FAA Approved
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September 2010

Propeller Owner's Manual
and Logbook

Models: HC-E4A-3( )
HC-E4N-3( )
HC-E5A-2( )
HC-E5B-5( )

Lightweight Turbine Propellers with Composite Blades

Hartzell Propeller Inc.
One Propeller Place
Piqua, OH 45356-2634 U.S.A.
Ph: 937-778-4200 (Hartzell Propeller Inc.)
Ph: 937 - 778 - 4379 (Product Support)
Product Support Fax: 937-778-4391

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

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

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



Jim Brown
Chairman, Hartzell Propeller Inc.

WARNING

People who fly should recognize that various types of risks are involved; and they should take all precautions to minimize them, since they cannot be eliminated entirely. The propeller is a vital component of the aircraft. A mechanical failure of the propeller could cause a forced landing or create vibrations sufficiently severe to damage the aircraft, possibly causing it to become uncontrollable.

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

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

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

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

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

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

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

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REVISION 4 HIGHLIGHTS

- Revised the Cover, Revision Highlights, List of Effective Pages, and Table of Contents to match the revision
- DESCRIPTION AND OPERATION:
  - Revised to add propeller model HC-E4N-3A/NC9208K
  - Made other minor changes to the chapter
- INSTALLATION AND REMOVAL:
  - Added a caution and an inspection to make sure that the beta feedback collar does not contact any engine component or mounting bolt safety wire
  - Made other minor changes to the chapter
- INSPECTION AND CHECK:
  - Revised the section "Loose Blades" to include propeller model HC-E4N-3A/NC9208K
- MAINTENANCE PRACTICES:
  - Incorporated TR-001 that added the lubrication interval for HC-E5A-2( ) propellers installed on the Pilatus PC-21 aircraft
- RECORDS:
  - Added record pages for the NC9208K blade
  - Made other minor changes to the chapter

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REVISION HIGHLIGHTS

1. Introduction
   A. General
      This is a list of current revisions that have been issued against this manual. Please compare it to the RECORD OF REVISIONS page to ensure that all revisions have been added to the manual.
   B. Components
      (1) Revision No. indicates the revisions incorporated in this manual.
      (2) Issue Date is the date of the revision.
      (3) Comments indicates the level of the revision.
         (a) New Issue is a new manual distribution. The manual is distributed in its entirety. All the page revision dates are the same and no change bars are used.
         (b) Reissue is a revision to an existing manual that includes major content and/or major format changes. The manual is distributed in its entirety. All the page revision dates are the same and no change bars are used.
         (c) Major Revision is a revision to an existing manual that includes major content or minor content changes over a large portion of the manual. The manual is distributed in its entirety. All the page revision dates are the same, but change bars are used to indicate the changes incorporated in the latest revision of the manual.
         (d) Minor Revision is a revision to an existing manual that includes minor content changes to the manual. Only the revised pages of the manual are distributed. Each page retains the date and the change bars associated with the last revision to that page.

Revision No.	Issue Date	Comments
Original	Nov/99	New Issue
Revision 1	Nov/02	Minor Revision
Revision 2	Apr/05	Minor Revision
Revision 3	Nov/09	Minor Revision
Revision 4	Sep/10	Minor Revision

RECORD OF REVISIONS

Rev. No.	Issue Date	Date Inserted	Inserted By
1	Nov/02	Nov/02	HPI
2	Apr/05	Apr/05	HPI
3	Nov/09	Nov/09	HPI
4	Sep/10	Sep/10	HPI

RECORD OF REVISIONS

Rev. No.	Issue Date	Date Inserted	Inserted By

RECORD OF TEMPORARY REVISIONS

TR No.	Issue Date	Date Inserted	Inserted By	Date Removed	Removed By
TR-001	Feb/10	Feb/10	HPI	Sep/10	HPI

RECORD OF TEMPORARY REVISIONS

TR No.	Issue Date	Date Inserted	Inserted By	Date Removed	Removed By

SERVICE DOCUMENTS LIST

Service Document Number	Incorporation Rev/Date
Service Bulletins:	
HC-SB-61-225	Original, Nov/99
HC-SB-61-239	Original, Nov/99
Service Letters:	
HC-SL-61-184	Revision 1, Nov/02
HC-SL-61-187	Original, Nov/99
HC-SL-61-254	Revision 3, Nov/09

SERVICE DOCUMENTS LIST

Service Document Number	Incorporation Rev/Date

AIRWORTHINESS LIMITATIONS

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

FAA APPROVED

by: _____ date: NOV 1 9 2009

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

Rev. No.	Description of Revision
3	Adds airworthiness limitation information about propellers that use composite blades from Hartzell Overhaul Manual 143A (61-10-43), Hartzell Overhaul Manual 157 (61-10-57), and Hartzell Overhaul Manual 158A (61-10-58).

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 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).

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AIRWORTHINESS LIMITATIONS

(1) The following list specifies life limits for blades only. Associated hub parts are not affected. Blade models shown are life limited only on the specified applications.

PROPELLER MODELS ON AIRCRAFT WITHOUT AN FAA TYPE CERTIFICATE	
Aircraft/Engine/Propeller	Blade Life Limit
Aircraft: Grumman S-2E Tracker Engine: Garrett TPE331-15AW Propeller: HC-E5B-5/E12902( )	12,500 hours
Aircraft: Pilatus Model PC-21 Engine: Pratt & Whitney Model PT6A-68B Propeller: HC-E5A-2/E9193(B,K)	20,000 hours

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Federal Aviation Administration

AIRWORTHINESS LIMITATIONS, CONTINUED

(2) The following list specifies life limits for propeller hubs only. Hubs listed are life limited only on the specified applications.

PROPELLER MODELS ON AIRCRAFT WITHOUT AN FAA TYPE CERTIFICATE	
Aircraft/Engine/Propeller	Hub Life Limit
Aircraft: Pilatus Model PC-21 Engine: Pratt & Whitney Model PT6A-68B Propeller: HC-E5A-2/E9193(B,K)	20,000 hours, hub part number D-7432

(3) The following list specifies life limits for propeller cylinders only. Cylinders listed are life limited only on the specified applications.

PROPELLER MODELS ON AIRCRAFT WITHOUT AN FAA TYPE CERTIFICATE	
Aircraft/Engine/Propeller	Cylinder Life Limit
Aircraft: Pilatus Model PC-21 Engine: Pratt & Whitney Model PT6A-68B Propeller: HC-E5A-2/E9193(B,K)	16,946 hours cylinder part number E-7417

(4) The following list specifies life limits for propeller pistons only. Pistons listed are life limited only on the specified applications.

PROPELLER MODELS ON AIRCRAFT WITHOUT AN FAA TYPE CERTIFICATE	
Aircraft/Engine/Propeller	Piston Life Limit
Aircraft: Pilatus Model PC-21 Engine: Pratt & Whitney Model PT6A-68B Propeller: HC-E5A-2/E9193(B,K)	16,946 hours piston part number C-7616

AIRWORTHINESS LIMITATIONS, CONTINUED

3. Periodic Inspections

A. For propeller model HC-E5B-5/E12902K used on Grumman S-2E Tracker aircraft with Garrett TPE331-15AW engines:

(1) Visual crack inspection of blade, part no. E12902K, is required at intervals not to exceed 25 hours of operation in accordance with the section "On Wing Blade Shank Inspection" in the Maintenance Practices chapter of this manual.

B. For propeller model HC-E5A-2/E9193 used on Pilatus PC-21 aircraft:

(1) The composite blade assembly E9193(B,K) must be ultrasonically inspected in accordance with Hartzell Propeller Inc. Manual 135F (61-13-35) at an interval no greater than every 3000 flight hours.

C. For propeller model HC-E4A-3( )/E10950P used on Beech 1900D aircraft:

(1) At 10,000 hours of operation, the E10950P( )( ) blades must be inspected within the next 5,000 hours of operation and thereafter at intervals not to exceed 5,000 hours of operation. Inspect in accordance with Hartzell Composite Blade Maintenance Manual 135F (61-13-35).

(2) The propeller blades, model E10950P( )( ), for the HC-E4A-3( ) propeller used on the Beech 1900D aircraft that were previously life limited have had the blade life limit removed.

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Chapter	Page	Revision	Date
Cover and Inside cover	Cover and Inside cover	Rev. 4	Sep/10
Message	1 thru 4	Orig.	Nov/99
Revision Highlights	5 thru 8	Rev. 4	Sep/10
Record of Revisions	9 and 10	Orig.	Nov/99
Record of Temporary Revisions	11 and 12	Orig.	Nov/99
Service Documents List	13 and 14	Rev. 3	Nov/09
Airworthiness Limitations	15 thru 20	Rev. 3	Nov/09
List of Effective Pages	21 and 22	Rev. 4	Sep/10
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Introduction	1-4 and 1-5	Rev. 1	Nov/02
Introduction	1-6 thru 1-16	Rev. 3	Nov/09
Description and Operation	2-1 and 2-2	Rev. 2	Apr/05
Description and Operation	2-3 and 2-4	Orig.	Nov/99
Description and Operation	2-5 thru 2-18	Rev. 2	Apr/05
Description and Operation	2-19 thru 2-21	Rev. 4	Sep/10
Description and Operation	2-22 thru 2-24	Rev. 2	Apr/05
Installation and Removal	3-1 and 3-2	Rev. 3	Nov/09
Installation and Removal	3-3	Rev. 2	Apr/05
Installation and Removal	3-4 and 3-5	Rev. 3	Nov/09
Installation and Removal	3-6	Rev. 2	Apr/05
Installation and Removal	3-7	Rev. 3	Nov/09
Installation and Removal	3-8	Orig.	Nov/99
Installation and Removal	3-9 and 3-10	Rev. 3	Nov/09
Installation and Removal	3-11	Rev. 2	Apr/05

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Testing and Troubleshooting	4-1 thru 4-4	Rev. 3	Nov/09
Testing and Troubleshooting	4-5 thru 4-12	Rev. 1	Nov/02
Inspection and Check	5-1	Rev. 4	Sep/10
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Inspection and Check	5-3 thru 5-6	Rev. 1	Nov/02
Inspection and Check	5-7 and 5-8	Rev. 3	Nov/09
Inspection and Check	5-9 and 5-10	Rev. 2	Apr/05
Inspection and Check	5-11	Rev. 1	Nov/02
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Inspection and Check	5-13 and 5-14	Rev. 1	Nov/02
Inspection and Check	5-15 thru 5-19	Rev. 2	Apr/05
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Inspection and Check	5-21 thru 5-24	Rev. 2	Apr/05
Inspection and Check	5-25 thru 5-36	Rev. 3	Nov/09
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Maintenance Practices	6-10 thru 6-23	Rev. 1	Nov/02
Maintenance Practices	6-24 thru 6-32	Rev. 3	Nov/09
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Records	8-1 and 8-2	Rev. 4	Sep/10
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1. Purpose

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

This manual supports constant speed feathering and reversing lightweight turbine propellers with composite blades.

The purpose of this manual is to enable qualified personnel to install, operate, and maintain a Hartzell Constant Speed Feathering and Reversing Lightweight Turbine Propeller. Separate manuals are available concerning overhaul procedures and specifications for the propeller.

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

NOTE: All propeller models included in this manual use composite propeller blades. Identical propellers types that use aluminum blades are supported by Hartzell Manual 149 (61-00-49).

2. Airworthiness Limitations

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

3. Airframe or Engine Modifications

   A. Propellers are approved vibrationwise on airframe and engine combinations based on tests or analysis based on tests 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 effect 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), the addition of approved flight maneuvers (utility and aerobatic).

   B. Engine modifications can also 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. Examples of such engine modifications include, but are not limited to: changes to the compressor, power turbine or hot section of a turboprop engine; and on piston engines, 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.

   C. All such modifications must be reviewed and approved by the propeller manufacturer before obtaining approval on the aircraft.

4. Restrictions and Placards

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

5. General

A. Personnel Requirements

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

B. Maintenance Practices

(1) The propeller and its components are highly vulnerable to damage when they are removed from the engine. Properly protect all components until they are reinstalled on the engine.

(2) Never attempt to move the aircraft by pulling on the propeller.

(3) Avoid the use of blade paddles.If blade paddles must be used, use at least two 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.

(4) Use only the approved consumables e.g. cleaning agents, lubricants, etc.

(5) Observe applicable torque values during maintenance.

(6) Before installing the propeller on the engine, the propeller must be statically balanced. New propellers are statically balanced at Hartzell. Overhauled propellers must be statically balanced by the overhaul facility before return to service.

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

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

(8) As applicable, follow military standard NASM33540 for safety-wiring and cotter pinning general practices. Use 0.032 inch (0.81 mm) stainless steel safety wire unless otherwise indicated.

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

(9) The information in this manual revision supersedes data in all previously published revisions of this manual.

(10) Refer to the airframe manufacturer's manuals in addition to the information in this manual because of possible special requirements for specific aircraft applications.

(11) If the propeller is equipped with an ice protection system that uses components supplied by Hartzell Propeller Inc., applicable instructions and technical information for the components supplied by Hartzell can be found in the following publications available on the Hartzell website at www.hartzellprop.com:

(a) Manual 180 (30-61-80) - Propeller Ice Protection System Manual
(b) Manual 181 (30-60-81) - Propeller Ice Protection System Component Maintenance Manual
(c) Manual 182 (61-12-82) - Propeller Electrical De-Ice Boot Removal and Installation Manual
(d) Manual 183 (61-12-83) - Propeller Anti-Icing Boot Removal and Installation Manual

(12) Propeller ice protection system components not supplied by Hartzell Propeller Inc. are controlled by the applicable TC or STC holder's Instructions for Continued Airworthiness (ICA).

C. Continued Airworthiness

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

6. Reference Publications

The following publications are referenced within this manual:

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

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

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

Hartzell Manual No. 135F (61-13-35) - Composite Blade Maintenance Manual

Hartzell Manual No. 143A (61-10-43) - Four-Blade Lightweight Turbine Propeller Maintenance Manual

Hartzell Manual No. 157 (61-10-57) - Five-Blade Lightweight Turbine Propeller Maintenance Manual

Hartzell Manual No. 158A (61-10-58) - Five and Six-Blade Lightweight Turbine Propeller Maintenance Manual

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

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

Hartzell Manual No. 180 (30-61-80) - Propeller Ice Protection System Manual - Also available on the Hartzell website at www.hartzellprop.com

Hartzell Manual No. 181 (30-60-81) - Propeller Ice Protection System Component Maintenance Manual - Also available on the Hartzell website at www.hartzellprop.com

Hartzell Manual No. 182 (61-12-82) - Propeller Electrical De-ice Boot Removal and Installation Manual - Also available on the Hartzell website at www.hartzellprop.com

Hartzell Manual No. 183 (61-12-83) - Propeller Anti-icing Boot Removal and Installation Manual - Also available on the Hartzell website at www.hartzellprop.com

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

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

7. Definitions

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

Term	Definition
Annealed	Softening of material due to overexposure to heat.
Blade Angle	Measurement of blade airfoil location described as the angle between the blade airfoil and the surface described by propeller rotation.
Brinelling	A depression caused by failure of the material in compression.
Chord	A straight line distance between the leading and trailing edges of an airfoil.
Composite Material	Kevlar® (yellow) or graphite (black) fibers bound together with or encapsulated within an epoxy resin.
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	Gradual material removal or deterioration due to chemical action.
Crack	Irregularly shaped separation within a material, sometimes visible as a narrow opening at the surface.
Debond	Separation of two materials that were originally bonded together in a separate operation.
Delamination	Internal separation between the layers of composite material.

