitch Stop Adjustment

- (1) The feathering pitch stop is set by Hartzell Propeller LLC in accordance with the aircraft manufacturer's recommendations.
- (2) The feathering pitch stop can only be adjusted by Hartzell or by a certified propeller repair station with the appropriate rating.

10. Reverse Pitch Stop Settings (Rev. 2)

A. Reverse Pitch Stop Adjustment

- (1) The reverse pitch stop is set by Hartzell Propeller LLC in accordance with the aircraft manufacturer's recommendations.
- (2) The reverse pitch stop can only be adjusted by Hartzell or by a certified propeller repair station with the appropriate rating.

11. Start Lock Settings (Rev. 2)

## A. Start Lock Adjustment

- (1) The start locks are set by Hartzell Propeller LLC in accordance with the aircraft manufacturer's recommendations.
- (2) The start locks can only be adjusted by Hartzell or by a certified propeller repair station with the appropriate rating.

12. Erosion Tape on Composite Blades (Rev. 2)

## A. General

- (1) Some composite blades require erosion tape on the leading edge if there is no de-ice/anti-ice boot installed.
- (2) Refer to the Minor Repair chapter of Hartzell Propeller Composite Blade Field Maintenance and Minor Repair Manual 170 (61-13-70) for the following information:
  - (a) Composite blade models that require erosion tape if no de-ice/anti-ice boot is installed
  - (b) Erosion tape installation instructions

13. Propeller Ice Protection Systems (Rev. 1)

## A. Maintenance Information

- (1) Refer to the Anti-ice and De-ice Systems chapter of this manual for ice protection system maintenance information.

14. Tachometer Calibration (Rev. 2)

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

A. Important Information

- (1) All engine/propeller combinations have operating conditions at which the propeller blade stresses begin to reach design limits.
  - (a) In most cases, these conditions occur above the maximum rated RPM of the engine.
  - (b) Some engine/propeller combinations have certain ranges of RPM that are less than maximum engine speed, where stresses are at a level considered too high for continuous operation. This results in a restricted operating range where continuous operation is not permitted. A placard on the instrument panel or yellow arc on the tachometer will inform the pilot to avoid operation in this range.
  - (c) In other cases, the limiting condition occurs at an RPM only slightly above the maximum engine RPM.
  - (d) For these reasons, it is very important to accurately monitor engine speed.

- (2) The accuracy of the tachometer is critical to the safe operation of the aircraft.
  - (a) Some tachometers have been found to be in error by as much as 200 RPM.
  - (b) Operating the aircraft with an inaccurate tachometer could cause continued operation at unacceptably high stresses, including repeatedly exceeding the maximum engine RPM.
  - (c) Continuous operation in a restricted RPM range subjects the propeller to stresses that are higher than the design limits.
  - (d) Stresses that are higher than the design limits will shorten the life of the propeller and could cause a catastrophic failure.

#### B. Tachometer Calibration

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

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

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| A. De-ice and Anti-ice Systems .....     | 7-6 |

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1. Anti-ice System Description (Rev. 1)

**WARNING:** CONSULT THE PILOT OPERATING HANDBOOK (INCLUDING ALL SUPPLEMENTS) REGARDING FLIGHT INTO CONDITIONS OF KNOWN ICING. THE AIRCRAFT MAY NOT BE CERTIFICATED FOR FLIGHT INTO KNOWN ICING CONDITIONS, EVEN THOUGH AN ICE PROTECTION SYSTEM IS INSTALLED.

**NOTE:** There are many configurations of anti-ice systems. This section provides a general overview of system operation. Consult the airframe manufacturer's manual for a description of your specific anti-ice system and controls.

## A. Overview of an Anti-ice System

(1) A propeller anti-ice system prevents formation of ice on the propeller blades. The system dispenses a liquid (usually isopropyl alcohol) onto the propeller blades. This liquid mixes with moisture on the blades and lowers the freezing point of the water, allowing the water/alcohol mixture to flow off of the blades before ice forms.

(a) Anti-ice systems must be in use before ice forms. This system is not effective for removing ice after it has formed.

## B. Components of an Anti-ice System

(1) A typical anti-ice system includes the following components:

(a) Fluid tank, pump, slinger ring, blade mounted anti-icing boots, and fluid dispensing tubes located at each blade mounted anti-icing boot

## C. Anti-ice System Operation

- (1) The anti-ice system is typically controlled by the pilot using a cockpit mounted rheostat. The rheostat controls the pump and the flow of anti-ice fluid from the fluid tank.
- (2) The anti-ice fluid is pumped through airframe mounted distribution tubing and into a rotating slinger ring that is mounted on the rear of the propeller hub.
- (3) From the slinger ring, centrifugal force pushes the anti-icing fluid through the fluid dispensing tubes onto the blade mounted anti-icing boots.
- (4) The anti-icing boots evenly distribute the fluid along the leading edge of the propeller blade to prevent ice from forming.

2. De-ice System Description (Rev. 1)

**WARNING:** CONSULT THE PILOT OPERATING HANDBOOK (INCLUDING ALL SUPPLEMENTS) REGARDING FLIGHT INTO CONDITIONS OF KNOWN ICING. THE AIRCRAFT MAY NOT BE CERTIFICATED FOR FLIGHT INTO KNOWN ICING CONDITIONS, EVEN THOUGH AN ICE PROTECTION SYSTEM IS INSTALLED.

**NOTE:** There are many configurations of de-ice systems. This section provides a general overview of system operation. Consult the airframe manufacturer's manual for a description of your specific de-ice system and controls.

## A. Overview of a De-ice System

- (1) A propeller de-ice system removes ice after it forms on the propeller blades. The system uses electrical heating elements to melt the ice layer next to the blade permitting the ice to be thrown from the blade by centrifugal force.

## B. Components of a De-ice System

- (1) A typical de-ice system includes the following components:
  - (a) ON/OFF switch(es), ammeter, timer or cycling unit, slip ring, brush blocks, and blade mounted de-ice boots

### C. De-ice System Operation

- (1) The de-ice system is controlled by the pilot using a cockpit control switch. When this switch is ON, electrical power is supplied to the de-ice system.
  - (a) Some systems may have additional controls to adjust for different icing conditions.
    - 1 A mode selector switch lets the pilot set the cycling speed for heavy or light icing conditions.
    - 2 For twin engine aircraft, a full de-ice mode switch lets the pilot de-ice both propellers simultaneously. This switch is used when ice builds up on the propeller before the system is turned on and may only be used for short periods.
- (2) The ammeter indicates current draw by the system. It is typically located near the de-ice system switches. The ammeter may indicate total system load, or in twin engine aircraft, a separate ammeter may be supplied for each propeller.
- (3) The timer or cycling unit is controlled by the pilot using a cockpit control switch. When the timer/cycling unit is ON, power is applied to each de-ice boot (or boot segment) in a sequential order for a preset amount of time. This heating interval evenly de-ices the propeller.
- (4) The brush block supplies electrical current to the de-ice boot on each propeller blade via a slip ring. The brush block is typically mounted on the engine just aft of the propeller. The slip ring rotates with the propeller and is typically mounted on the spinner bulkhead.
- (5) The de-ice boots contain internal heating elements that melt the ice layer from the blades when electrical current is applied. De-ice boots are attached to the leading edge of each blade using adhesive.

3. Operational Checks (Rev. 2)

A. De-ice and Anti-ice Systems

- (1) Perform the applicable Operational Check procedure(s) in accordance with the Check chapter in Hartzell Propeller Ice Protection System Manual 180 (30-61-80) and/or the Aircraft Maintenance Manual.

4. Troubleshooting (Rev. 2)

A. De-ice and Anti-ice Systems

- (1) Refer to the applicable chapter(s) in Hartzell Propeller Ice Protection System Manual 180 (30-61-80) to troubleshoot malfunctions in Hartzell de-ice and anti-ice systems.
  - (a) Part numbers for components used in Hartzell de-ice and anti-ice systems are found in Hartzell Propeller Ice Protection System Manual 180 (30-61-80).

5. Periodic Inspections (Rev. 2)

A. De-ice and Anti-ice Systems

- (1) Refer to the Check chapter in Hartzell Propeller Ice Protection System Manual 180 (30-61-80) for detailed information about inspection intervals and procedures.

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1. Record Keeping (Rev. 2)

A. General

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

B. Information to be Recorded

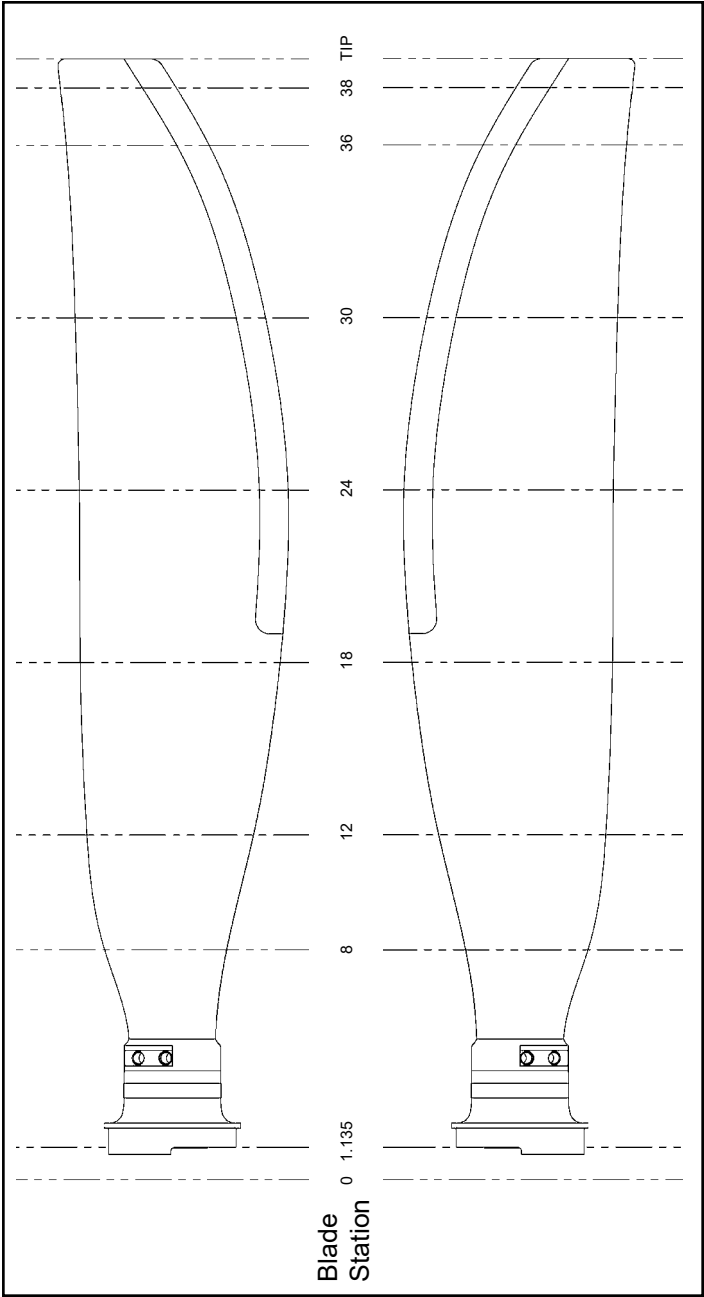
- (1) Refer to Title 14 Code of Federal Regulations (CFR) Part 43 for a list of information that must be recorded.
- (2) The log book may also be used to record:
  - (a) Propeller position (on aircraft)
  - (b) Propeller model
  - (c) Propeller serial number
  - (d) Blade design number
  - (e) Blade serial numbers
  - (f) Spinner assembly part number
  - (g) Propeller pitch range
  - (h) Aircraft information (aircraft type, model, serial number and registration number)

C. Blade Damage Repair Sheets

NOTE: The use of the Blade Damage Repair Sheets in this chapter is at the discretion of the user.