Term	Definition
Depression	Surface area where the material has been compressed but not removed.
Distortion	Alteration of the original shape or size of a component.
Erosion	Gradual wearing away or deterioration due to action of the elements.
Exposure	Material open to action of the elements.
Feathering	The capability of blades to be rotated parallel to the relative wind, thus reducing aerodynamic drag.
Fretting	Damage that develops when relative motion of small displacement takes place between contacting parts, wearing away the surface.
Gouge	Surface area where material has been removed.
Horizontal Balance	Balance between the blade tip and the center of the hub.
Impact Damage	Damage that occurs when the propeller blade or hub assembly strikes, or is struck by, an object while in flight or on the ground.
Nick	Removal of paint and possibly a small amount of material.
Onspeed	Condition in which the RPM selected by the pilot through the propeller control lever and the actual engine (propeller) RPM are equal.
Overhaul	The periodic disassembly, inspection, repair, refinish, and reassembly of a propeller assembly to maintain airworthiness.

Term	Definition
Overspeed	Condition in which the RPM of the propeller or engine exceeds predetermined maximum limits; the condition in which the engine (propeller) RPM is higher than the RPM selected by the pilot through the propeller control lever.
Overspeed Damage	Damage that occurs when the propeller hub assembly rotates at a speed greater than the maximum limit for which it is designed.
Pitch	Same as "Blade Angle".
Pitting	Formation of a number of small, irregularly shaped cavities in surface material caused by corrosion or wear.
Reversing	The capability of rotating blades to a position to generate reverse thrust to slow the aircraft or back up.
Scratch	Same as "Nick".
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.
Synchronizing	Adjusting the RPM of all the propellers of a multi-engine aircraft to the same RPM.
Synchrophasing	A form of propeller sychronization 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.

Term	Definition
Track	In an assembled propeller, a measurement of the location of the blade tip with respect to the plane of rotation, in order to compare blade tip location with respect to the locations of the other blades in the assembly.
Underspeed	The condition in which the actual engine (propeller) RPM is lower than the RPM selected by the pilot through the propeller control lever.
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.
Windmilling	The rotation of an aircraft propeller caused by air flowing through it while the engine is not producing power.

8. Abbreviations

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

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

9. Hartzell Product Support

   Hartzell Propeller is ready to assist you with questions concerning your propeller system. Hartzell product support may be reached during business hours (8:00 am through 5:00 pm, United States Eastern Time) at (937) 778-4379 or at (800) 942-7767, toll free from the United States and Canada. Hartzell Product Support can also be reached by fax at (937) 778-4391, and by e-mail at techsupport@hartzellprop.com.

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

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

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

10. Warranty Service

    If you believe you have a warranty claim, it is necessary to contact Hartzell's Warranty Administrator. Hartzell's Warranty Administrator will provide a blank *Warranty Application* form. It is necessary to complete this form and return it to the Warranty Administrator for evaluation **before proceeding with repair or inspection work**. Upon receipt of this form, the Warranty Administrator will provide instructions on how to proceed. Hartzell Warranty may be reached during business hours (8:00 am. through 5:00 pm., United States Eastern Time) at (937) 778-4380, or toll free from the United States and Canada at (800) 942-7767. Hartzell Warranty Adminstration can also be reached by fax, at (937) 778-4391, or by e-mail at warranty@hartzellprop.com.

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

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

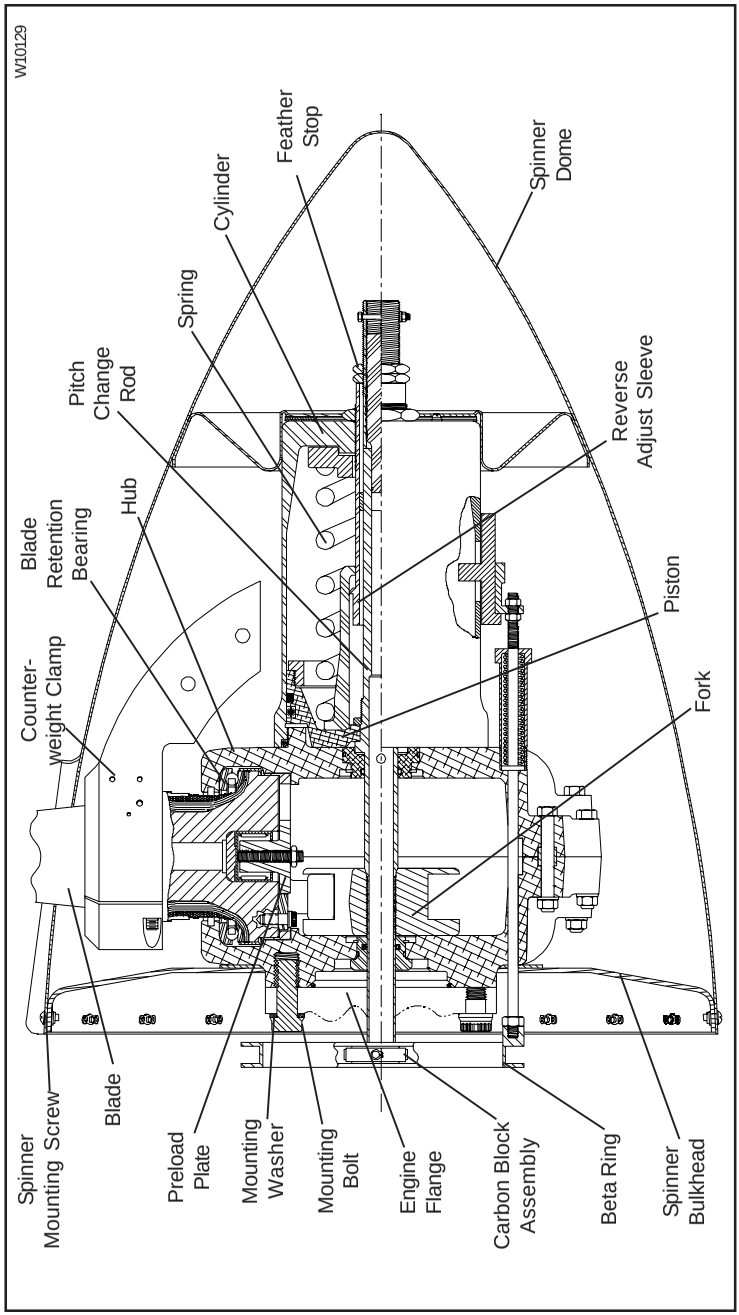
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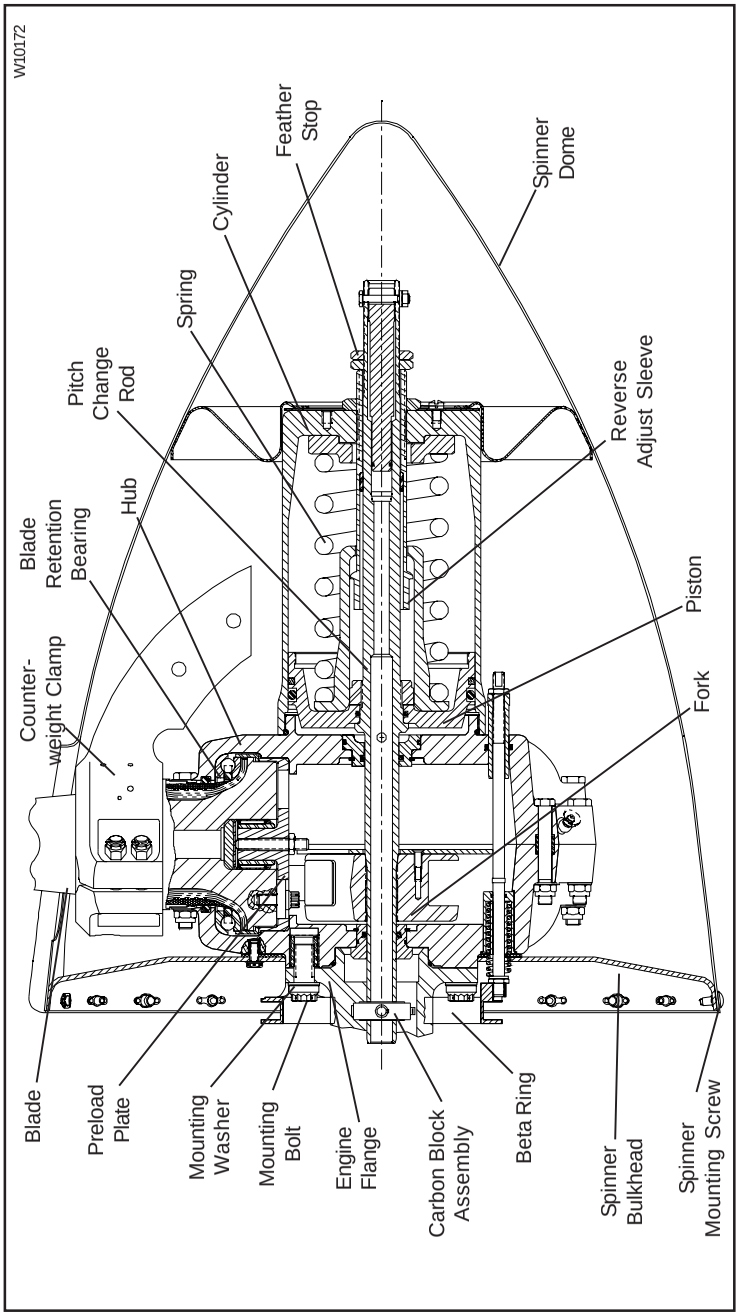
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HC-E4A-3( ) Series Propeller
Figure 2-1



HC-E4N-3( ) Series Propeller
Figure 2-2

1. Functional Description of Constant Speed Propeller Types

   A. Feathering and Reversing Propellers HC-E4( )-3( ) Series

   Refer to Figures 2-1 and 2-2. 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 have four blades and 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.

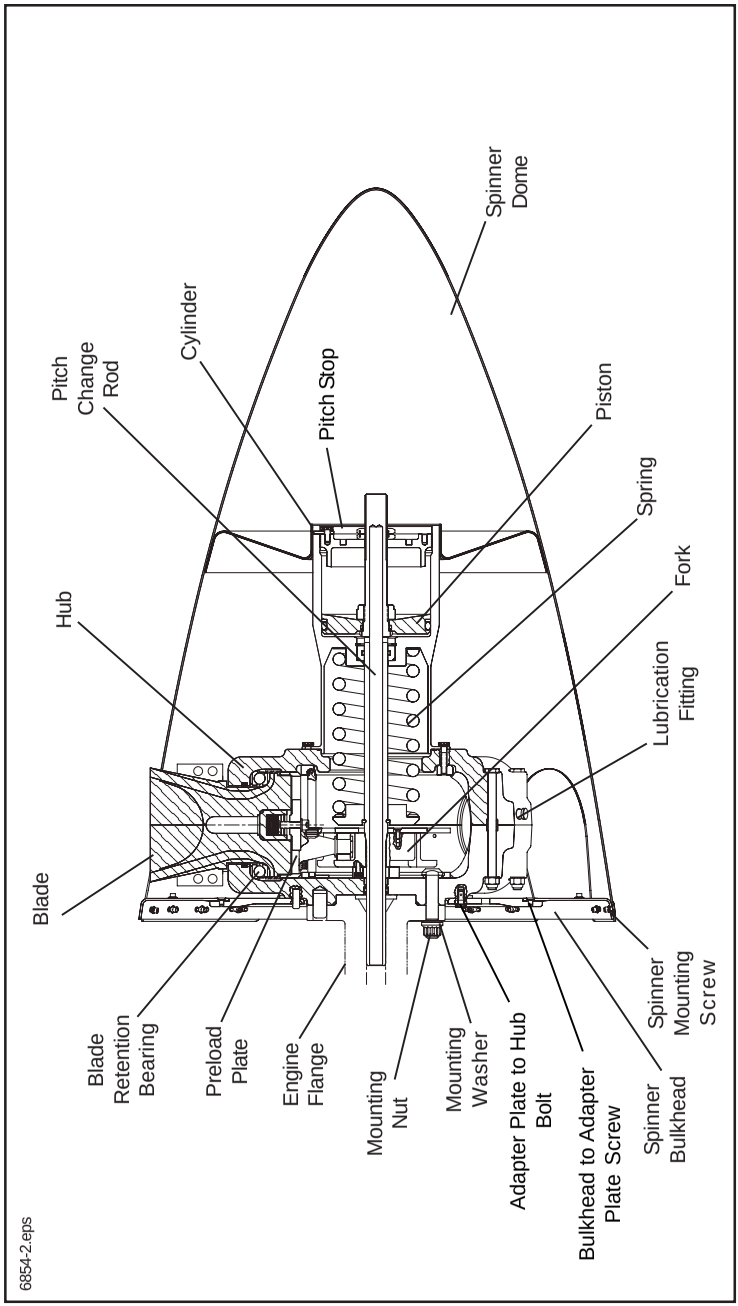
In reverse mode of operation the governor operates in an underspeed condition to act strictly as a source of pressurized oil, without attempting to control RPM. Control of the propeller blade angle in reverse is accomplished with the beta valve.

NOTE: The beta valve is normally built into the base of the governor.

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 carbon 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 carbon 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.

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HC-E5A-2( ) Series Propeller
Figure 2-3

B. Feathering Propellers HC-E5A-2 Model

Refer to Figure 2-3. The propeller described in this section is constant speed and feathering. It utilizes a single oil supply from a governing device to hydraulically actuate a change in blade angle. This propeller has five blades and is 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 usually very small in relation to the other forces and can attempt to increase or decrease blade angle.

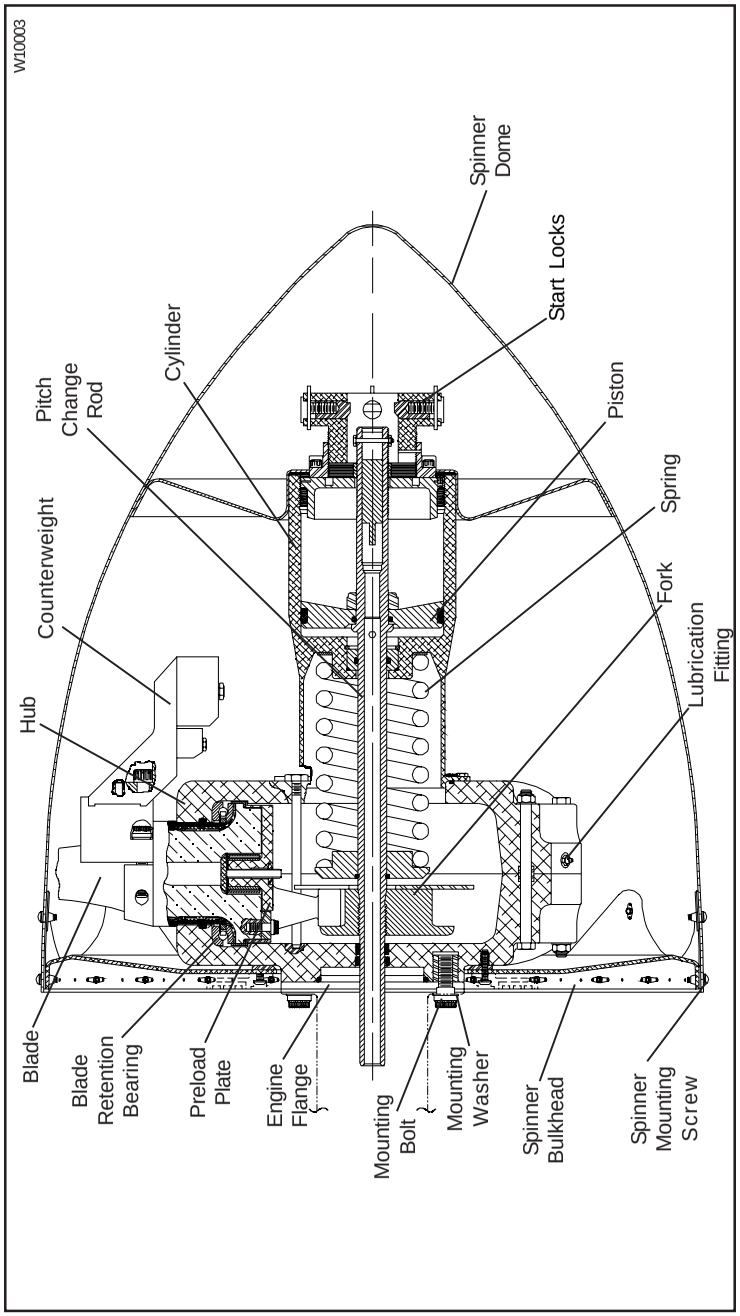
The summation of the propeller forces is toward higher pitch (low RPM) and is opposed by a variable force toward lower pitch (high RPM). The variable force is oil under pressure from a governor with an internal pump that is mounted on and driven by the engine. The oil from the governor is supplied to 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 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.