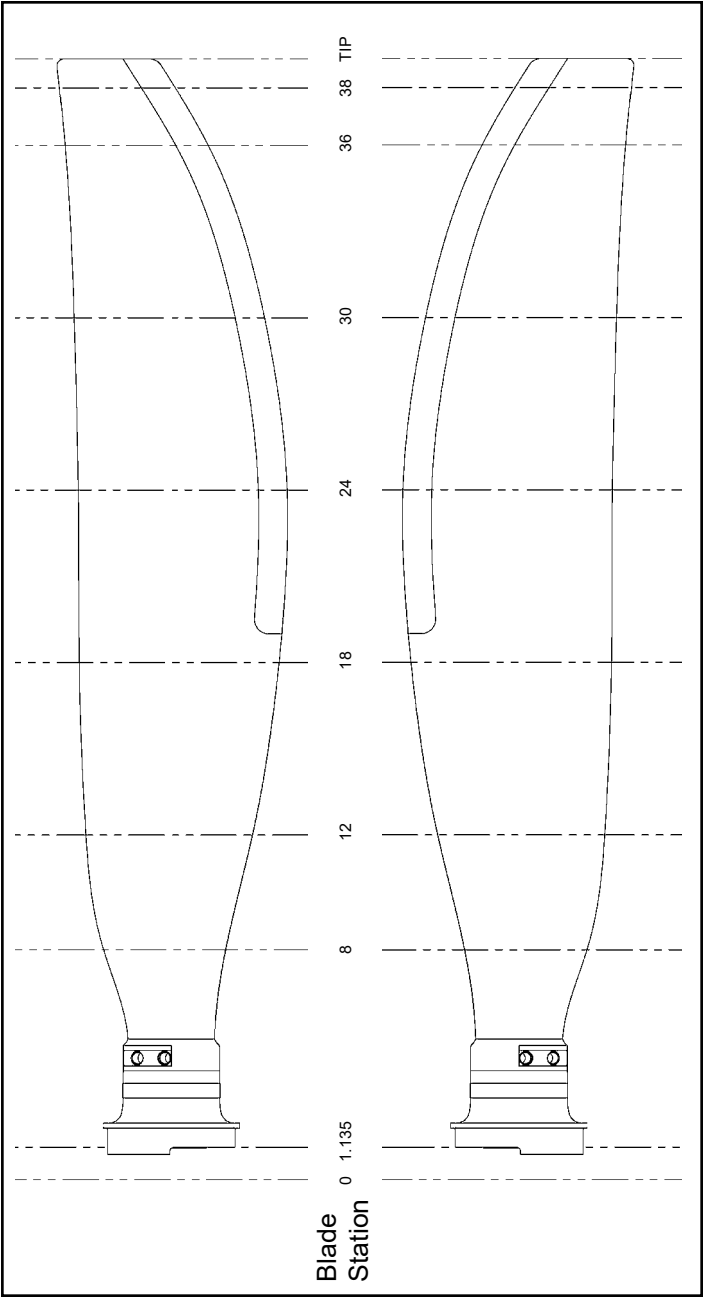
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Blade Serial No. \_\_\_\_\_



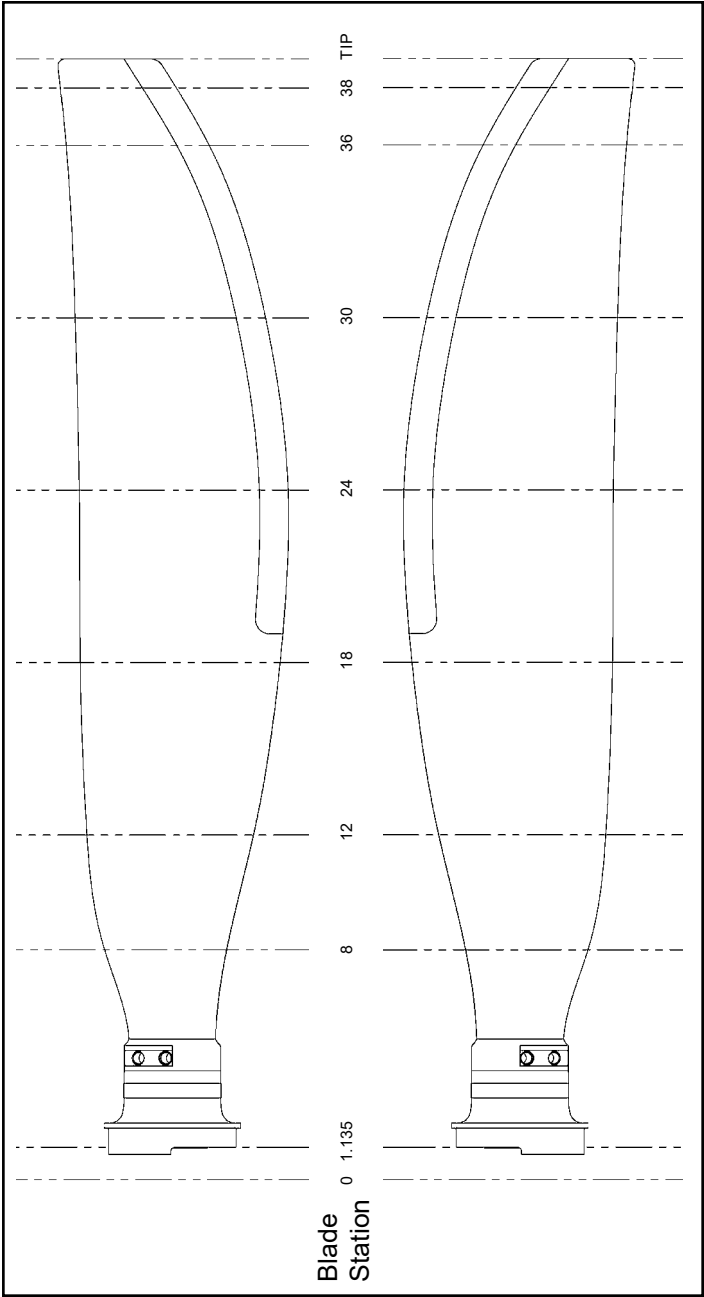
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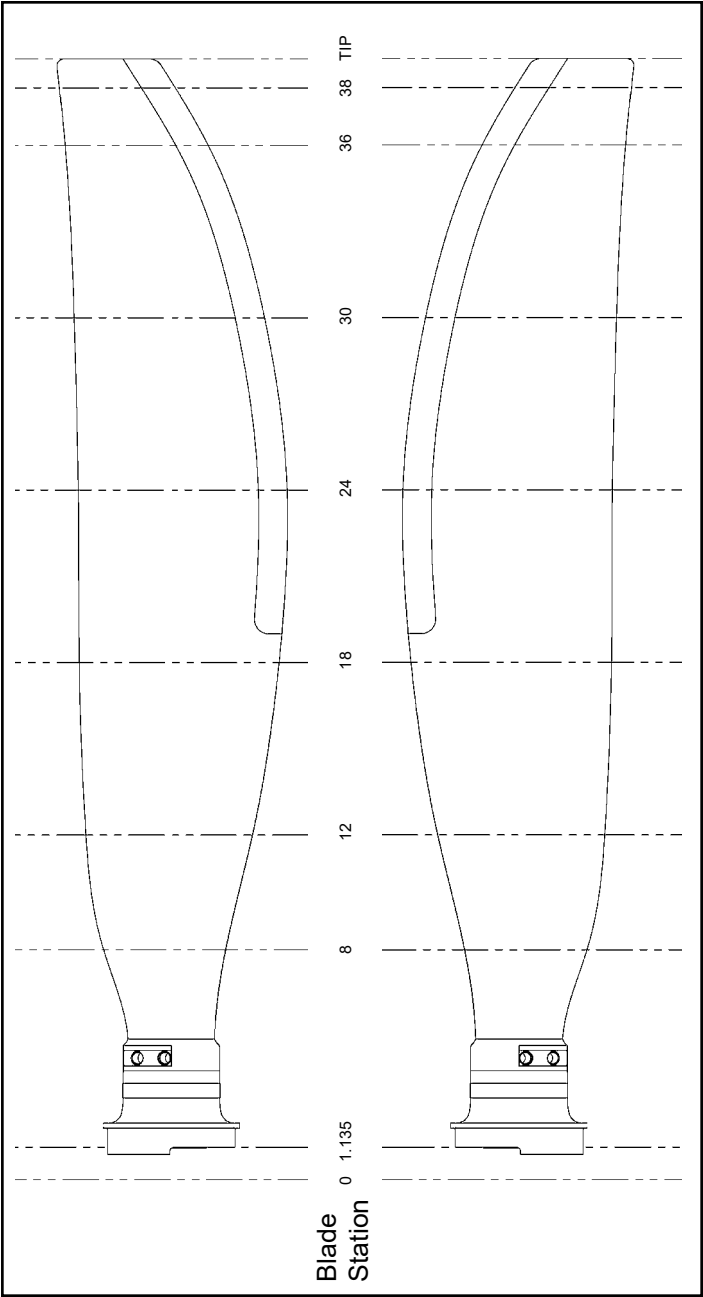
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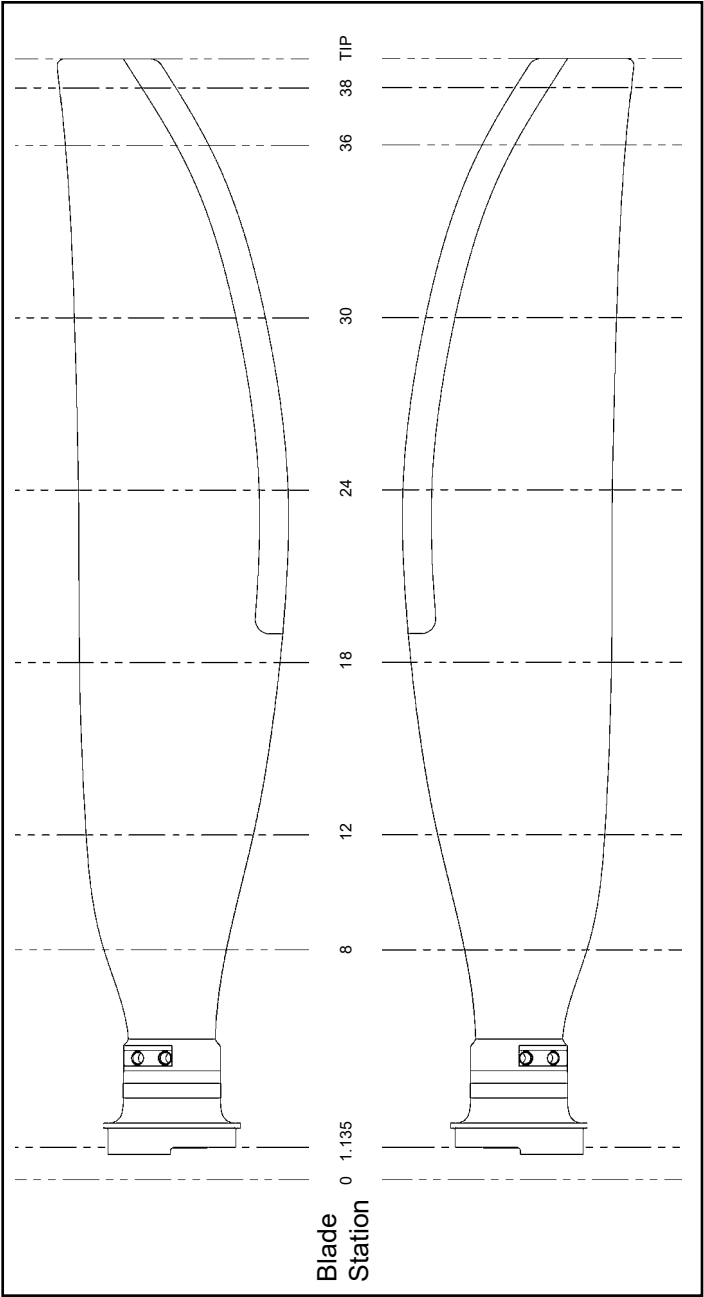
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Record of 78D01( ) Composite Blade Damage Repair