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HC-E5B-5A Series Propeller
Figure 2-4

C. Feathering and Reversing Propellers HC-E5B-5A Model

Refer to Figure 2-4. The propeller described in this section is constant speed, feathering and reversing. It utilizes a single oil supply from a governing device to hydraulically actuate a change in blade angle. This propeller has five blades and is used primarily on Garrett (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 usually very small in relation to the other forces and can attempt to increase or decrease blade angle.

The summation of the propeller forces is toward higher pitch (low RPM) and is opposed by a variable force toward lower pitch (high RPM). The variable force is oil under pressure from a governor with an internal pump, which 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 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 allow 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 reduction gearbox opposite the propeller.

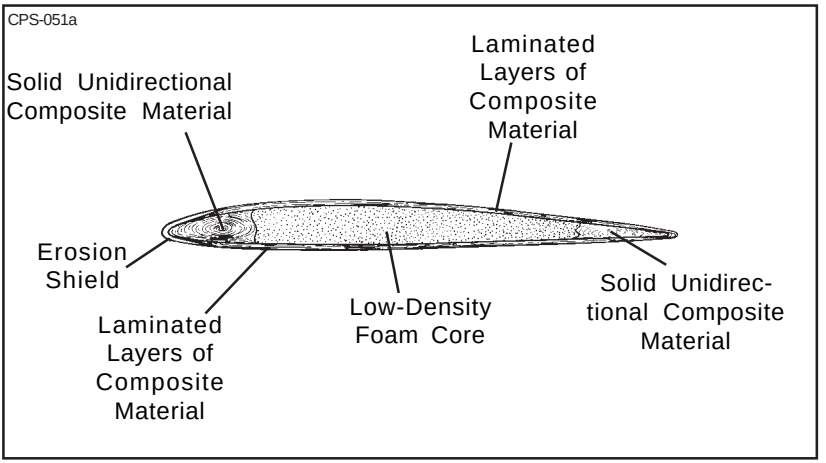
The propeller is reversed by manually repositioning the cockpit-control to cause the beta valve to supply oil from the governor pump to the propeller. A beta rod inserted into the front of the propeller communicates propeller blade angle position to the beta valve.

When the propeller reaches the desired reverse position, movement of the beta rod, initiated by the propeller piston, will cause the beta valve to shut off 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.

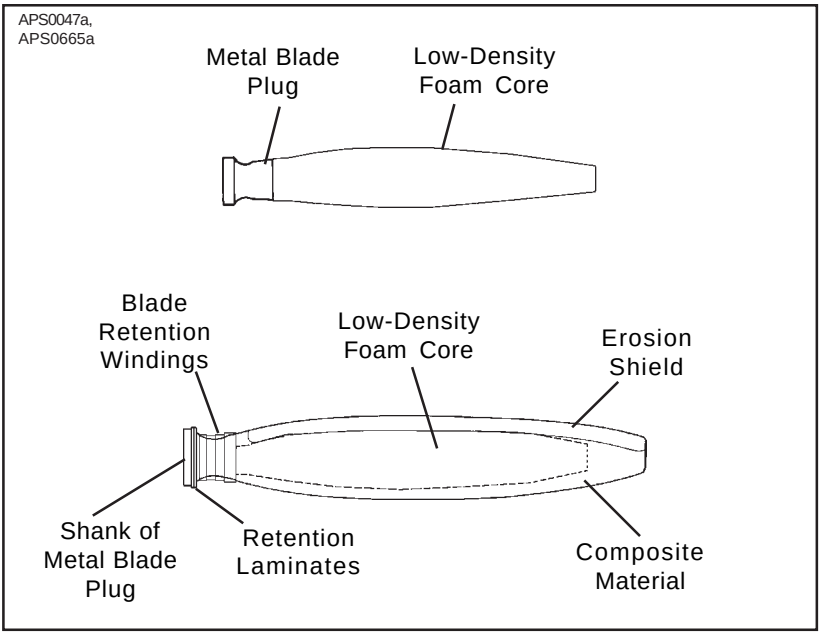
It is undesirable to feather the propeller when the engine is stopped after landing the aircraft. This propeller type is normally installed on a fixed shaft engine that causes the propeller to rotate during an engine start process. If the propeller is in feather position, an overload on the electric engine starter will occur.

To prevent feathering during normal engine shutdown, the propeller incorporates spring-energized latch pins, called start locks. Two start locks are installed on the cylinder. If propeller rotation is approximately 800 RPM or above, the start locks disengage from the piston by centrifugal force acting on the latch pins to compress the spring (within the units). When RPM drops below 800 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.



Section of Typical Composite Blade
Figure 2-5



Basic Components of the Composite Blade
Figure 2-6

2. Description of Composite Blades

The Hartzell composite blade is composed of a metal blade shank retention section into which is molded a low-density foam core that supports built-up layers of composite laminate (Figure 2-5).

An erosion shield of electroformed nickel is bonded to the blade to protect the blade leading edge from erosion and impact damage.

Some designs incorporate a stainless steel wire mesh into the fabrication on the face and camber surfaces to inhibit erosion in blade tip areas.

Filament windings of composite material provide blade retention of the blade material to the internal metal plug (Figure 2-6). The composite laminates that are a structural component of the blade also provide a retention load path directly under the bearing for blade retention.

Some designs use a filament winding on the inboard end of the erosion shield to aid the retention of the erosion shield. This winding is sometimes referred to as an erosion shield winding and should not be confused with the blade retention winding used to secure the blade material to the internal metal plug.

The composite blade is balanced in the horizontal plane during production by adding lead wool to a centrally located balance tube in the metal blade shank that may protrude into the blade's foam core.

Some composite blade models are painted with conductive coating to prevent electrostatic discharges that can interrupt the operation of electronic equipment.

Some composite blade models are painted with Lightning Guard (copper) paint for protection against lightning strike damage.

All composite blade models are painted with a finish covering of polyurethane paint to protect the entire blade from erosion and ultraviolet damage. Aircraft that require de-ice protection use an external de-ice boot.

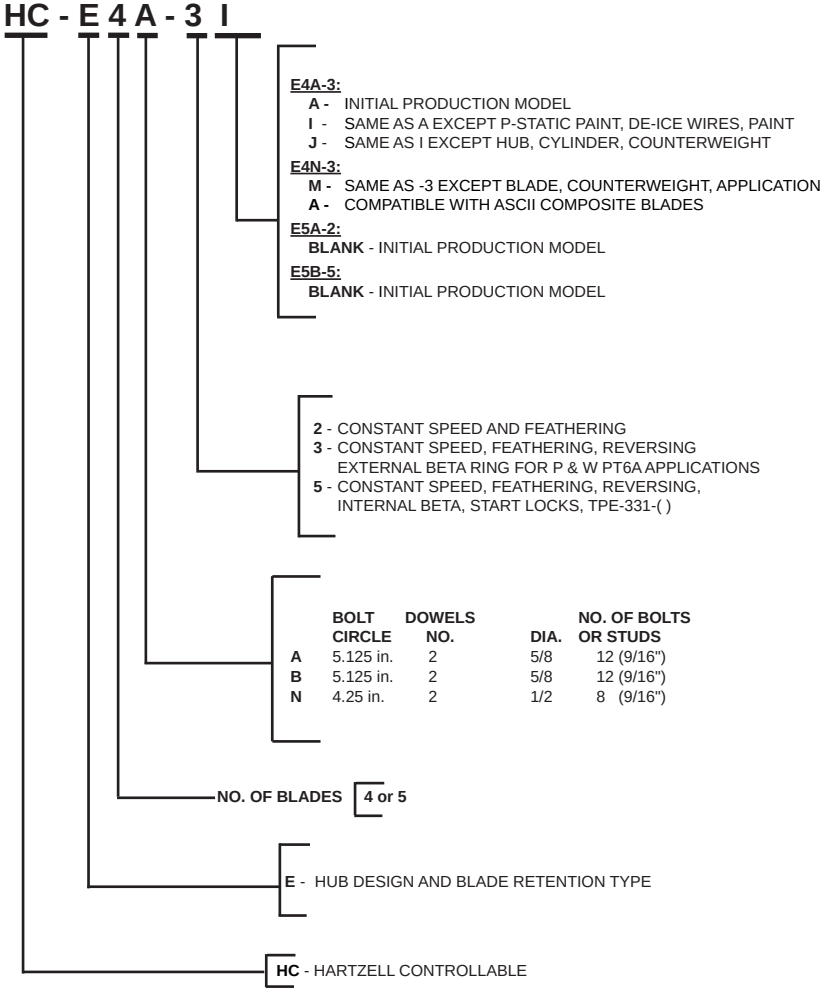
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3. Model Designation

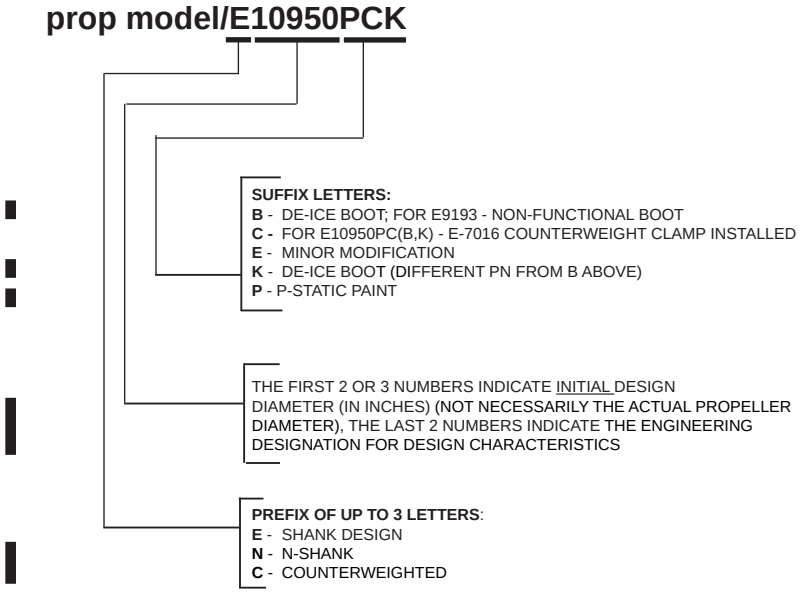
The following pages illustrate sample model designations for Hartzell lightweight propeller hub assemblies and blades. Hartzell uses a model designation to identify specif c propeller and blade assemblies. Example: HC-E4A-3I/E10950PK. A slash mark separates the propeller and blade designations.

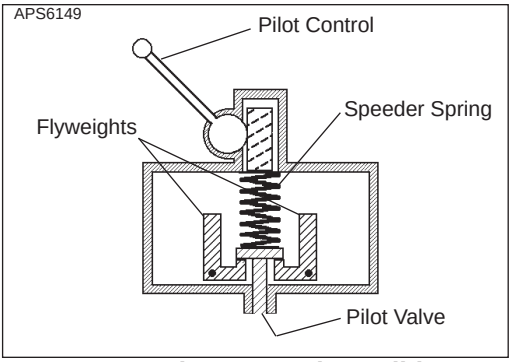
A. Aluminum Hub Propeller Model Identif cation

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

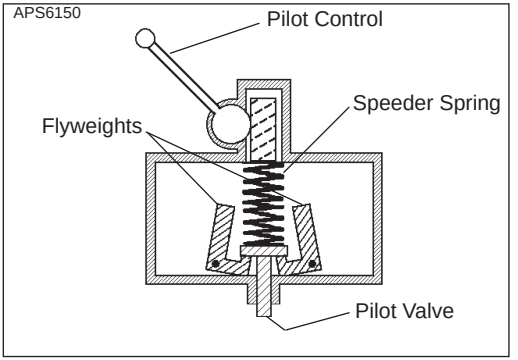


B. Composite Blade Model Identif cation
The blade designation is impression stamped on the blade butt end (internal) and is either on a decal or ink stamped on the blade camber side (external).

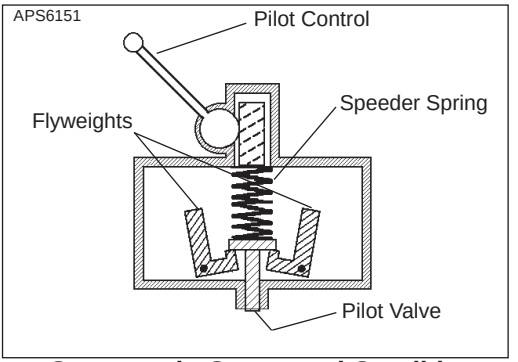




Governor in Onspeed Condition
Figure 2-7



Governor in Underspeed Condition
Figure 2-8



Governor in Overspeed Condition
Figure 2-9

4. Governors

A. Theory of Operation

(1) A governor is an engine RPM sensing device and high pressure oil pump. In a constant speed propeller system, the governor responds to a change in engine RPM by directing oil under pressure to the propeller hydraulic cylinder or by releasing oil from the hydraulic cylinder. The change in oil volume in the hydraulic cylinder changes the blade angle and returns the propeller system RPM to the set value. The governor is set for a specific RPM via the cockpit propeller control, which 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 2-7. 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 2-8. 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 2-9. 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.

(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.

5. Propeller De-Ice Systems

A Hartzell turbine propeller is sometimes equipped with a de-ice system.

A. System Overview

A propeller de-ice system is a system that permits ice to form, and then removes it by electrically heating the de-ice boots. The ice partially melts and is thrown from the blade by centrifugal force.

(1) A de-ice system consists of one or more on/off switches, a timer or cycling unit, a slip ring and brush blocks, and de-ice boots. The pilot controls the operation of the de-ice system by turning on one or more switches. All de-ice systems have a master switch, and may have another toggle switch for each propeller. Some systems also have a selector switch to adjust for light or heavy icing conditions.

(2) The timer or cycling unit determines the sequence of which blades (or portion thereof) are currently being de-iced, and for what length of time. The timer controls the application of power to each de-ice boot or boot segment in a sequential order.