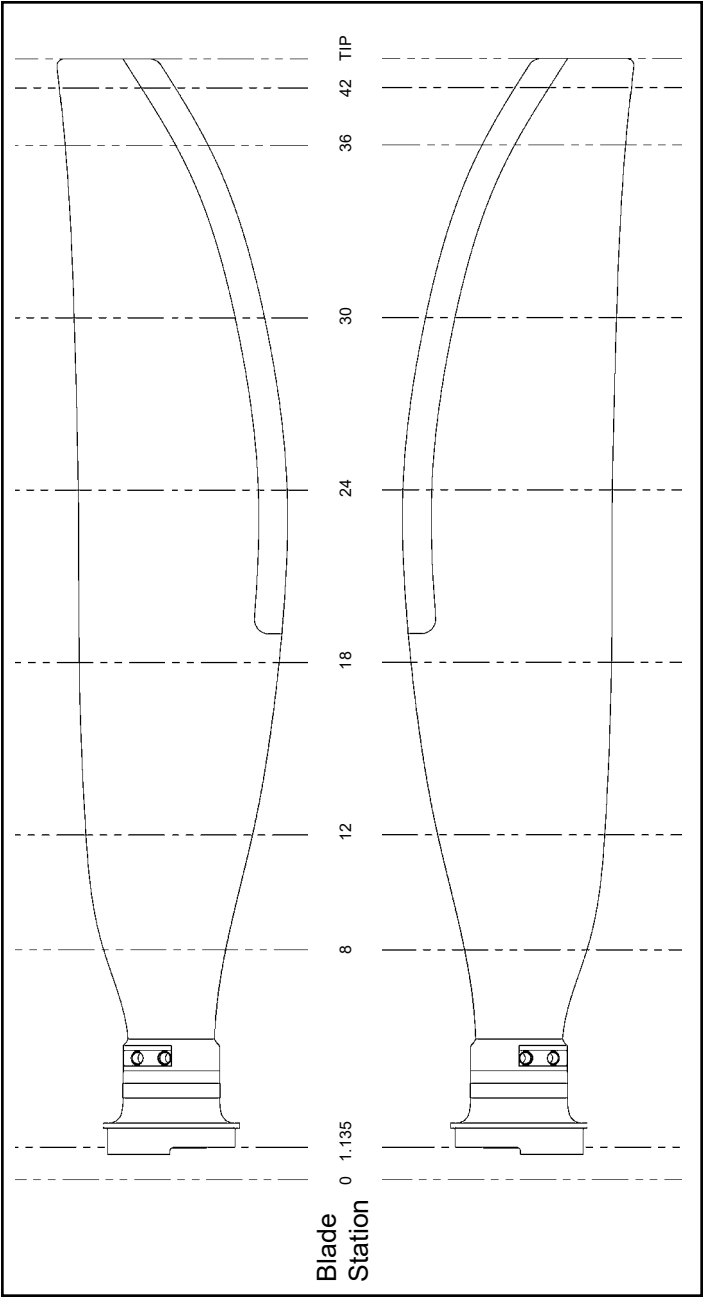
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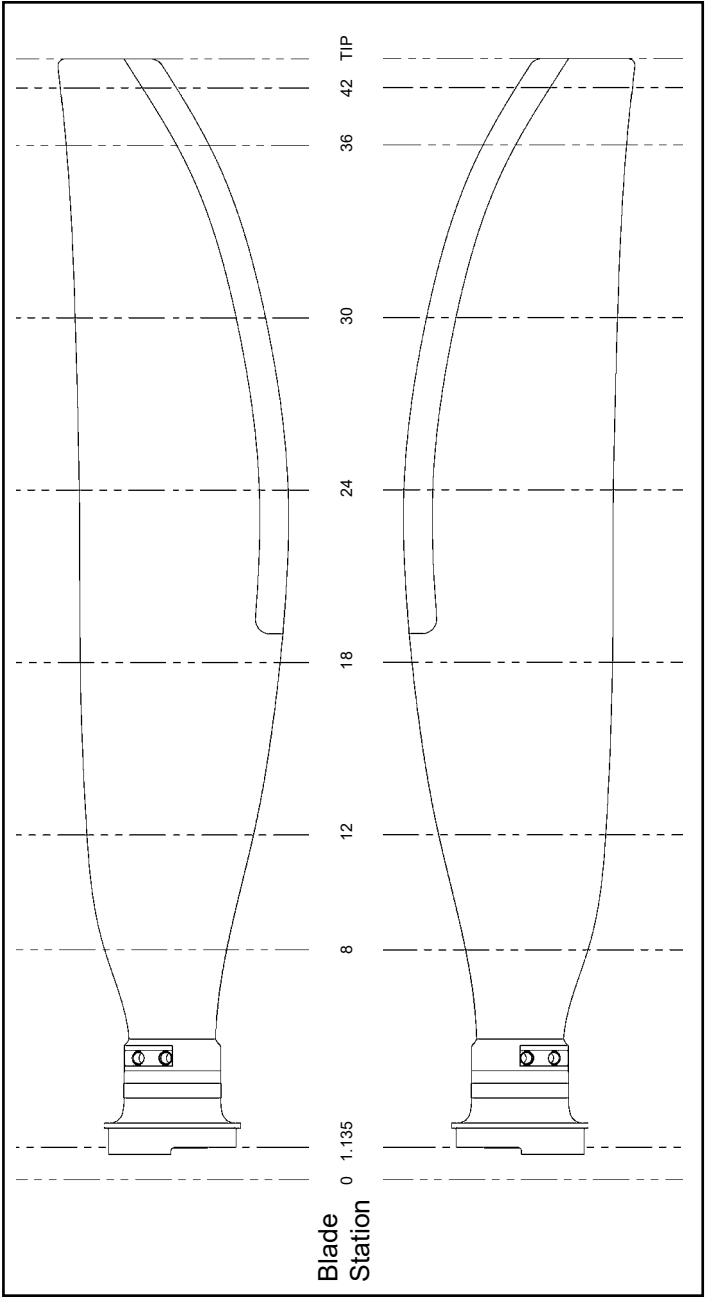
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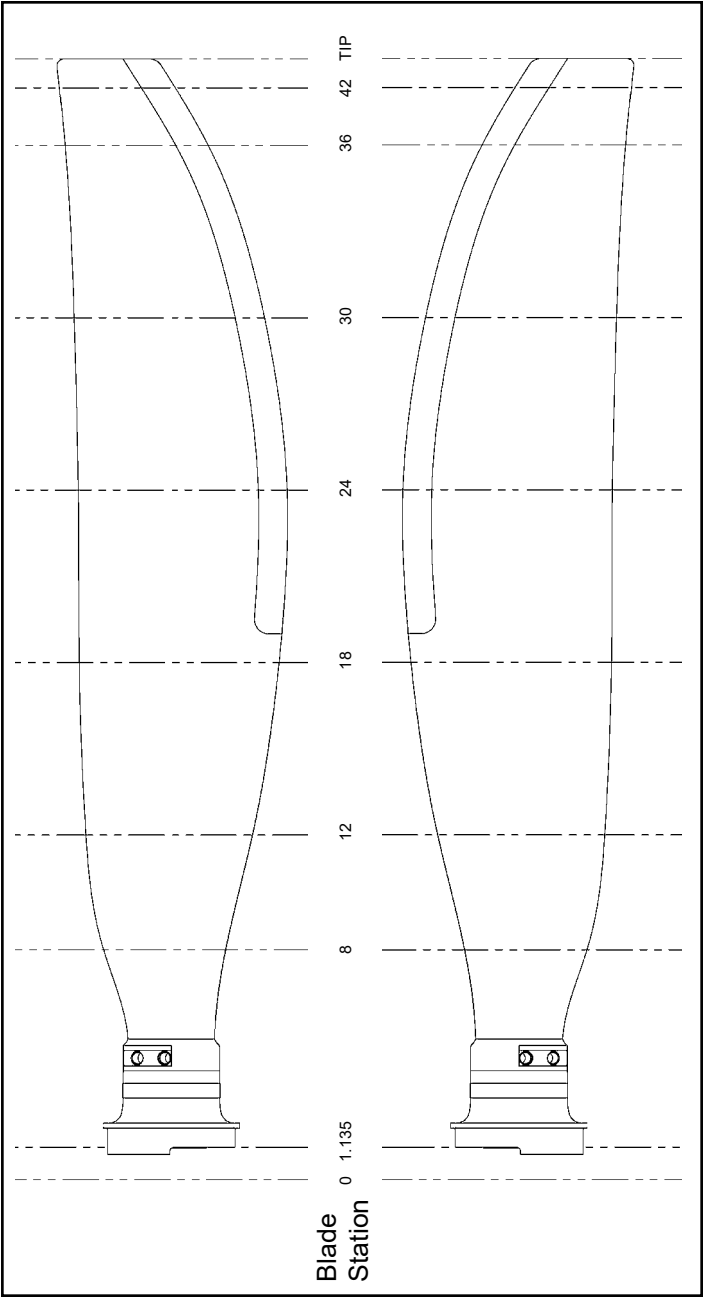
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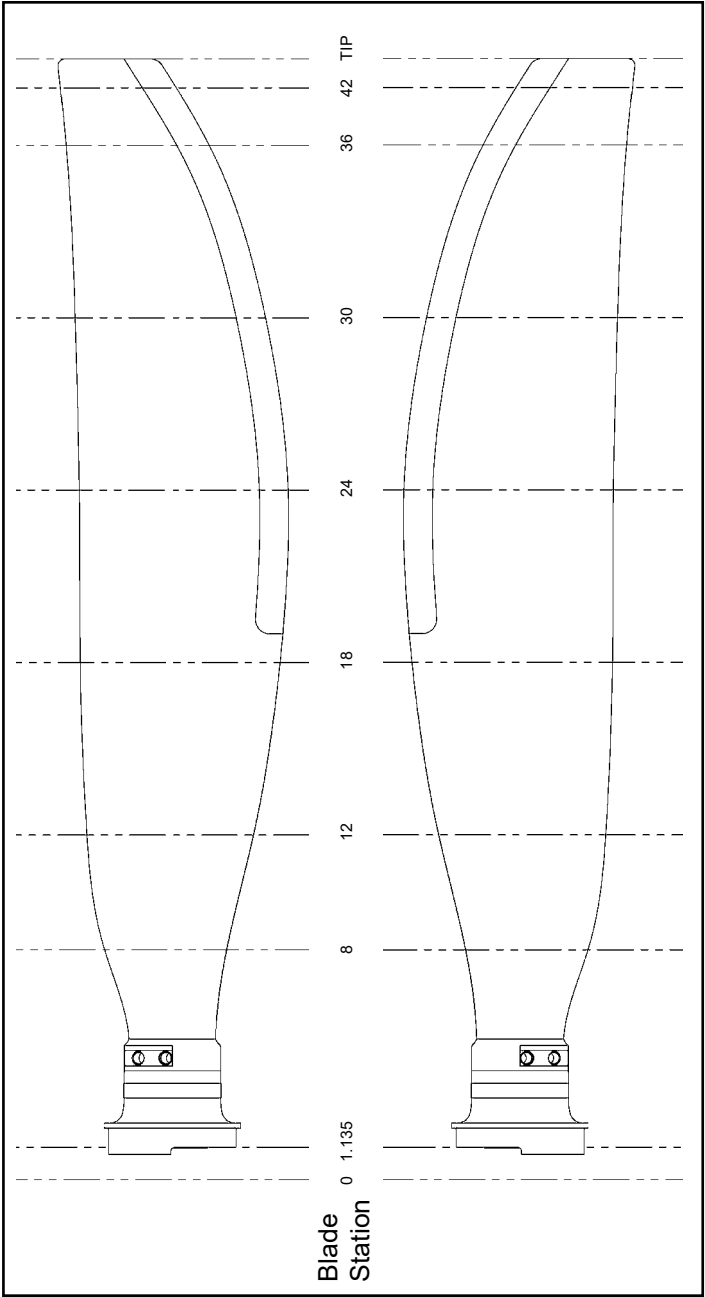
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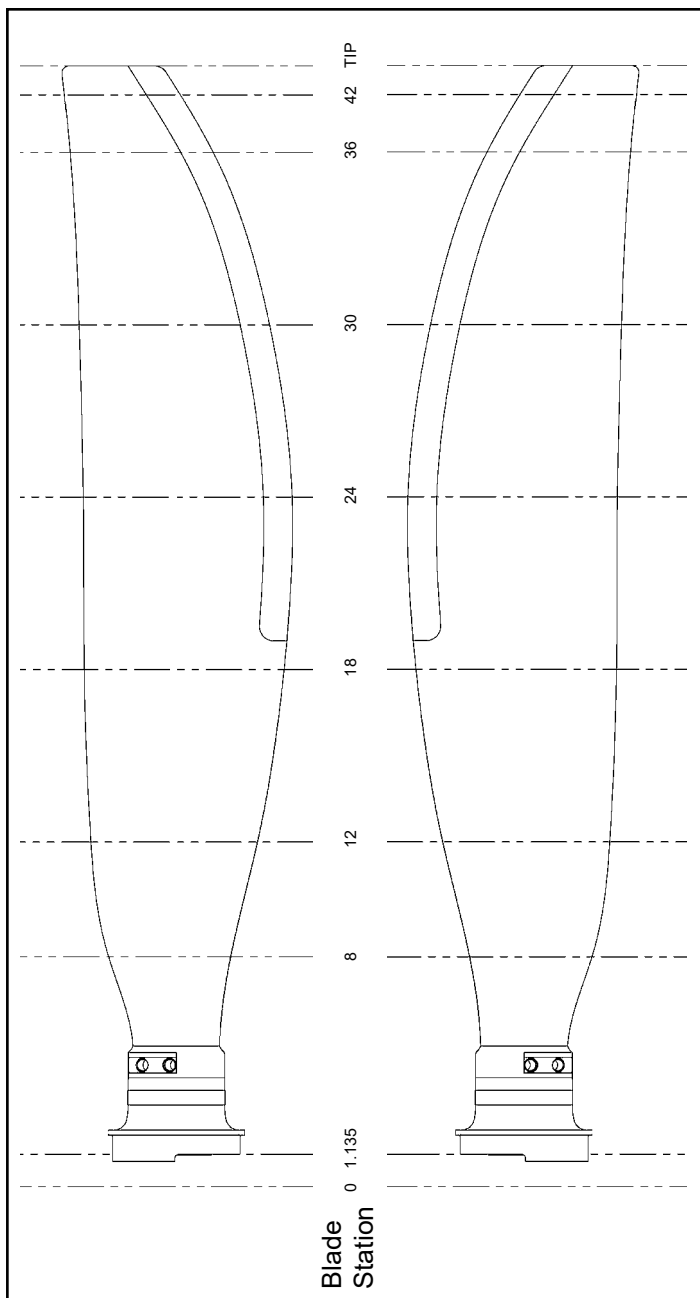