(3) A brush block, which is normally mounted on the engine just behind the propeller, is used to transfer electricity to the slip ring. The slip ring rotates with the propeller, and provides a current path to the blade de-ice boots.

(4) De-ice boots contain internal heating elements. These boots are securely attached to the leading edges of each blade with adhesive.

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1. Tools, Consumables, and Expendables

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

NOTE: Lightweight turbine propellers are manufactured with different flange designs. The flange types are A, B, and N. The flange type used on a particular propeller installation is indicated in the propeller model identification number stamped on the hub. For example, HC-E4**A**-3 indicates an A flange. Refer to Aluminum Hub Model Identification in the Description and Operation chapter of this manual for description of each flange type.

A. Tooling

A Flange
- Safety wire pliers
- Torque wrench
- Torque wrench adapter (Hartzell P/N AST-2877)

B Flange
- Safety wire pliers
- Torque wrench
- Torque wrench adapter (Hartzell P/N AST-2877)

N Flange
- Safety wire pliers
- Torque wrench
- Torque wrench adapter (Hartzell P/N AST-2877)

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
- O-ring, Propeller-to-Engine Seal (see Table 3-1)

2. Pre-Installation

A. Inspection of Shipping Package

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

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 propeller over a large area.

(5) Remove the plastic dust cover cup from the propeller mounting flange (if installed).

C. Inspection after Shipment

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

D. Reassembly of a Propeller Disassembled for Shipment

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

3. Propeller Assembly Installation

A. Precautions

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

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

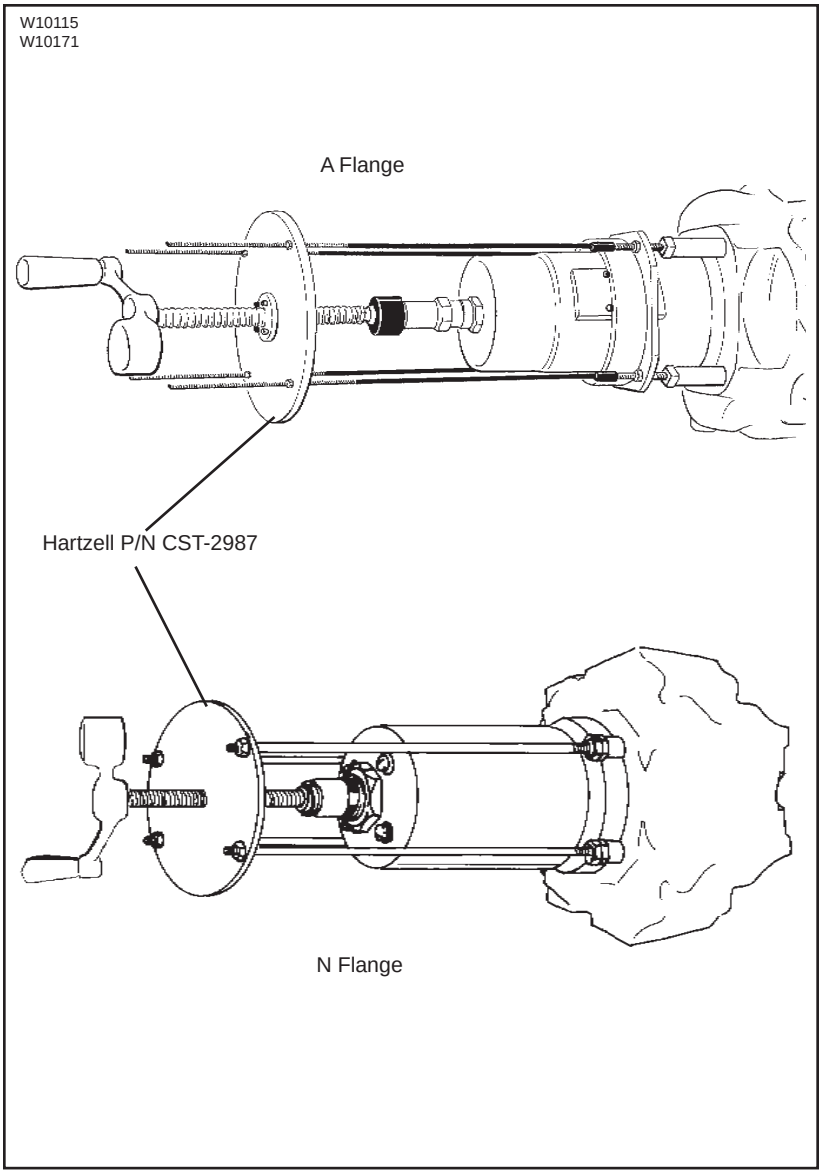
CAUTION: AVOID THE USE OF BLADE PADDLES. DO NOT PLACE THE BLADE PADDLE IN THE AREA OF THE DE-ICE BOOT WHEN APPLYING TORQUE TO A BLADE ASSEMBLY. PLACE THE BLADE PADDLE IN THE THICKEST AREA OF THE BLADE, JUST OUTSIDE OF THE DE-ICE BOOT. USE ONE BLADE PADDLE PER BLADE.

(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.



Tool for Decompressing HC-E4( )-3( ) Series
External Beta System
Figure 3-1

B. Installing HC-E4( )-3( ) Propeller on the Aircraft Engine

(1) Use a beta system puller CST-2987 (Figure 3-1) to compress the beta system and pull the beta ring forward to permit installation of the double hex head propeller mounting bolts.

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

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

(2) With a suitable crane hoist and sling, carefully move the propeller assembly to the aircraft engine mounting flange.

(a) Some propellers may require installation of an accessory drive pulley. If installation procedures are not in this manual, refer to the aircraft manufacturer's instructions.

(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.

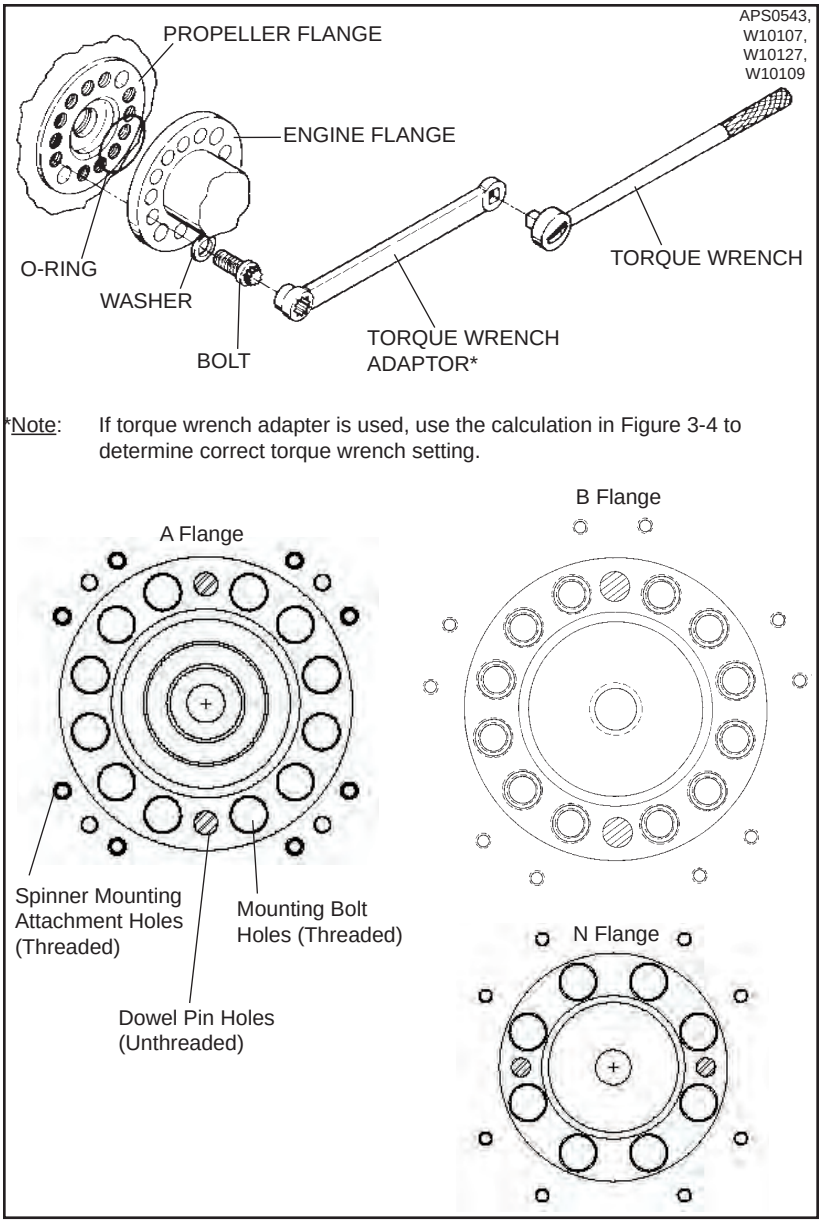
(5) Install the specified O-ring on the engine flange. Refer to Table 3-1.

(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.

Flange	O-ring	Bolt/Stud	Washer	Nut
A (except E5A-2)	C-3317-239-2	B-3347	A-2048-2	n/a
E5A-2	C-3317-239-2	B-7435	A-2048-2	C-6006
B	C-3317-239-2	B-3347	A-2048-2	n/a
N	C-3317-230	B-3339-1	A-2048-2	n/a

Propeller/Engine Flange O-rings and Mounting Hardware
Table 3-1



Installing Propeller on Engine Flange
Figure 3-2

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

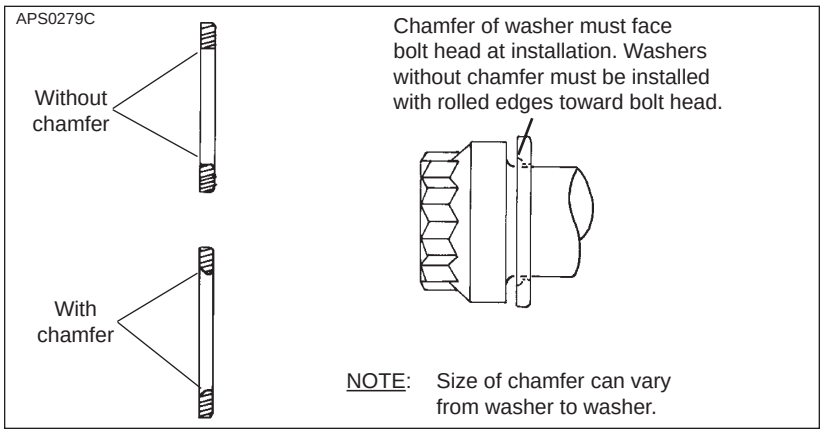
CAUTION 2: NEW PROPELLER MOUNTING BOLTS MUST BE USED WHEN INITIALLY INSTALLING A NEW OR OVERHAULED PROPELLER.

(8) Apply MIL-PRF-83483( ) (Hartzell Part No. 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.

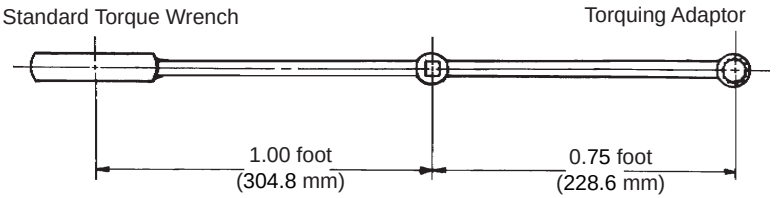
CAUTION: ID CHAMFER OF WASHER MUST BE FACING TOWARD THE BOLT HEAD. WASHERS WITHOUT CHAMFER MUST BE INSTALLED WITH ROLLED EDGES TOWARD THE BOLT HEAD. (REFER TO FIGURE 3-3).

(9) Install the mounting bolts with washers through the engine flange and into the propeller hub flange. Refer to Figure 3-2.



Mounting Bolt and Washer
Figure 3-3

APS0212A



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

EXAMPLE:

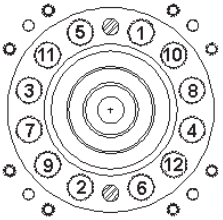
$$\frac{\text{100 Ft-Lb (136 N•m) x 1 ft (308.4 mm)}}{\text{1 ft (308.4 mm) + 0.75 ft (228.6 mm)}} = \text{57.1 Ft-Lb (77.4 N•m)} < \text{reading on torque wrench with 9-inch (228.6 mm) adapter for actual torque of 100 Ft-Lb (136 N•m)}$$

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.

Determining Torque Value When Using Torquing Adaptor
Figure 3-4

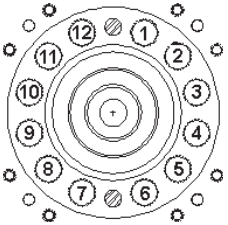
W10107C,
W10107B,
W10108C,
W10109C,
W10109B

A or B Flange



SEQUENCE A

Use Sequence A for steps one and two.

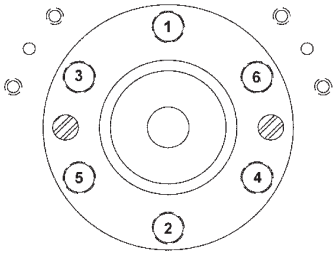


SEQUENCE B

Use Sequence B for step three.

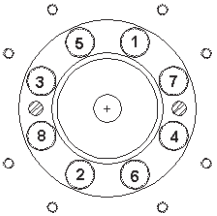
Step 1 - Torque all bolts to 40 Ft-Lbs (54 N•m).
Step 2 - Torque all bolts to 80 Ft-Lbs (108 N•m).
Step 3 - Torque all bolts to Table 3-2.

F Flange



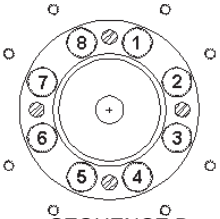
Step 1 -Torque all bolts to 40 Ft-Lbs (54 N•m).
Step 2 -Torque all bolts to Table 3-2.

N Flange



SEQUENCE A

Use Sequence A for steps one and two.



SEQUENCE B

Use Sequence B for step three.

Step 1 - Torque all bolts to 40 Ft-Lbs (54 N•m).
Step 2 - Torque all bolts to 80 Ft-Lbs (108 N•m).
Step 3 - Torque all bolts to Table 3-2.

Diagram of Torquing Sequence for Propeller Mounting Bolts
Figure 3-5

CAUTION 1: 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 3-4 FOR TORQUE READING WHEN USING A TORQUE WRENCH ADAPTER.

A flange propeller mounting bolts (except E5A-2)	100-105 Ft-Lbs (136-142 N•m) Wet
E5A-2 flange propeller mounting nuts	120-130 Ft-Lbs (163-176 N•m) Wet
B flange propeller mounting bolts	100-105 Ft-Lbs (136-142 N•m) Wet
N flange propeller mounting bolts	100-105 Ft-Lbs (136-142 N•m) Wet
Adapter Plate to Hub bolts - B-3384-4H	8-10 Ft-Lbs (10.8-13.5 N•m)
Slip Ring and adapter Plate Unit to Hub screws - A-2070-7	8-10 Ft-Lbs (10.8-13.5 N•m)
Bulkhead to Adapter Plate screws -B-3867-269	Until snug
Pulley to Adapter Ring - Pilatus fastener	48 In-Lbs (5.4 N•m)

Torque Table
Table 3-2

(10) Using a torque wrench and a torque wrench adapter Hartzell P/N AST-2877, torque all mounting bolts in sequences and steps shown in Figure 3-5. Refer to Table 3-2 and Figure 3-4 to determine the proper torque value.