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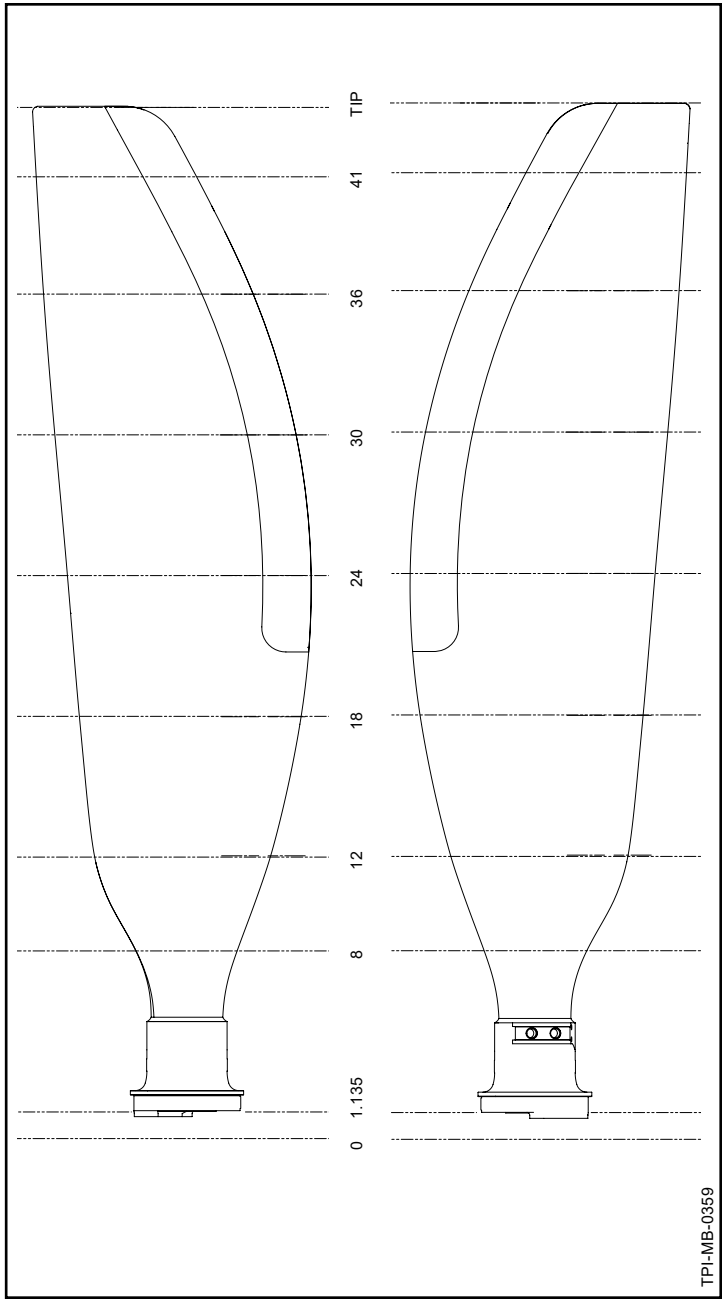
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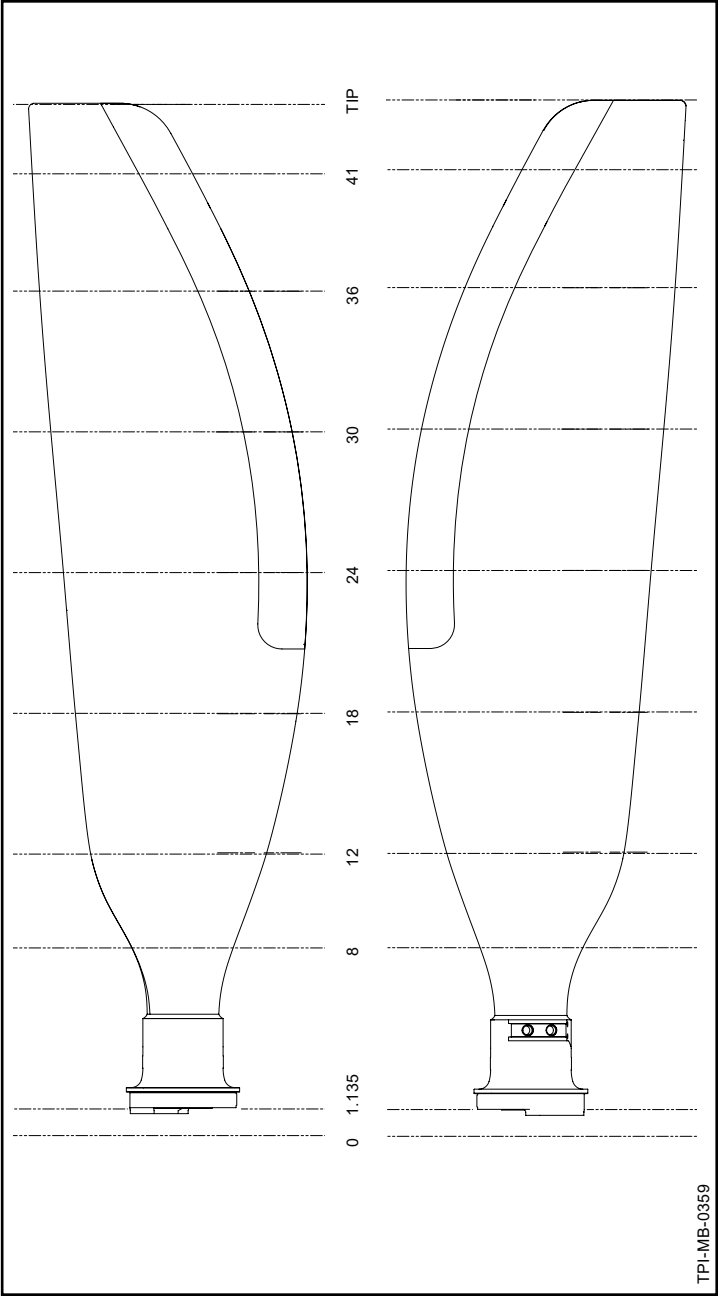
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The diagram shows a side view of a composite propeller blade. A vertical grid of dashed lines is overlaid on the blade, with numerical labels on the right side: 0, 1.135, 8, 12, 18, 24, 30, 36, 41, and TIP. The blade has a curved airfoil shape. At the base (root) of the blade, there is a detailed drawing of the mounting bracket and hardware, including a nut and washer. The entire diagram is enclosed in a rectangular border.