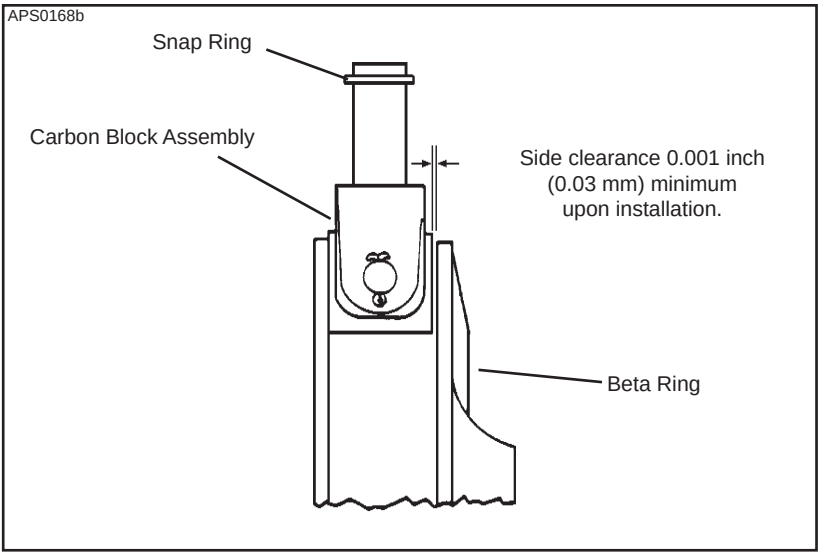
(11) Safety all mounting bolts with 0.032 inch (0.81 mm) minimum diameter stainless steel wire. (Two bolts per safety.)

(12) Decompress and remove the beta system puller.

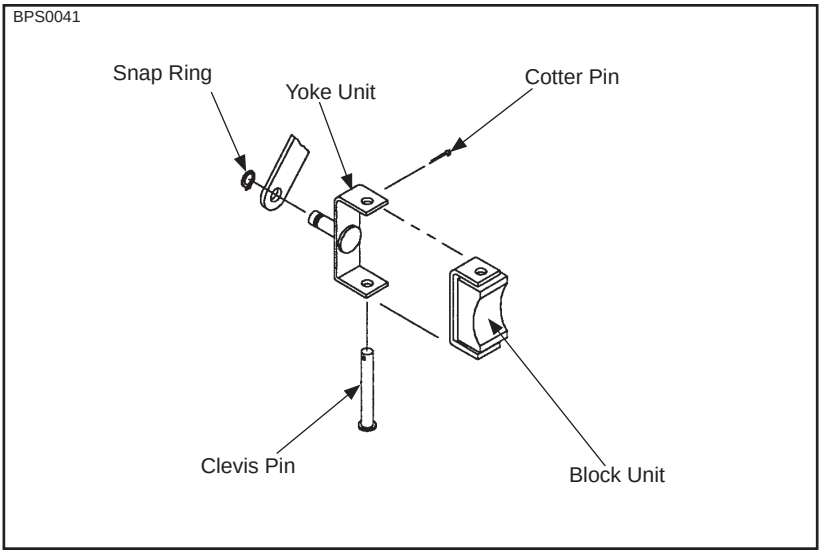
CAUTION: THE BETA FEEDBACK COLLAR MUST NOT CONTACT ANY ENGINE COMPONENT OR MOUNTING BOLT SAFETY WIRE. THE BETA MECHANISM FEEDBACK COULD BE DAMAGED IF IT CONTACTED ANY STATIC ENGINE COMPONENT WHILE ROTATING.

(13) Examine the beta feedback collar to make sure that it is not in contact with any engine components or mounting bolt safety wire.

(a) If there is contact between the beta feedback collar and any engine components or mounting bolt safety wire, consult qualif ed personnel at an appropriately licensed propeller service facility.



Carbon Block and Beta Ring Clearance
Figure 3-6



Carbon Block Assembly
Figure 3-7

(14) Install the carbon block into the beta linkage lever, per the airframe manufacturer's instructions.

CAUTION: FIT THE BLOCK IN THE BETA RING WITH A MINIMUM SIDE CLEARANCE OF 0.001 INCH (0.03 mm). REFER TO FIGURE 3-6.

(15) Install the carbon block assembly (Figure 3-7) into the beta ring.

(16) Install, adjust and safety the beta linkage per the airframe manufacturer's instructions.

(17) If the propeller is equipped with an accessory drive pulley, follow the applicable manufacturer's instructions for installation of the accessory drive pulley hardware.

(18) If the propeller is equipped with an ice protection system that uses components supplied by Hartzell Propeller Inc., applicable instructions and technical information for the components supplied by Hartzell can be found in the following publications available on the Hartzell web site at www.hartzellprop.com:

(a) Manual 180 (30-61-80) - Propeller Ice Protection System Manual

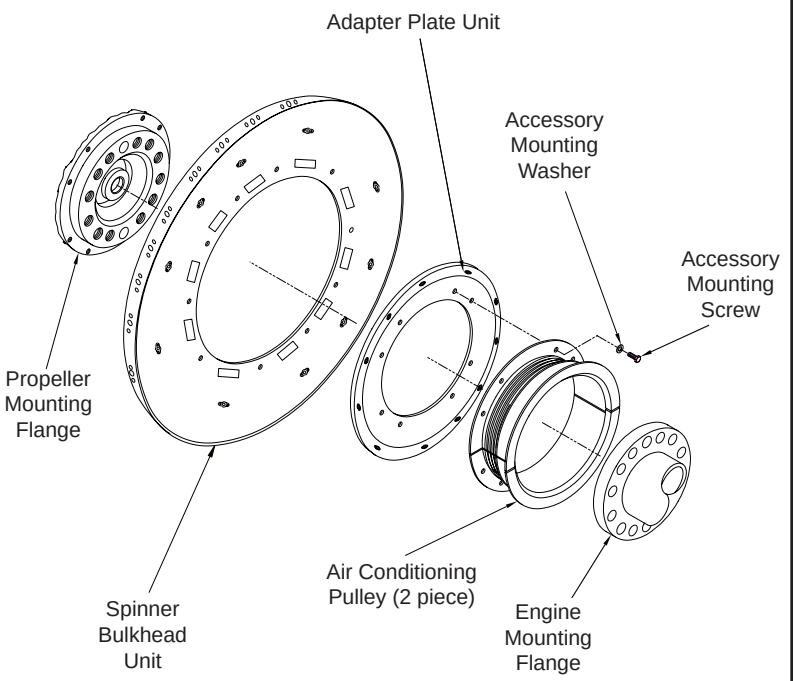
(b) Manual 181 (30-60-81) - Propeller Ice Protection Component Maintenance Manual

(c) Manual 182 (61-12-82) - Propeller Electrical De-ice Boot Removal and Installation Manual

(d) Manual 183 (61-12-83) - Propeller Anti-icing Boot Removal and Installation Manual

(19) Propeller ice protection system components not supplied by Hartzell Propeller Inc. are controlled by the applicable TC or STC holder's Instructions for Continued Airworthiness (ICA).

147AIR_CON2.eps



Part Description	Part Number
Air Conditioning Pully	Pilatus Part
Adapter Plate Unit	Hartzell Part Number D-6663
Accessory Mounting Screw	Pilatus Part
Accessory Mounting Washer	Pilatus Part

Air Conditioning Drive Accessories
Table 3-3

C. Installing HC-E5A-2 Propeller on the Aircraft Engine

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

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

(1) With a suitable crane hoist and sling, carefully move the propeller assembly to the aircraft engine mounting flange.

(a) Some propellers may require installation of an accessory drive pulley. If installation procedures are not in this manual, refer to the aircraft manufacturer's instructions.

(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) For propeller models without air conditioning accessories or de-ice:

(a) Apply Loctite 222 low strength threadlocker to the B-3867-269 screws.

(b) Using the B-3867-269 screws and B-3860-10L washers, attach the spinner bulkhead unit to the adapter plate unit.

(c) Attach the adapter plate unit to the hub using B-3837-0432 washers and B-3384-4H bolts. Torque the B-3384-4H bolts in accordance with the torque specified in Table 3-2.

(d) Using 0.032 inch (0.81 mm) stainless steel aircraft safety wire, safety wire the B-3384-4H bolts.

(6) For propeller models with air conditioning accessories and de-ice:

(a) Apply Locktite 222 low strength threadlocker to the B-3867-269 screws.

(b) Using the B-3867-269 screws and B-3860-10L washers, attach the spinner bulkhead unit to the adapter plate unit.

(c) Attach the slip ring and adapter plate unit to the hub using A-2070-7 screws. Torque the A-2070-7 screws in accordance with the torque specified in Table 3-2.

(d) Align the dowel pin holes in the propeller hub flange with the dowel pins in 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 NUTS MUST BE USED WHEN INITIALLY INSTALLING A NEW OR OVERHAULED PROPELLER.

(7) Apply a MIL-PRF-83483( ) (Hartzell Part No. 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 nuts and washers may be reused if they are not damaged or corroded.

CAUTION: DO NOT DISLODGE THE MOUNTING STUDS FROM THE PRESS FIT IN THE HUB MOUNTING FLANGE WHEN INSTALLING THE PROPELLER. IF A STUD IS DISLODGED FROM THE CORRECT POSITION, THE STUD MUST BE CORRECTLY REINSTALLED IN ACCORDANCE WITH HARTZELL STANDARD PRACTICES MANUAL 202A (61-01-02).

(8) Slide the propeller flange onto the engine flange.

(9) Install the mounting nuts with washers on the mounting studs.

(10) Use a torque wrench and a torque wrench adaptor Hartzell part number AST-2877-1 or equivalent to torque all mounting nuts in sequences and steps shown in Figure 3-5. Refer to Table 3-2 and Figure 3-4 to determine the proper torque value.

(11) Safety all mounting nuts with 0.032 inch (0.81 mm) minimum diameter stainless steel wire. (Two nuts per safety.)

(12) If the propeller is equipped with an accessory drive pulley, follow the applicable manufacturer's instructions for installation of the accessory drive pulley hardware.

(13) If the propeller is equipped with an ice protection system that uses components supplied by Hartzell Propeller Inc., applicable instructions and technical information for the components supplied by Hartzell can be found in the following publications available on the Hartzell web site at www.hartzellprop.com:

   (a) Manual 180 (30-61-80) - Propeller Ice Protection System Manual

   (b) Manual 181 (30-60-81) - Propeller Ice Protection Component Maintenance Manual

   (c) Manual 182 (61-12-82) - Propeller Electrical De-ice Boot Removal and Installation Manual

   (d) Manual 183 (61-12-83) - Propeller Anti-icing Boot Removal and Installation Manual

(14) Propeller ice protection system components not supplied by Hartzell Propeller Inc. are controlled by the applicable TC or STC holder's Instructions for Continued Airworthiness (ICA).

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D. Installing HC-E5B-5A Propeller on the Aircraft Engine

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

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

(1) With a suitable crane hoist and sling, carefully move the propeller assembly to the aircraft engine mounting flange.

(a) Some propellers may require installation of an accessory drive pulley. If installation procedures are not in this manual, refer to the aircraft manufacturer's instructions.

(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) Align the mounting and dowel pin holes in the propeller hub flange with the mounting holes and dowel pins in the engine flange.

(6) 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.

(7) Apply MIL-PRF-83483( ) (Hartzell Part No. A-3338-[ ]) anti-seize compound to the threaded surfaces of the mounting bolts. Refer to Table 3-1 for the appropriate mounting hardware.

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

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 3-3).

(8) Install the mounting bolts with washers through the engine flange and into the propeller hub flange. Refer to Figure 3-2.

(9) Use a torque wrench with a torque wrench adapter Hartzell P/N AST-2877 to torque all mounting bolts in sequences and steps shown in Figure 3-5. Refer to Table 3-2 and Figure 3-4 to determine the proper torque value.

(10) Safety all mounting bolts with 0.032 inch (0.81 mm) minimum diameter stainless steel wire. (Two bolts per safety.)

(11) Install the beta tube per airframe and/or engine manufacturer's instructions.

NOTE 1: Follow the airframe manufacturer's instructions for adjusting the beta tube to obtain the correct low pitch (flight idle blade angle).

NOTE 2: Refer to the Aircraft Type Certificate Data Sheet for the low pitch blade angle setting.

(12) If the propeller is equipped with an accessory drive pulley, follow the applicable manufacturer's instructions for installation of the accessory drive pulley hardware.

(13) If the propeller is equipped with an ice protection system that uses components supplied by Hartzell Propeller Inc., applicable instructions and technical information for the components supplied by Hartzell can be found in the following publications available on the Hartzell web site at www.hartzellprop.com:

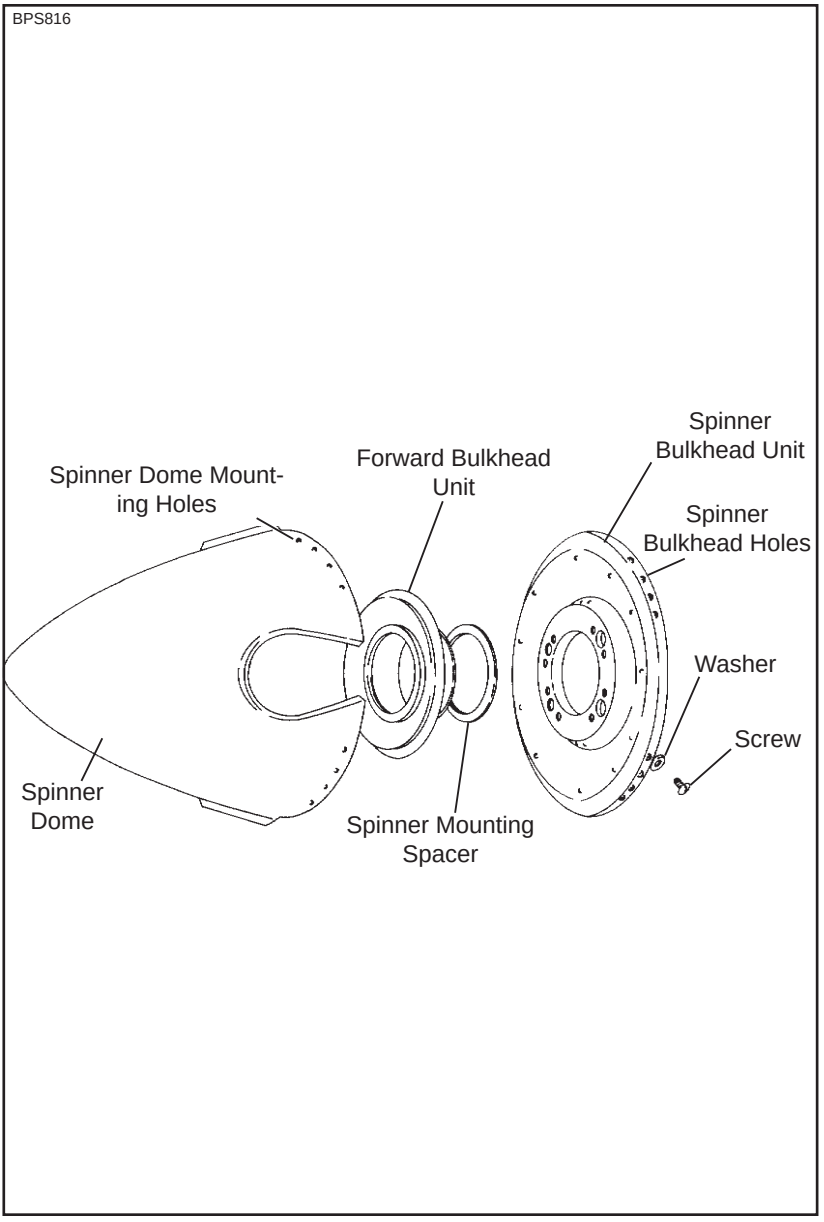
(a) Manual 180 (30-61-80) - Propeller Ice Protection System Manual