TPL-MB-0359

Record of 86DB01( ) Composite Blade Damage Repair

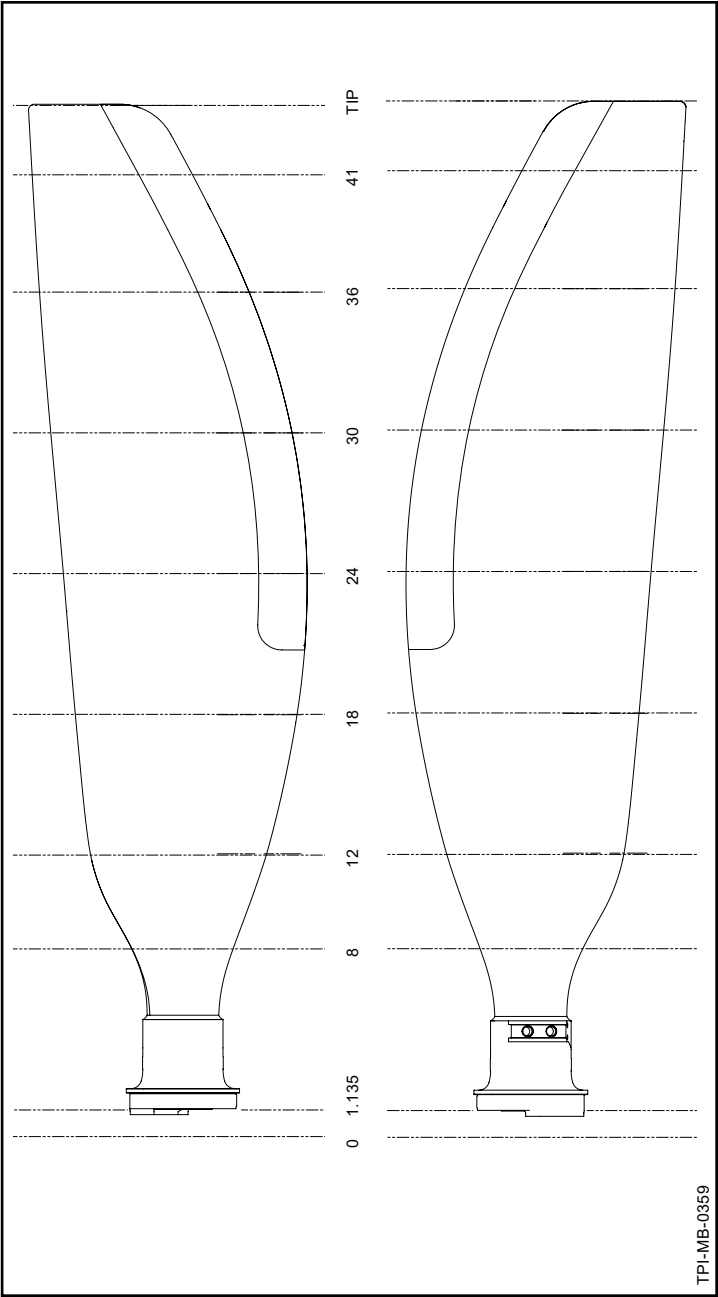
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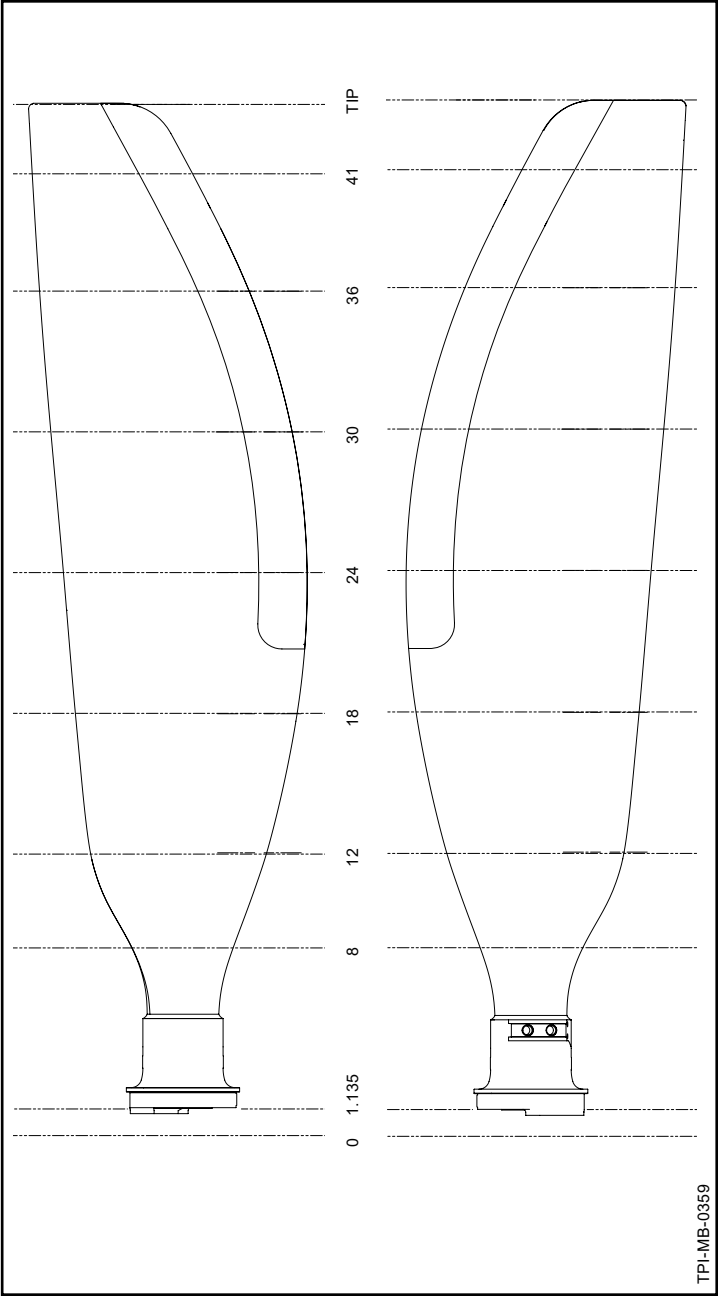
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Record of 86DB01( ) Composite Blade Damage Repair

Blade Serial No. \_\_\_\_\_



TPL-MB-0359

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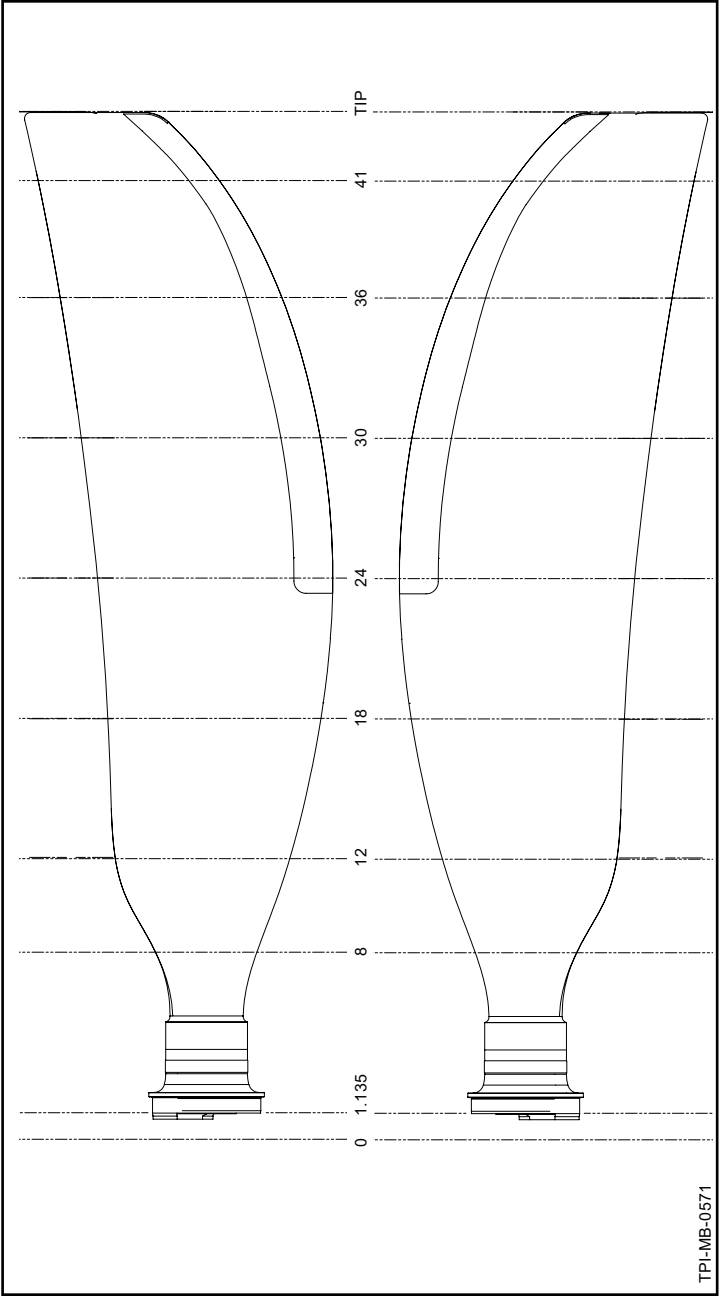
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Diagram of a propeller blade with a grid for recording damage repair. The blade is shown from the hub to the tip. The grid has vertical lines labeled 0, 1.135, 8, 12, 18, 24, 30, 36, 41, and TIP. The blade is divided into two halves by a vertical line at the 12 mark. The left half is labeled '0' and the right half is labeled '1.135'.

TPI-MB-0571

Record of 84DB26( ) Composite Blade Damage Repair

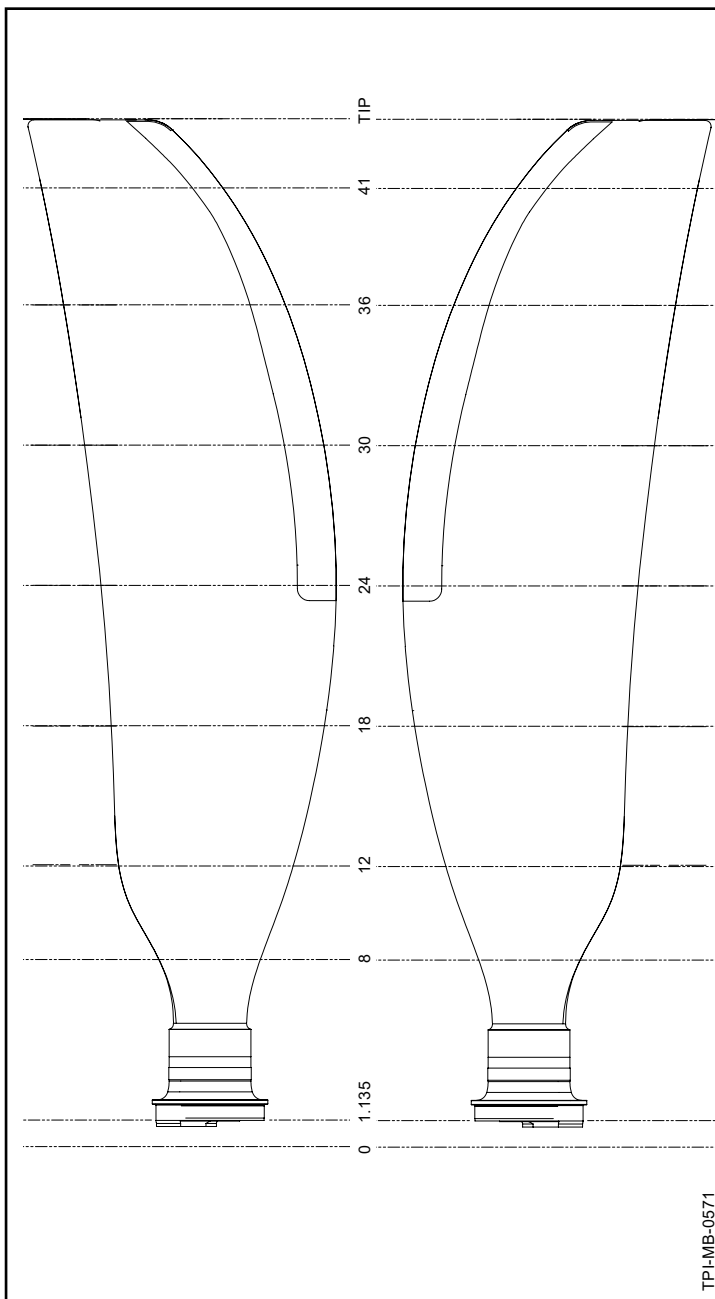
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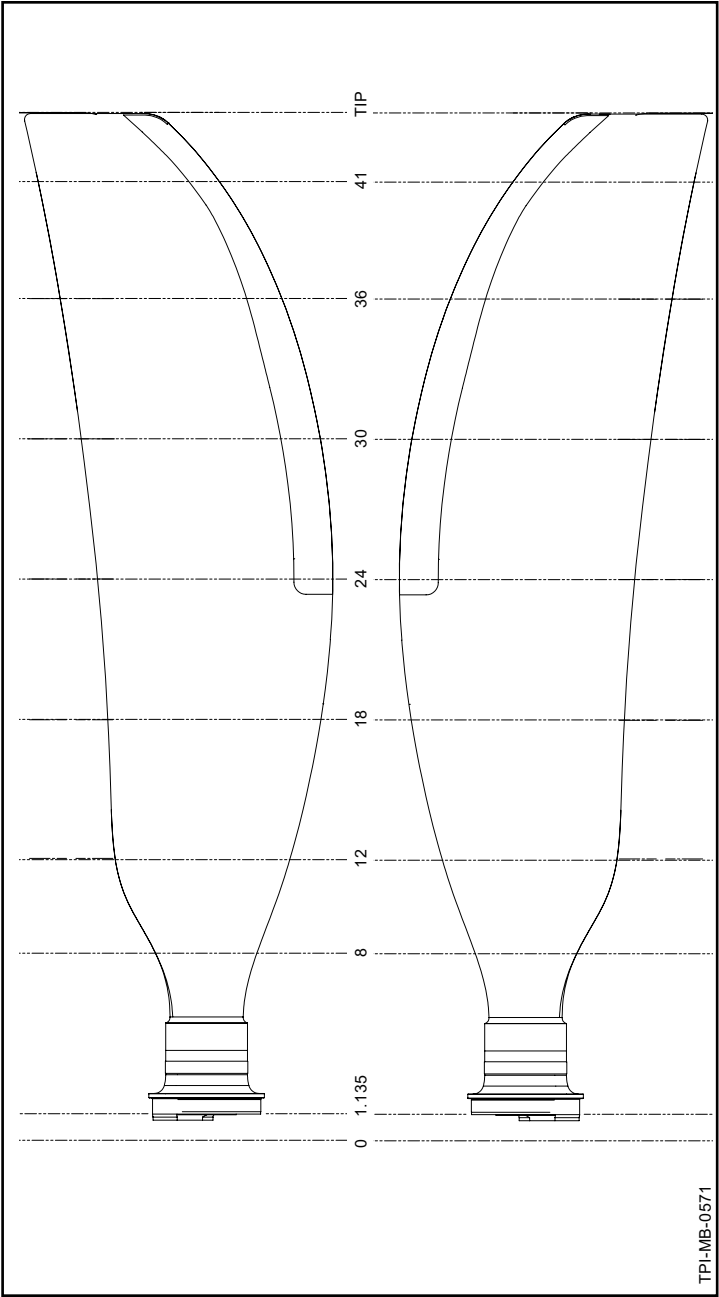
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Record of 84DB26( ) Composite Blade Damage Repair

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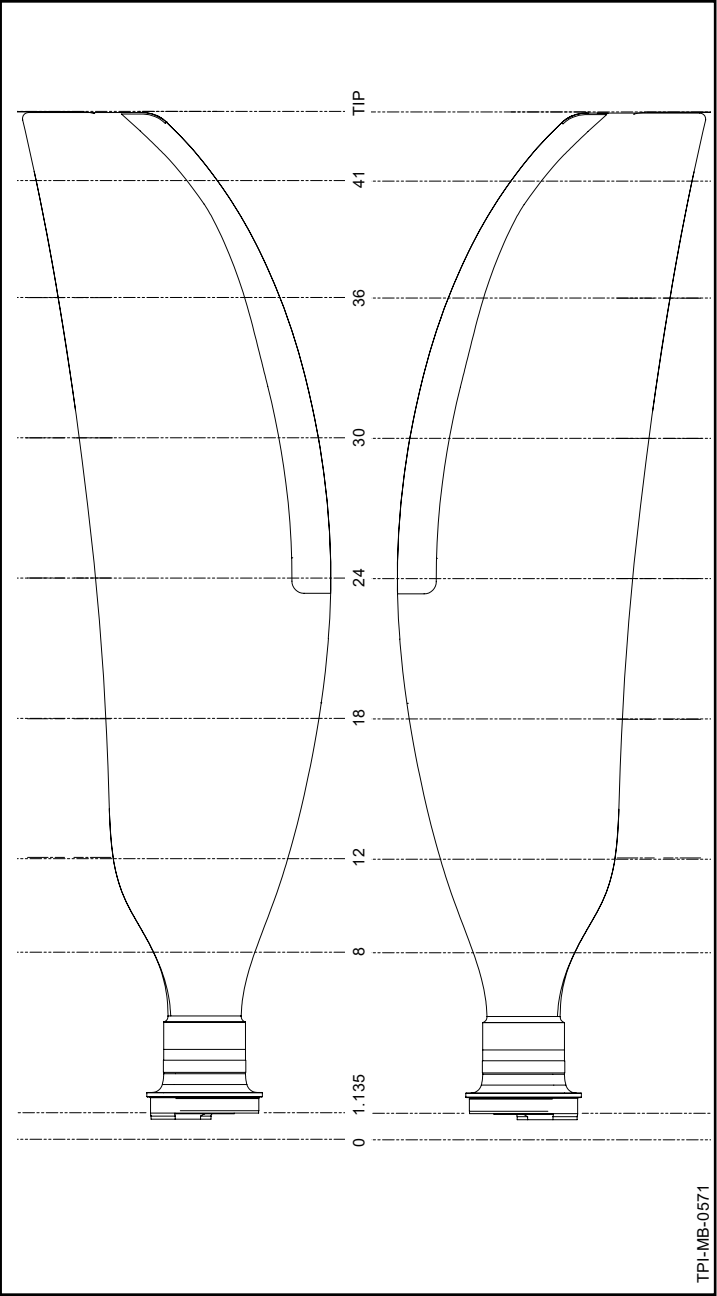
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Diagram of a propeller blade with a grid for recording damage. The blade is shown from the hub to the tip. The grid has vertical lines labeled 0, 1.135, 8, 12, 18, 24, 30, 36, 41, and TIP. The blade is divided into two halves by a vertical line at the center. The left half is labeled '1.135' and the right half is labeled 'TIP'.

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Record of 84DB26( ) Composite Blade Damage Repair