(b) Manual 181 (30-60-81) - Propeller Ice Protection Component Maintenance Manual

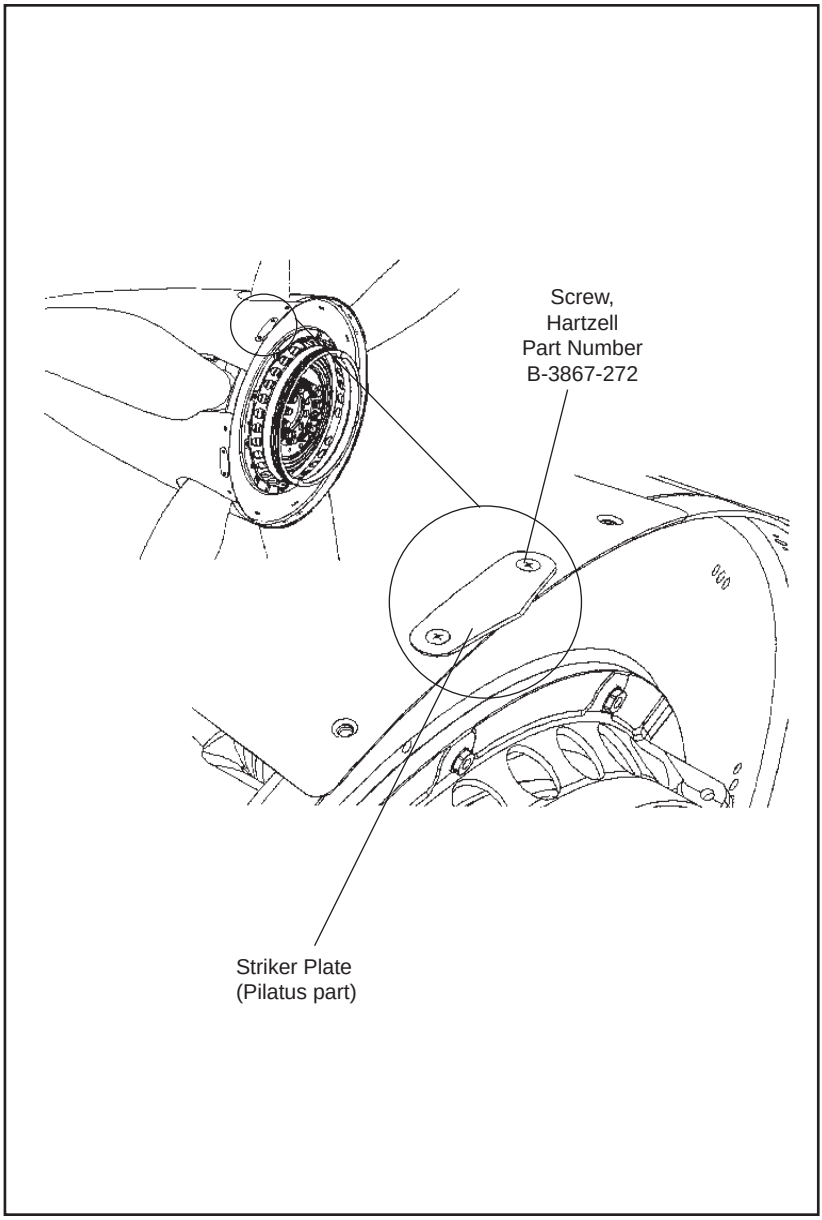
(c) Manual 182 (61-12-82) - Propeller Electrical De-ice Boot Removal and Installation Manual

(d) Manual 183 (61-12-83) - Propeller Anti-icing Boot Removal and Installation Manual

(14) Propeller ice protection system components not supplied by Hartzell Propeller Inc. are controlled by the applicable TC or STC holder's Instructions for Continued Airworthiness (ICA).



Spinner Assembly
Figure 3-8



Striker Plate
Figure 3-9

4. Spinner Installation

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

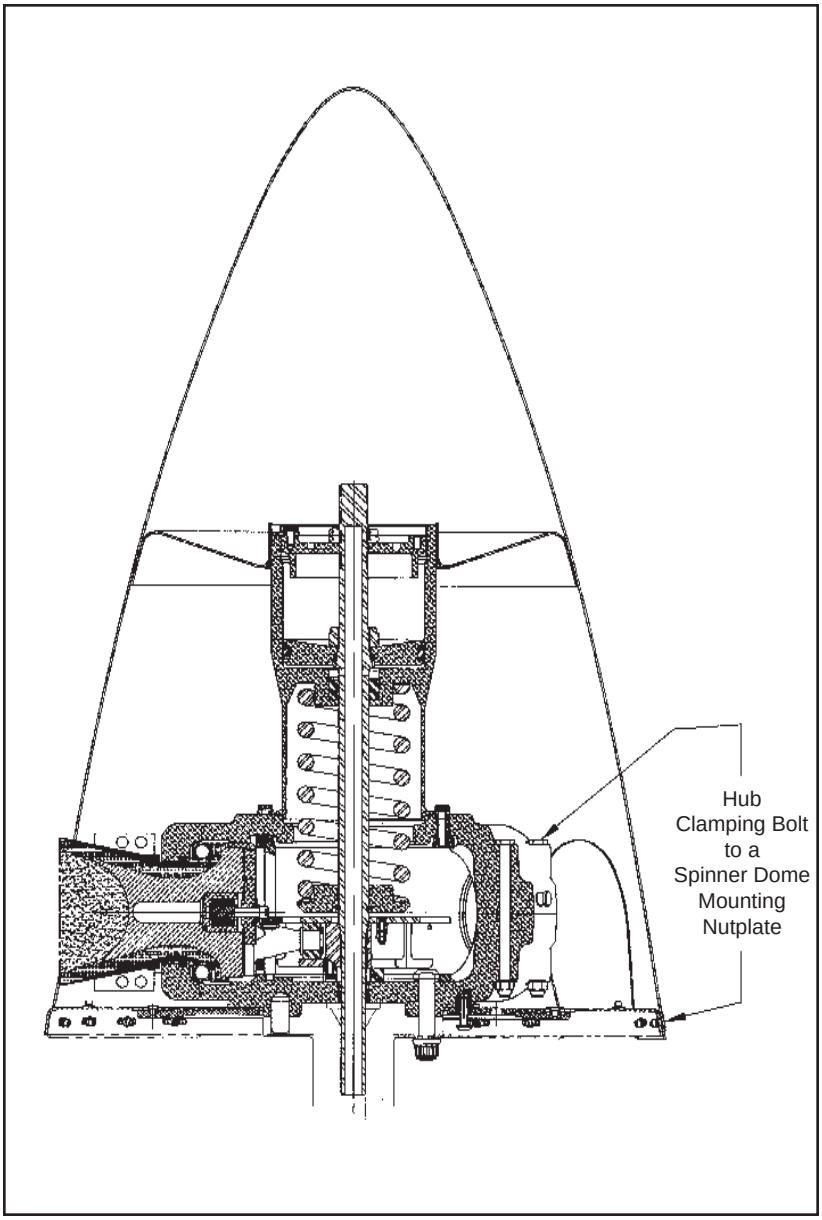
NOTE: The following instructions relate to Hartzell spinners only. In some cases, the airframe manufacturer produced the spinner assembly. Refer to the airframe manufacturer's manual for spinner installation instructions.

A. For Propeller model HC-E5A-2, install the striker plates (Pilatus part). Refer to Figure 3-9.

(1) The striker plates must have a curvature to match that of the dome and must have a weight of not more than 0.458 ounces (13 grams).

(2) Using screws, part number B-3867-272, install the striker plates centered between the blades, using the mounting holes provided.

NOTE: Washers, part number B-3860-10L, are not used at the striker plate attachment points.



Resistance Check Locations
Figure 3-10

B. For Propeller model HC-E5A-2, perform resistance checks.

(1) Using an ohm meter capable of 20 Megohms, measure the resistance from the hub clamping bolt to a spinner dome mounting nutplate on the bulkhead. Refer to Figure 3-10.

(2) Perform a resistance check of the dome unit before installation.

NOTE: The dome is not installed on the bulkhead.

(a) In each of two dome mounting holes with the maximum distance possible between them, install a screw with washers and a nut in accordance with the information in Figure 3-11.

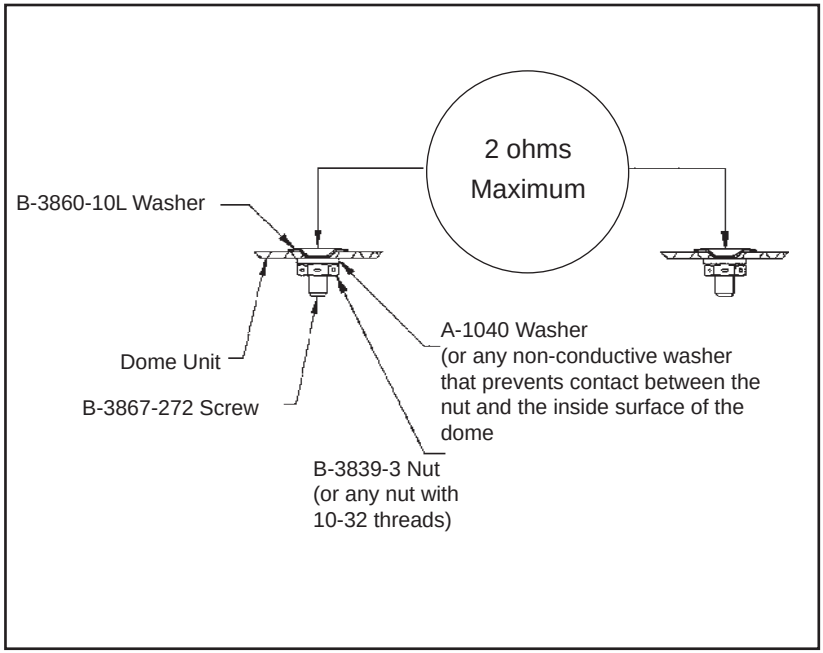
(b) Using an ohm meter capable of 20 Megohms, measure the resistance from one screw in a dome mounting hole to the other screw in a dome mounting hole. Refer to Figure 3-11 and Table 3-4 for limits.

a If the resistance measurement is not satisfactory, clean the contact points using a solvent such as Stoddard Kwik Dry solvent or equivalent and repeat the resistance measurement.

b If the resistance measurement is not satisfactory for the two holes after cleaning, use two different holes with the maximum distance possible between them and repeat the measurement. Repeat the measurement using different holes with the maximum distance possible between them until the resistance measurement is satisfactory.

c If after measuring between all possible combinations of holes the resistance measurement is not satisfactory, contact Hartzell Propeller Inc. for assistance.

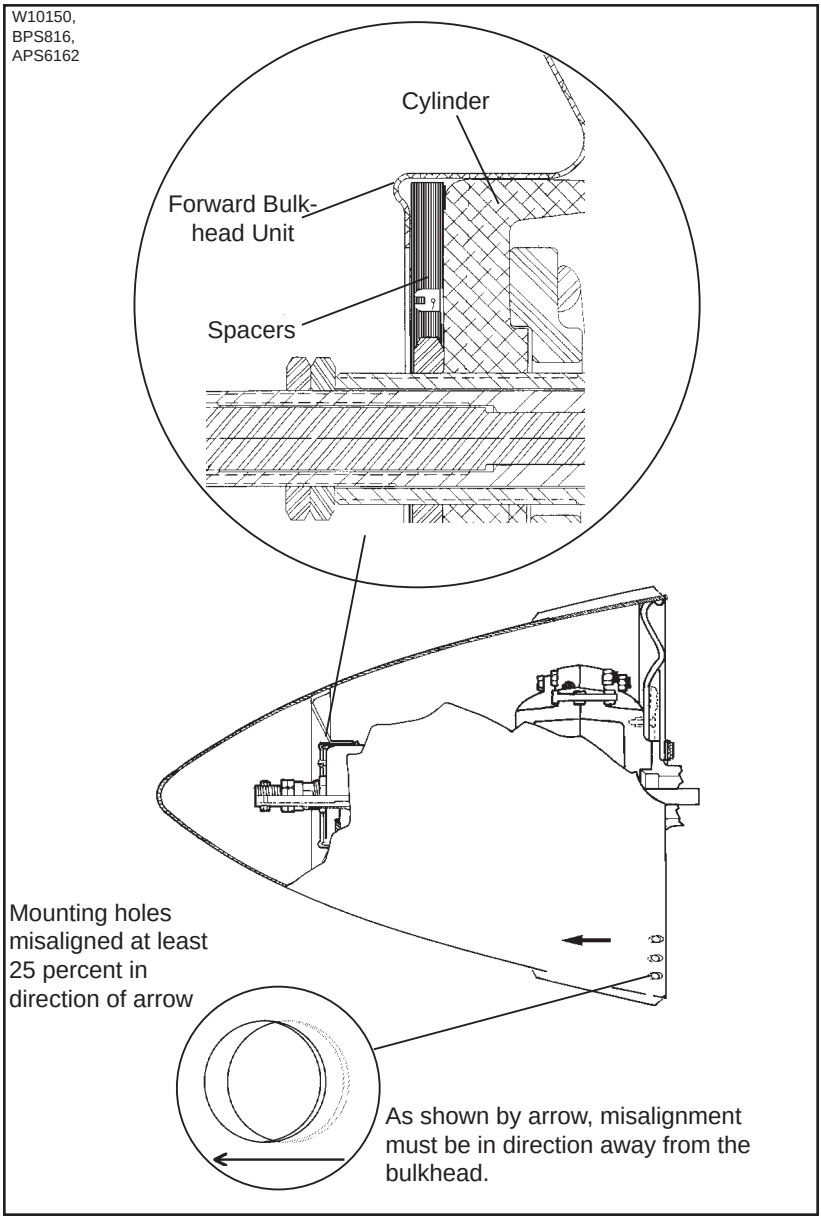
(c) Remove the hardware from the dome mounting holes that was used for the resistance check of the dome.



Resistance Check of the Dome
Figure 3-11

Area to Check	Value
Hub Clamping Bolt to the Spinner Dome Mounting Nutplate	2 ohms Maximum
One Screw in Dome Mounting Hole to Another Screw in a Dome Mounting Hole	2 ohms Maximum

Resistance Checks
Table 3-4



Spinner Reassembly Procedures
Figure 3-12

C. The spinner dome is supported by a forward bulkhead unit (see Figure 3-8) that encircles the propeller cylinder.

(1) For propellers in this manual other than the HC-E5A-2, if the forward bulkhead unit does not fit snugly on the cylinder, the cylinder may need to be wrapped with one or more layers of fluoroglas or UHMW tape (Hartzell P/N B-6654-100). Apply a layer of tape, check, and repeat until the forward bulkhead unit fits snugly on the cylinder.