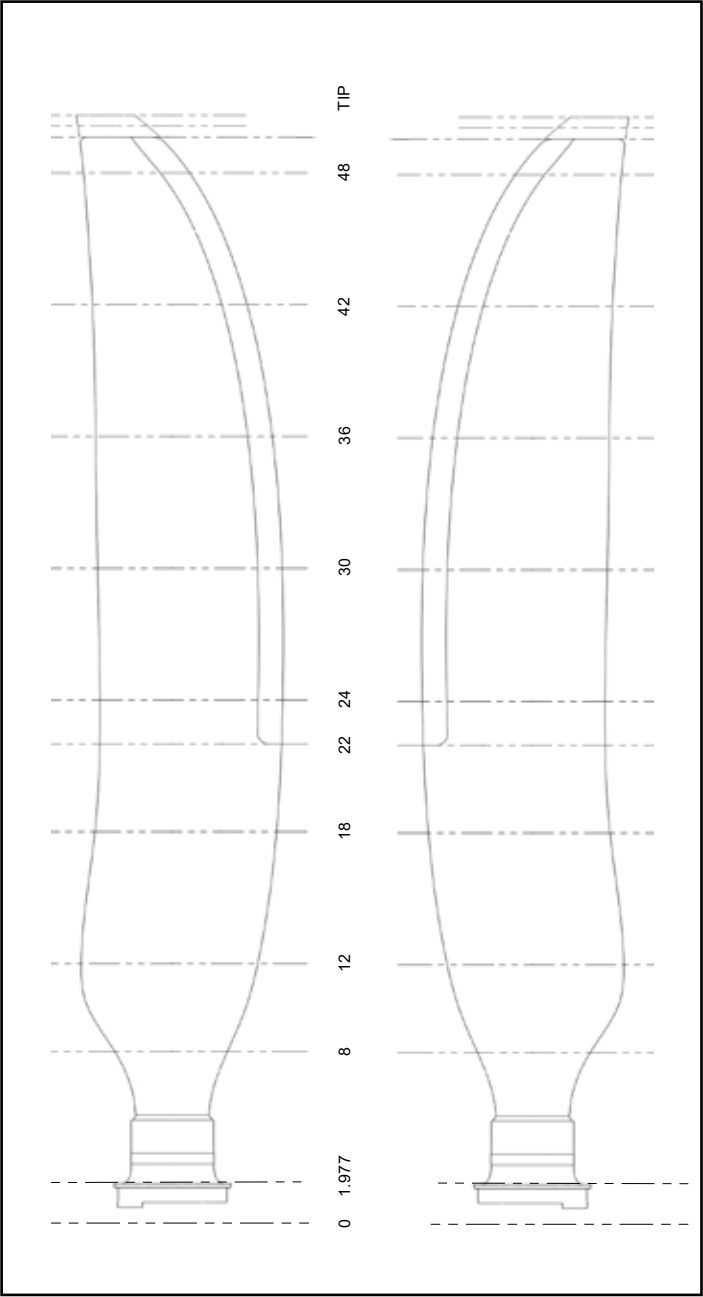
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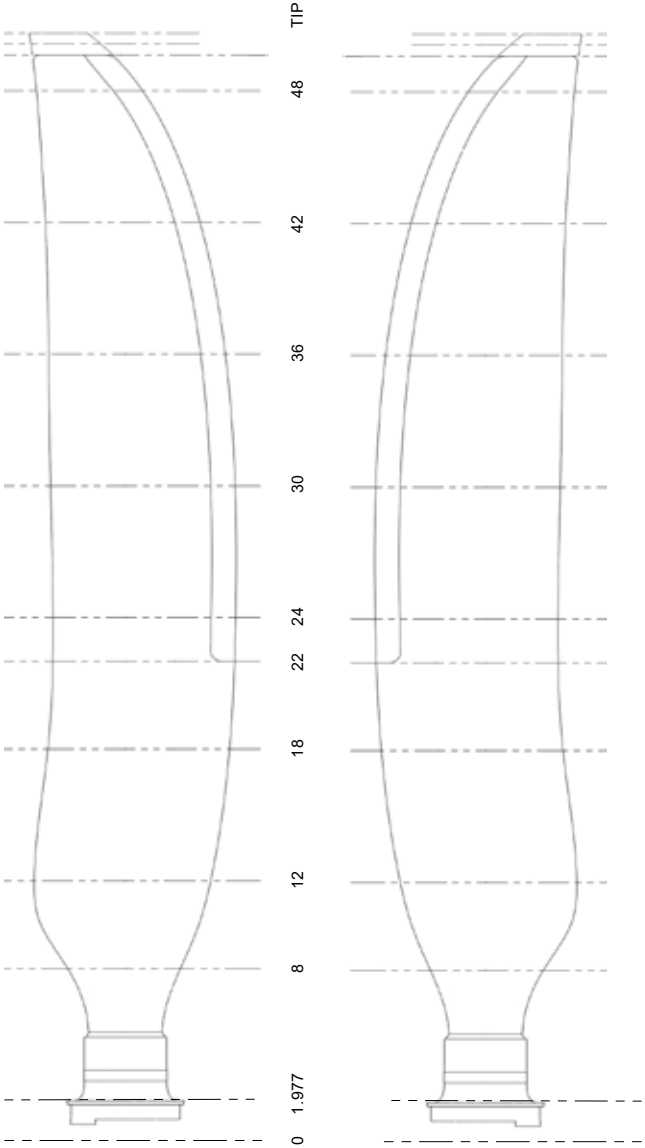
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Blade Serial No. \_\_\_\_\_



Record of 100DD44( ) Composite Blade Damage Repair

Blade Serial No. \_\_\_\_\_



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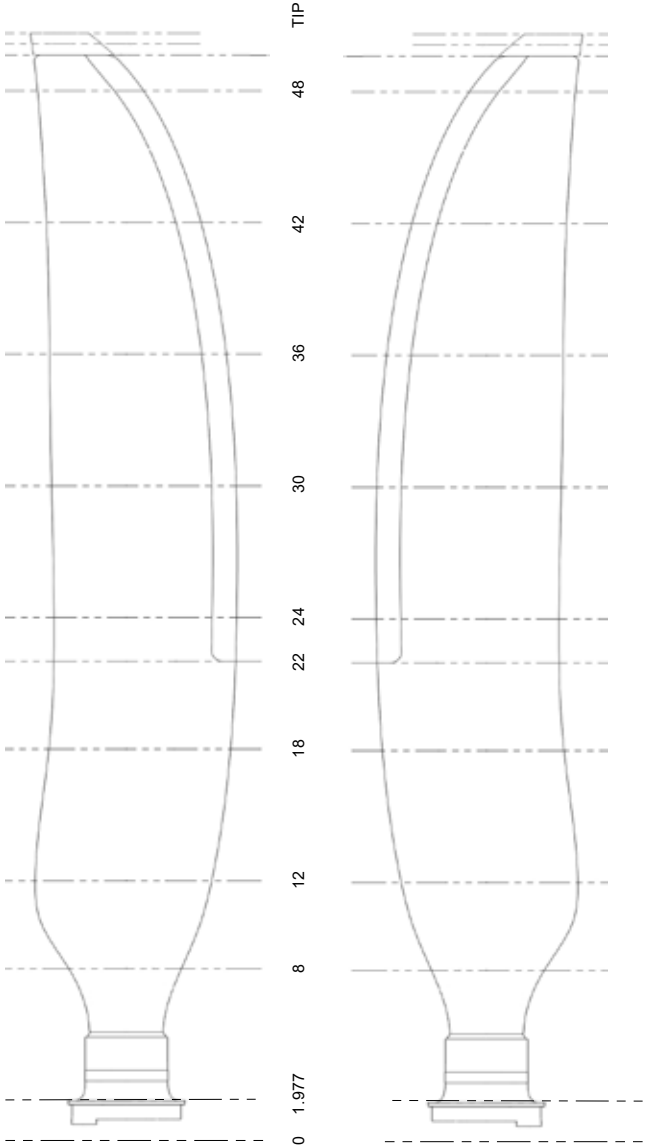
Record of 100DD44( ) Composite Blade Damage Repair

Blade Serial No. \_\_\_\_\_

The diagram shows a side view of a propeller blade. A vertical grid of dashed lines is overlaid on the blade, with numerical labels on the right side: 0, 1.977, 8, 12, 18, 22, 24, 30, 36, 42, 48, and TIP. The blade has a curved airfoil shape. Two horizontal dashed lines are drawn across the blade, one near the base and one near the tip, likely indicating specific measurement or repair zones. The blade is mounted on a hub at the bottom.