NOTE 1: The forward bulkhead unit is positioned away from the cylinder with spacers to cause the spinner dome mounting holes to stop short of full alignment with the bulkhead holes by 25 percent of the spinner dome mounting hole diameter. (Refer to Figure 3-12.)

NOTE 2: Positioning of the spinner dome mounting holes and forward bulkhead unit is accomplished by installing or removing spacers that are between the cylinder and forward bulkhead. (Refer to Figure 3-12.)

(2) For the HC-E5A-2 propeller apply one or more layers of fluoroglas or UHMW tape (Hartzell P/N B-6654-100) to the forward bulkhead where the bulkhead touches the cylinder. Apply a layer of tape, check, and repeat until the forward bulkhead unit fits snugly on the cylinder.

D. Carefully slide the spinner dome over the propeller and forward bulkhead to check for proper positioning of the spinner dome mounting holes. Add or remove spacers, if applicable, to obtain the spinner dome mounting hole and spinner bulkhead hole misalignment. (Refer to Figure 3-12.)

E. Push the spinner dome with firm pressure toward the spinner bulkhead unit to make sure that the spinner dome mounting holes will fully align with the spinner bulkhead holes. Remove a minimum quantity of spacers to obtain hole alignment while maintaining preload.

F. Attach the spinner dome to the spinner bulkhead with the supplied screws and washers.

5. Post-Installation Checks
   A. Refer to the airframe manufacturer's instructions for post-installation checks.
   B. Perform a Static RPM Check as outlined in the Maintenance Practices chapter of this manual.

6. Spinner Removal

   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.

   A. Remove the screws and washers that secure the spinner dome to the spinner bulkhead.
   B. Remove the spinner dome.

7. Propeller Removal

A. Removal of HC-E4( )-3( ) Propellers

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

(2) If the propeller is equipped with an ice protection system that uses components supplied by Hartzell Propeller Inc., applicable instructions and technical information for the components supplied by Hartzell can be found in the following publications available on the Hartzell web site at www.hartzellprop.com:

(a) Manual 180 (30-61-80) - Propeller Ice Protection System Manual

(b) Manual 181 (30-60-81) - Propeller Ice Protection Component Maintenance Manual

(c) Manual 182 (61-12-82) - Propeller Electrical De-ice Boot Removal and Installation Manual

(d) Manual 183 (61-12-83) - Propeller Anti-icing Boot Removal and Installation Manual

(3) Propeller ice protection system components not supplied by Hartzell Propeller Inc. are controlled by the applicable TC or STC holder's Instructions for Continued Airworthiness (ICA).

(4) Disconnect the engine beta linkage and carbon block assembly from the beta ring per the airframe manufacturer's instructions.

(a) Remove the snap ring that retains the carbon block assembly to the beta linkage. Refer to Figure 3-7.

(b) Remove the carbon block assembly. Refer to Figure 3-6.

(5) Use the beta system puller CST-2987 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 3-1.

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 MANUALS 143A (61-10-43) OR 158A (61-10-58).

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

(6) Cut and remove the safety wire on the propeller mounting bolts.

(7) Support the propeller assembly with a sling.

NOTE 1: 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.

NOTE 2: 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.

NOTE: 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) Place the propeller on a suitable cart for transportation.

B. Removal of HC-E5A-2 Propellers

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

(2) If the propeller is equipped with an ice protection system that uses components supplied by Hartzell Propeller Inc., applicable instructions and technical information for the components supplied by Hartzell can be found in the following publications available on the Hartzell web site at www.hartzellprop.com:

(a) Manual 180 (30-61-80) - Propeller Ice Protection System Manual

(b) Manual 181 (30-60-81) - Propeller Ice Protection Component Maintenance Manual

(c) Manual 182 (61-12-82) - Propeller Electrical De-ice Boot Removal and Installation Manual

(d) Manual 183 (61-12-83) - Propeller Anti-icing Boot Removal and Installation Manual

(3) Propeller ice protection system components not supplied by Hartzell Propeller Inc. are controlled by the applicable TC or STC holder's Instructions for Continued Airworthiness (ICA).

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 157 (61-10-57).

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

(4) Cut and remove the safety wire on the propeller mounting nuts.

(5) Support the propeller assembly with a sling.

NOTE 1: 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 bolt removal.

NOTE 2: 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.

(6) Remove the propeller mounting nuts and washers.

NOTE: 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.

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

(8) Remove and discard the propeller mounting O-ring.

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

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

C. Removal of HC-E5B-5A Propellers

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

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

(2) If the propeller is equipped with an ice protection system that uses components supplied by Hartzell Propeller Inc., applicable instructions and technical information for the components supplied by Hartzell can be found in the following publications available on the Hartzell web site at www.hartzellprop.com:

(a) Manual 180 (30-61-80) - Propeller Ice Protection System Manual

(b) Manual 181 (30-60-81) - Propeller Ice Protection Component Maintenance Manual

(c) Manual 182 (61-12-82) - Propeller Electrical De-ice Boot Removal and Installation Manual

(d) Manual 183 (61-12-83) - Propeller Anti-icing Boot Removal and Installation Manual

(3) Propeller ice protection system components not supplied by Hartzell Propeller Inc. are controlled by the applicable TC or STC holder's Instructions for Continued Airworthiness (ICA).

CAUTION: THE BETA TUBE MUST BE REMOVED BEFORE THE PROPELLER ASSEMBLY IS REMOVED FROM THE AIRCRAFT. REFER TO THE AIRCRAFT MAINTENANCE INSTRUCTION MANUAL.

(4) Remove beta tube.

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 MANUALS 143A (61-10-43) OR 158A (61-10-58).

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

(5) Cut and remove the safety wire on the propeller mounting bolts.

(6) Support the propeller assembly with a sling.

NOTE 1: 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.

NOTE 2: 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.

(7) Remove the propeller mounting bolts and washers.

NOTE: 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.

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

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

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

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

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TESTING AND TROUBLESHOOTING - CONTENTS

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1. Operational Tests

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

   A. Initial Run-Up

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

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

      (2) Cycle the propeller control throughout its operating blade angle range from reverse or low, to high (or as directed by the POH).

      (3) Repeat this procedure at least three times to purge air from the propeller hydraulic system and to introduce warmed oil to the cylinder.

      (4) Verify proper operation from low pitch to high pitch and throughout operating range.

      (5) Shut down engine in accordance with the POH.

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

   B. Post-Run Check

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

   C. Maximum RPM (Static) Hydraulic Low Pitch Stop Check

      (1) The Maximum RPM (hydraulic low pitch stop) is normally set at the factory per the aircraft manufacturer's requirements, and should not require any additional adjustment. Adjustments may be required after maintenance or because of specific aircraft variances.

      (2) Adjustments must be done in accordance with the airframe manufacturer's specification found in the airframe manufacturer's manual.

D. Reverse Pitch Stop Adjustment

(1) The reverse pitch stop adjustment is set at the factory per the aircraft manufacturer's recommendations. This stop is adjustable only by an appropriately licensed propeller repair facility, aircraft manufacturer, or the Hartzell factory.

E. Feathering Pitch Stop Adjustment

(1) The feathering pitch stop is set at the factory per the aircraft manufacturer's recommendations. This stop is adjustable only by an appropriately licensed propeller repair facility, aircraft manufacturer, or the Hartzell factory.

F. Start Lock Adjustment

(1) The start locks are set at the factory per manufacturer's recommendations. These start locks are adjustable only by an appropriately licensed propeller repair facility or at the Hartzell factory.

G. Propeller Ice Protection System

(1) Consult the Pilot Operating Handbook (POH) (including all supplements) regarding flight into conditions of known icing. The aircraft may not be certificated for flight in known icing conditions, even though propeller de-ice equipment is installed.

(2) Refer to the Anti-ice and De-ice Systems chapter of this manual for functional tests of the ice protection system.

2. Troubleshooting

A. Hunting and Surging

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

(1) If propeller is hunting, an appropriately licensed propeller repair facility should check:

(a) Governor

(b) Fuel control

(c) Synchrophaser, or synchronizer.

(2) If propeller is surging:

(a) Perform the steps 1.A.(1) through 1.A.(5) under Operational Tests section in this chapter to release trapped air from the propeller. If surging reoccurs it is most likely due to a faulty governor. Have the governor tested by an appropriately licensed propeller repair facility.

(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.

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

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 not engaging.

(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)

(1) Broken feathering spring.

(2) Check for proper function and rigging of propeller/governor control linkage.

(3) Check governor drain function.

(4) Propeller must be checked for misadjustment or internal corrosion (usually in blade bearings or pitch changing mechanism) that results in excessive friction. This must be accomplished at a propeller repair facility.

E. Failure to Unfeather

(1) Check for proper function and rigging of propeller control linkage.

(2) Check governor function.

(3) Propeller must be checked for misadjustment or internal corrosion (usually in blade bearings or pitch change mechanism) that results in excessive friction. This must be accomplished at an appropriately licensed propeller repair facility.

F. Start Locks Fail to Latch on Shutdown

(1) Propeller was feathered before shutdown.

(2) Shutdown occurred at high RPM with propeller control off the low pitch stop.

The problem may be solved by restarting the engine, placing the propeller control in the proper shutdown position, and then shutting down the engine.

(3) Excessive governor pump leakage.

The problem should be referred to an appropriately licensed propeller repair facility.

(4) Broken Start Locks.

The problem should be referred to an appropriately licensed propeller repair facility.

G. Vibration

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

NOTE: Vibration problems due to propeller system imbalance are normally felt throughout the RPM range, with the intensity of vibration increasing with RPM. Vibration problems that occur in a narrow RPM range are a symptom of resonance, and are potentially harmful to the propeller. Avoid operation in that RPM range until the propeller can be checked by an appropriately licensed repair facility.

(1) Check:

(a) Control surfaces, exhaust system, landing gear doors, etc. for excessive play, which may be causing vibration unrelated to the propeller.

(b) Uneven lubrication of propeller.

(c) Proper engine/propeller flange mating.

(d) Blade track. (See the Inspection and Check chapter of this manual for procedure.)

(e) Blade angles: Blade angle must be within tolerance between blades and on the propeller as a whole. Refer to the Propeller Overhaul Manuals 143A (61-10-43) or 158A (61-10-58) for blade angle check procedure.

(f) Spinner for cracks, improper installation, or "wobble" during operation.

(g) Static balance.

(h) Airfoil profile identical between blades (after overhaul or rework - verify at an appropriately licensed repair facility).

(i) Hub or blade for damage or cracking.

(j) Grease or oil leakage from a seemingly solid surface of the hub or blade.

(k) Blade delamination.

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

J. Oil or Grease Leakage

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

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

(1) Grease Leakage - Probable Cause:

(a) Improperly torqued or loose lubrication fitting.

(b) Defective lubrication fitting.

(c) Faulty seal at the blade socket between the blade and hub. (Refer to an appropriately licensed propeller repair facility for replacement of the seal).

(d) HC-E4( )-3( ): Leakage from the hub and beta rod interface.

1 Over greased hub. (Refer to an appropriately licensed propeller repair facility for removal of excess grease.)

2 Faulty seal. (Refer to an appropriately licensed repair facility for replacement of seal.)

(e) Cracked hub. A cracked hub is often indicated by grease emerging from a seemingly solid surface, especially in the blade arm. (Refer to an appropriately licensed repair facility.)

(2) Oil Leakage - Probable Cause

(a) Leaks between the hub and cylinder - Faulty or missing seal between the hub and the cylinder.

Refer seal replacement to an appropriately licensed repair facility.

(b) Leaks between the hub halves, beta rod and hub, and lubrication fittings - Faulty seal(s) between hub and the pitch change rod.

Refer seal replacement to an appropriately licensed repair facility.

(c) Leaks from the front of the cylinder or through start lock units - Faulty seal(s) between the piston and cylinder or piston and pitch change rod.

Refer seal replacement to an appropriately licensed repair facility.

(d) Leaks between the hub and engine - Faulty or missing seal between the propeller hub and the engine flange.

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1. Pre-Flight Checks

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

A. Blades

(1) Visually inspect the entire blade and the erosion shield for nicks, gouges, looseness of material, erosion, cracks, and debonds. Refer to the Maintenance Practices chapter of this manual for composite blade airworthy damage limits.

(2) Visually inspect the blades for lightning strike. Refer to the Lightning Strike section in this chapter for a description of damage.

(3) Defects or damage discovered during preflight inspection must be evaluated in accordance with allowables outlined in the Maintenance Practices chapter of this manual to determine if repairs are required before further flight.

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

C. Check for loose/missing hardware. Retighten or reinstall as necessary.

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

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

E. Check the blades for radial play or movement of the blade tip (in and out or back and forth). Refer to Loose Blades in the Inspection Procedures section of this chapter for blade play limits.

F. Inspect de-ice boots (if installed) for damage. Refer to the Anti-ice and De-ice Systems chapter of this manual for inspection information.

G. Check the propeller speed control and operation from reverse or low pitch to high pitch, using the procedure specified in the Pilot Operating Handbook (POH) for the aircraft.

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

H. Perform initial run-up as outlined in the Operational Tests section of in the Testing and Troubleshooting chapter in this manual.

I. Check for any abnormal vibration during this run-up. If vibration occurs, shut the engine down, determine the cause, and correct it before further flight. Refer to the Vibration section in the Testing and Troubleshooting chapter of this manual.

J. Refer to the Periodic Inspections section of this chapter for additional inspection information and possible corrections to any discrepancies discovered as a result of pre-flight checks.

2. Operational Checks

   A. Following propeller installation or as required, perform initial run-up as outlined in Operational Tests in the Testing and Troubleshooting chapter of this manual.

   B. Check the propeller speed control and operation from reverse or low pitch to high pitch, using the procedure specified in the Pilot Operating Handbook (POH) for the aircraft.

   C. Check for any abnormal vibration during this run-up. If vibration occurs, shut the engine down, determine the cause, and correct it before further flight. Refer to the Vibration section in the Testing and Troubleshooting chapter of this manual.

   D. Refer to Periodic Inspections in this chapter for additional inspection information and possible corrections to any discrepancies discovered as a result of Pre-Flight Checks.

   E. Refer to the POH and/or AMM for aircraft manufacturers recommendations.

3. Required Periodic Inspections and Maintenance

A. Periodic Inspections

Except for the blade and erosion shield coin-tap inspection in this section, accomplish a detailed inspection at 400 hour intervals not to exceed twelve (12) calendar months. Procedures involved in these inspections are detailed below.

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

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

(1) Remove the spinner dome.

(2) Visually inspect the blade and the erosion shield for nicks, gouges, looseness of material, erosion, cracks and debonds. Refer to the Composite Blade Repairs section in the Maintenance Practices chapter of this manual for additional information. A cracked blade must be referred to an appropriately licensed propeller repair station. Do not attempt repair on a cracked blade.

(3) Visually inspect the hub parts for cracks or wear. Refer to Grease and Oil Leaks in the Inspection Procedures section of this chapter for procedure. A cracked hub must be referred to an appropriately licensed propeller repair facility. Do not attempt repair on a cracked hub.

(4) Check for oil and grease leaks. Refer to Grease and Oil Leaks in the Inspection Procedures section of this chapter.

(5) If a blade track problem is suspected, check the blade track. Refer to Blade Track in the Inspection Procedures section of this chapter.

(6) Check the preload plate set screw. Refer to Preload Plate Set Screw information in the Inspection Procedures section of this chapter.