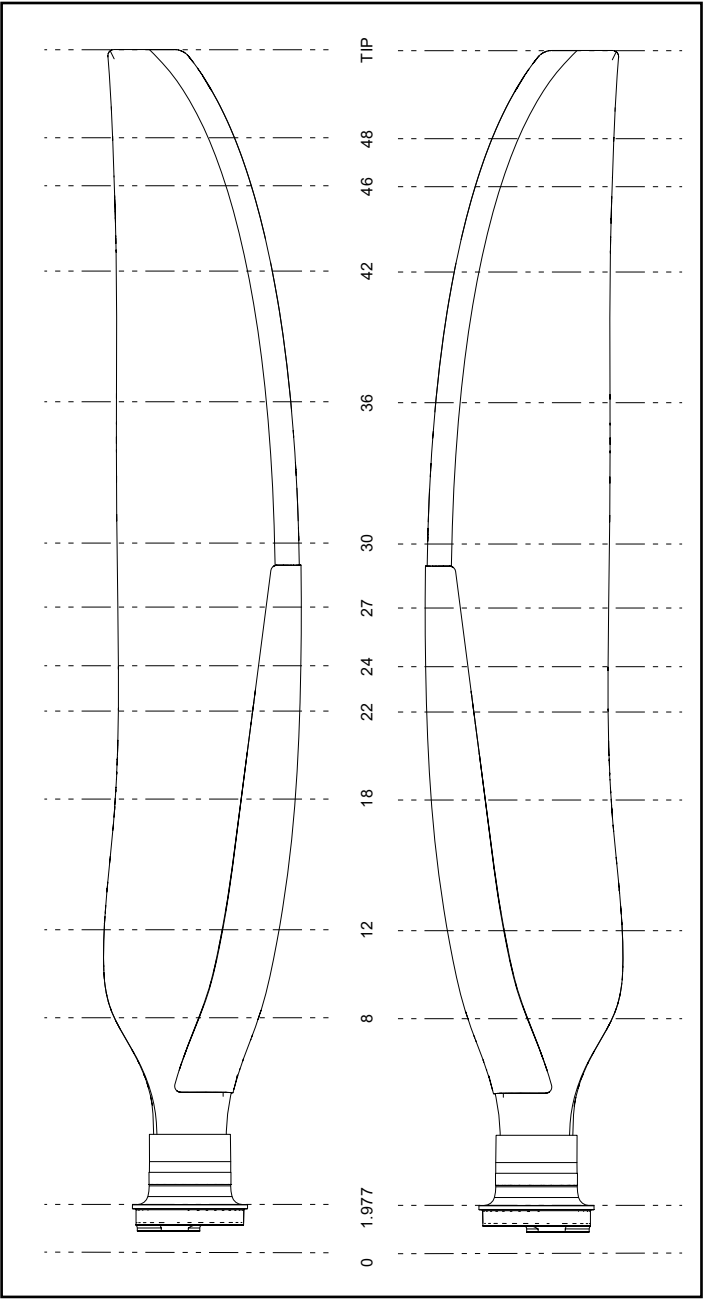
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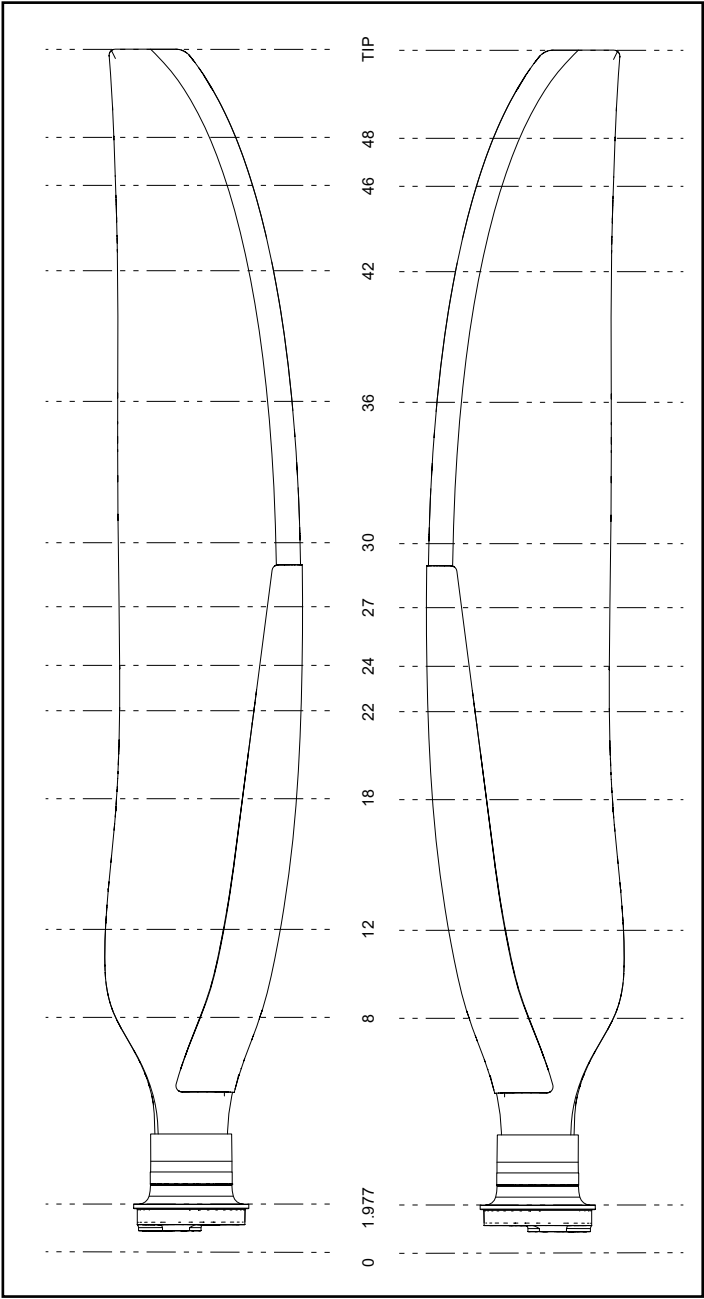
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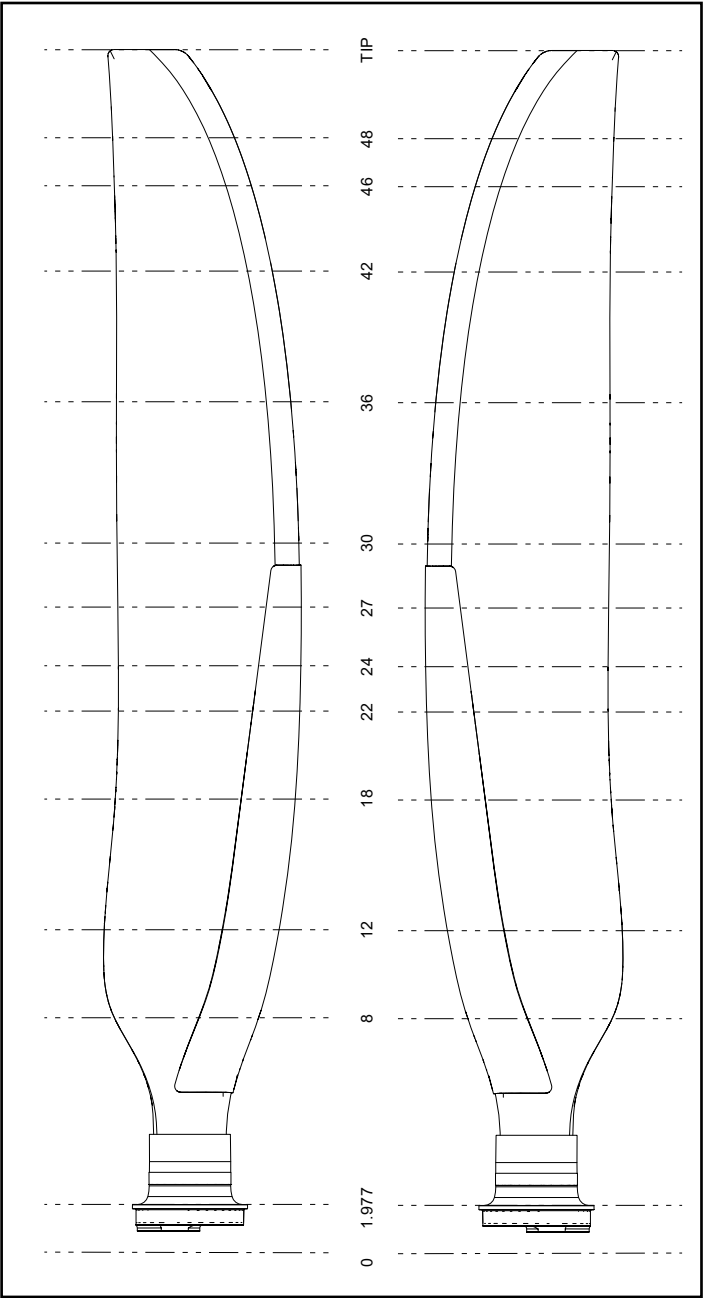
Record of J100DB45( ) Composite Blade Damage Repair

Blade Serial No. \_\_\_\_\_



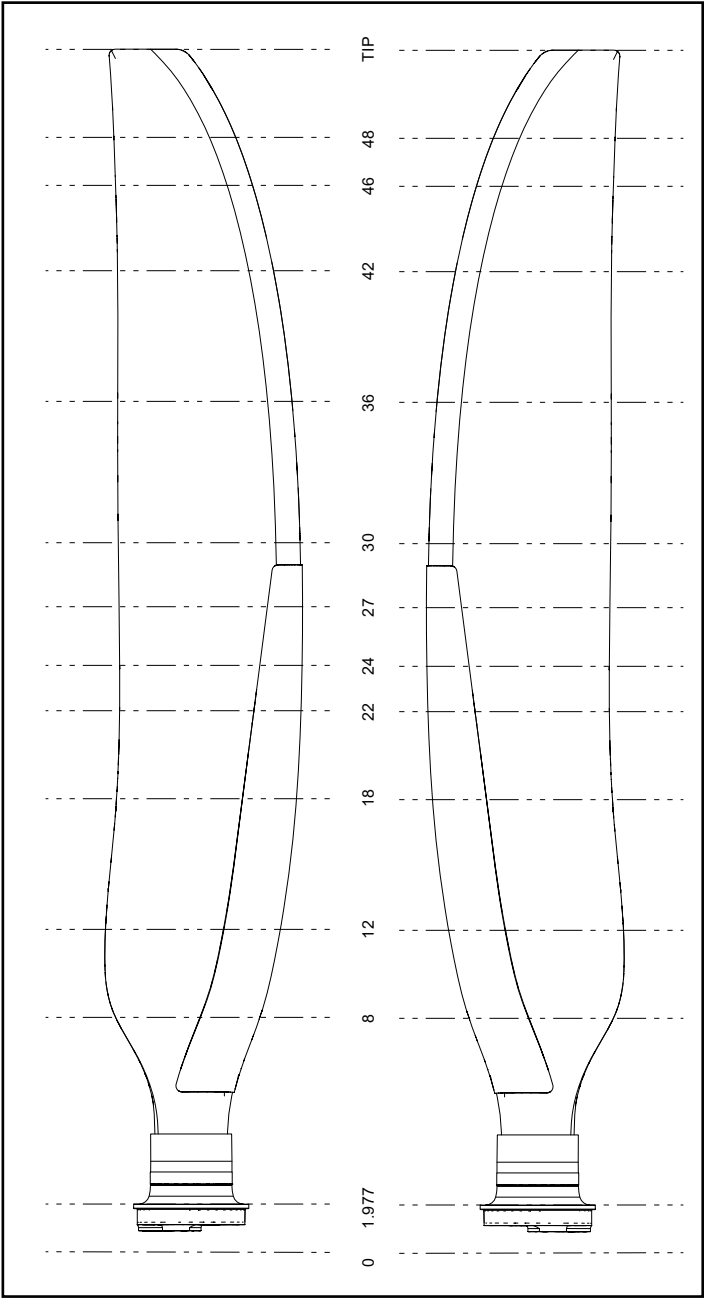
Record of J100DB45( ) Composite Blade Damage Repair

Blade Serial No. \_\_\_\_\_



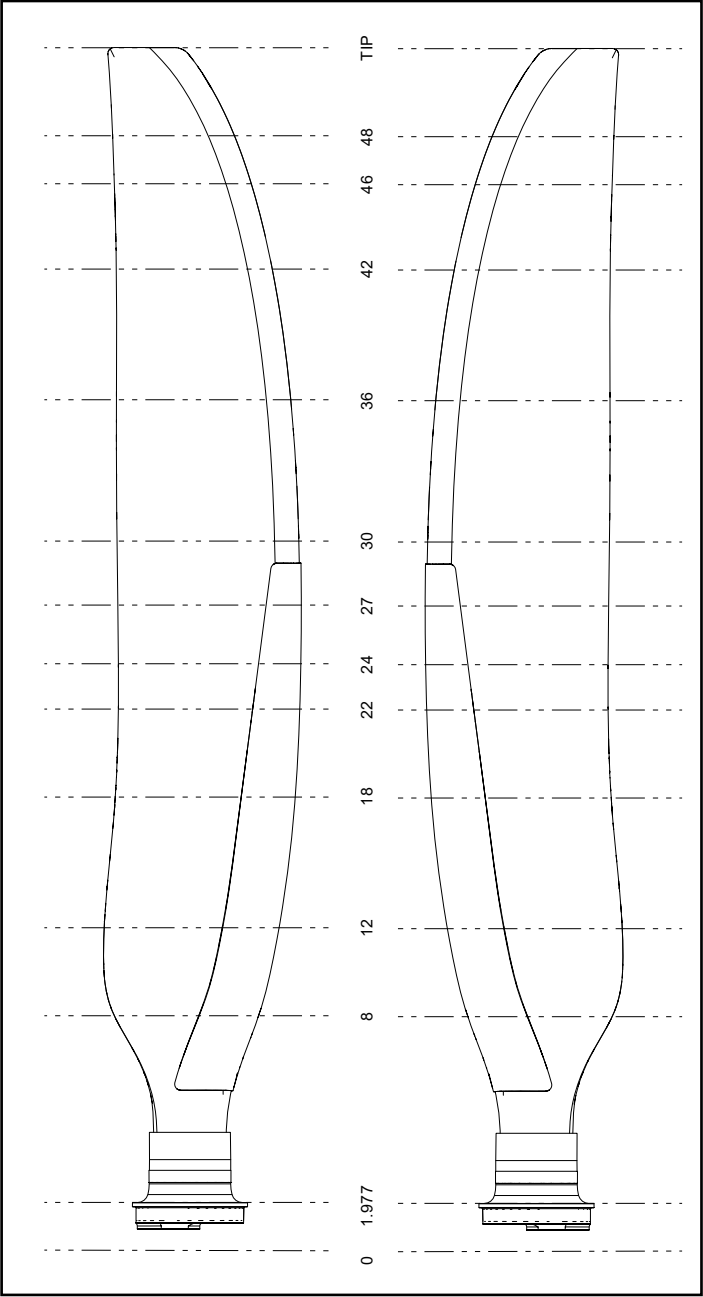
Record of J100DB45( ) Composite Blade Damage Repair

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