(7) Blade and Erosion Shield Coin-tap

(a) For all blade designs except E10950P( ): Coin-tap (described in the Maintenance Practices chapter of this manual) the exposed section of the blade, not to exceed 1200 hours, and the exposed section of the erosion shield surface, not to exceed 600 hours. Coin-tapping will indicate a delamination or debond by an apparent audible change.

(b) For E10950P( ) blade design only: Coin-tap (described in the Maintenance Practices chapter of this manual) the exposed section of the blade, not to exceed 1200 hours, and the erosion shield surface, not to exceed 300 hours. Coin-tapping will indicate a delamination or debond by an apparent audible change.

B. Periodic Maintenance

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

C. Airworthiness Limitations

(1) Certain components, as well as the entire propeller may have specific life limits established as part of the certification by the FAA. Such limits call for mandatory replacement of specified parts after a defined number of hours and/or cycles of use.

(2) Life limited component times may exist for the propeller models 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 Service Bulletins and Service Letters, which are available from Hartzell distributors or from the Hartzell factory by subscription. Selected information is also available on Hartzell Propeller's website at www.hartzellprop.com.

D. Overhaul Periods

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

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

CAUTION 2: CHECK THE LATEST REVISION OF HARTZELL SERVICE LETTER 61( ) FOR THE MOST CURRENT INFORMATION.

(1) HC-(D,E)4( )-( ) series propellers

(a) Propellers used for normal, commuter, or transport category airplanes are to be overhauled at 4000 hours of operation or 60 calendar months, whichever occurs first.

(b) Propellers used on utility or aerobatic category airplanes are to be overhauled at 3500 hours of operation or 60 calendar months, whichever occurs first.

NOTE: Once used on utility or aerobatic category airplanes, the 3500 hours overhaul limit is to be maintained until an overhaul is accomplished, even if propeller is later installed on normal, commuter, or transport category airplanes.

(c) Agricultural aircraft are to be overhauled at 3500 hours of operation or 36 calendar months, whichever occurs first.

NOTE: Once used on agricultural aircraft, the 36 month overhaul limit is to be maintained until an overhaul is accomplished, even if propeller is later installed on other category airplanes.

(2) All other agricultural aircraft are to be overhauled at 3000 hours of operation or 36 calendar months, whichever occurs first.

NOTE: Once used on agricultural aircraft, the 36 month overhaul limit is to be maintained until an overhaul is accomplished, even if propeller is later installed on other category airplanes.

(3) HC-E5A-2 series propellers are to be overhauled at 3000 hours of operation or 60 calendar months, whichever occurs first.

(4) All other Hartzell lightweight propellers installed on turbine engines are to be overhauled at 4000 hours of operation or 60 calendar months, whichever occurs first.

(5) Propellers manufactured or overhauled since October 1991 are required to have the internal hub surface painted for additional corrosion protection. Hubs with painted internal surfaces have a 72 calendar month overhaul limit. Hubs that have not had the internal surface painted have a 60 calendar month overhaul limit until the hub internal surface is painted for corrosion protection. After the hub internal surface is painted, the calendar limit increases to 72 months. The calendar limit remains 36 months for agricultural aircraft.

4. Inspection Procedures

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

A. Blade Damage

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

B. Grease or Oil Leakage

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

Leakage that persists beyond the first ten hours of operation on a new or newly overhauled propeller, or that occurs on a propeller that has been in service for some time, will require repair. A determination should be made as to the source of the leak. The only leakage that is field repairable is the removal and replacement of the O-ring seal between the engine and propeller flange. All other leakage repairs should be referred to an appropriately licensed propeller repair facility. An instance of abnormal grease leakage should be inspected following the procedure below:

(1) Remove the spinner dome.

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

(2) Perform a visual inspection for cracks in the hub. A crack may be readily visible, or may be indicated by grease leaking from a seemingly solid surface. Extra attention should be given to the blade retention area of the hub.

(3) Perform a visual inspection of the hub, blades and blade retention areas to locate the origin of leakage. If the origin of the grease leakage is determined to be a noncritical part, such as an O-ring, gasket or sealant, repairs can be accomplished during scheduled maintenance, as long as flight safety is not compromised.

(4) If cracks are suspected, additional inspections must be performed before further flight. These inspections must be performed by qualified personnel at an appropriately licensed propeller repair facility to verify the condition. Such inspections typically include disassembly of the propeller in accordance with Hartzell Manuals 143A (61-10-43), 157 (61-10-57), or 158A (61-10-58).

(5) If cracks or failing components are found, these parts must be replaced before further flight. Report such incidents to the appropriate airworthiness authorities and Hartzell Propeller Inc. Product Support.

C. Vibration

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

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

(1) Perform troubleshooting and evaluation of possible sources of vibration in accordance with engine or airframe manufacturer's instructions.

(2) Refer to the Vibration section in the Testing and Troubleshooting chapter of this manual. Perform the checks to determine possible cause of the vibration. If no cause is found, then consider that the origin of the problem could be the propeller and proceed with steps 4.C.(3) through 4.C.(8) in this chapter.

(3) Remove the spinner dome.

(4) Perform a visual inspection for cracks in the hub and blades. Pay particular attention to the blade retention areas of the hub.

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

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

(6) Check the blades and compare blade-to-blade differences:

(a) Inspect the propeller blades for unusual looseness or movement. Refer to Loose Blades in this section.

(b) Check blade track. Refer to Blade Track in this section.

CAUTION: DO NOT USE BLADE PADDLES TO TURN BLADES.

(c) Manually (by hand) attempt to turn the blades (change pitch). Do not use a blade paddles.

(d) Visually check for damaged blades.

(7) If abnormal blade conditions or damage are found, perform additional inspections (by qualified personnel at an appropriately licensed propeller repair facility) to evaluate the condition. Refer to Composite Blades section in the Maintenance Practices chapter of this manual.

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

D. Tachometer Inspection

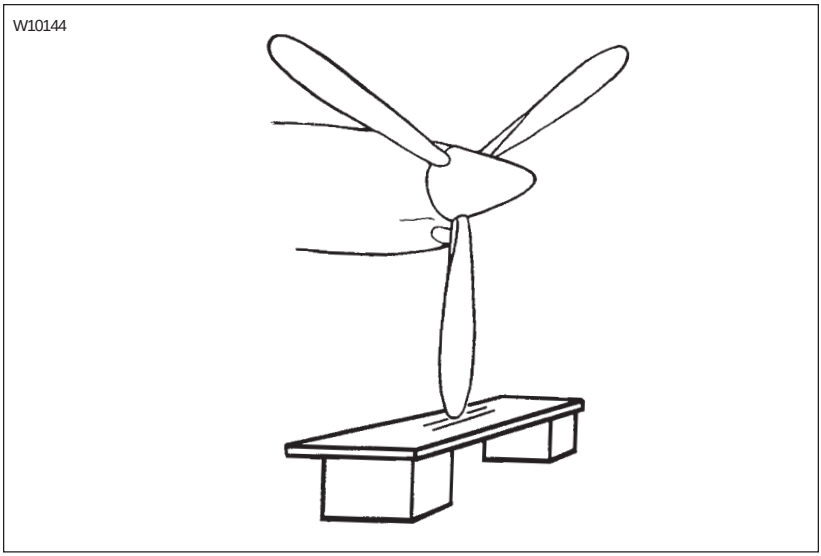
WARNING: OPERATION WITH AN INACCURATE TACHOMETER MAY RESULT IN OPERATION AT A RESTRICTED RPM AND DAMAGING HIGH STRESSES. BLADE LIFE WILL BE SHORTENED AND COULD RESULT IN CATASTROPHIC FAILURE.

NOTE: An appropriately licensed propeller repair facility may also be able to perform an engine tachometer inspection.

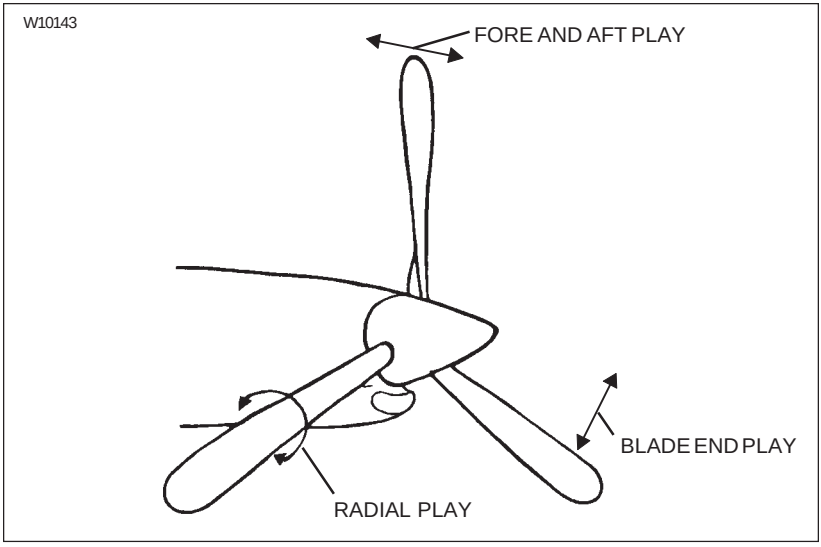
(1) For installations that use a mechanical tachometer, perform the following tachometer inspection.

(a) Use a hand held tachometer to verify the accuracy of the engine tachometer at 100 hour intervals or at annual inspection, whichever occurs first.

(b) Hartzell Propeller Inc recommends using a tachometer that is accurate within +/- 10 RPM, has NIST calibration (traceable), and has an appropriate calibration schedule.



Checking Blade Track
Figure 5-1



Blade Play
Figure 5-2

E. Blade Track

(1) If a blade track problem is suspected, examine the blade track as follows.

(2) For -2 and -3 turbines only, 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.

NOTE: 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 Screw the threaded rod of the tool onto the end of the pitch change rod as far as possible, hand tight.

2 Slide 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.

CAUTION: FOR -5 TURBINES ONLY, MAKE SURE THAT THE ENGINE WAS SHUT DOWN WITH THE PROPELLER ON THE LATCHES.

(a) Chock the aircraft wheels securely.

(b) Refer to Figure 5-1. Place a f xed reference point beneath the propeller, within 0.25 inch (6.4 mm) of the lowest point of the propeller arc.

NOTE: This reference point may be a f at 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.

(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 ± 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 f ange.

1 Examine the engine and propeller f anges for damage.

2 Repair any damage to the engine or propeller f ange. If necessary, refer to an appropriately licensed propeller repair facility.

(b) If no foreign matter is present, refer to an appropriately licensed propeller repair facility.

F. Loose Blades

For HC-E4A-3( ) propeller models only:

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

End Play	0.75 inch (19.0 mm)
Fore & Aft Movement	0.75 inch (19.0 mm)
In & Out	None
Radial Play (pitch change)	± 0.5 degree (1 degree total)

NOTE: Blades are intended to be tight in the propeller; however, movement less than the allowable limits is acceptable if the blade returns to its original position when released. Blades with movement greater than the allowable limits, or that do not return to their original position when released may indicate internal wear or damage that should be referred to an appropriately licensed propeller service facility.

G. Loose Blades

For all propeller models except HC-E4A-3( ):

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

End Play	See Note Below
Fore & Aft Movement	See Note Below
In & Out	None
Radial Play (pitch change)	± 0.5 degree (1 degree total)

NOTE: Blades are intended to be tight in the propeller, however slight movement is acceptable if the blade returns to its original position when released. Blades with excessive movement, or that do not return to their original position when released may indicate internal wear or damage which should be referred to an appropriately licensed propeller service facility.

H. Preload Plate Set Screw

(1) Manually rotate the propeller and listen for possible noise caused by a broken set screw or jam nut that may be in the propeller hub.

(2) With the propeller blades in feathered position, make sure the feather (low) stop nuts are seated on the reverse adjustment sleeve or plate. Refer to Figures 2-1 through 2-3 in the Description and Operation chapter.

(3) If there is noise indicating a loose part or the propeller blades do not go completely to feather; remove the propeller. Send the propeller to a repair station for disassembly and inspection for a possible broken preload plate set screw.

NOTE 1: If a broken set screw is found, the propeller must be inspected for damage that may have been caused by the broken set screw.

NOTE 2: Report any such incidents to the Hartzell Product Support Department.

I. Corrosion

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

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

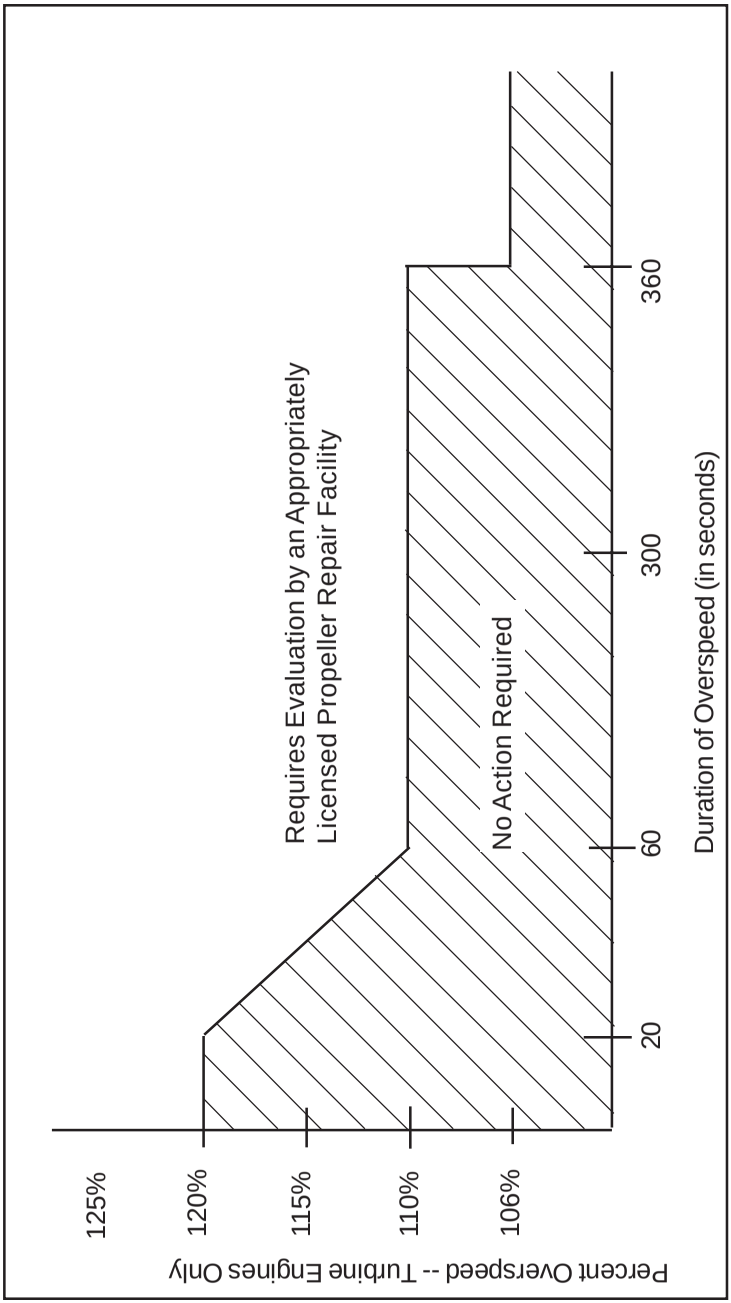
Heavy corrosion that results in severe pitting must be referred to an appropriately licensed propeller repair facility.

J. Spinner Damage

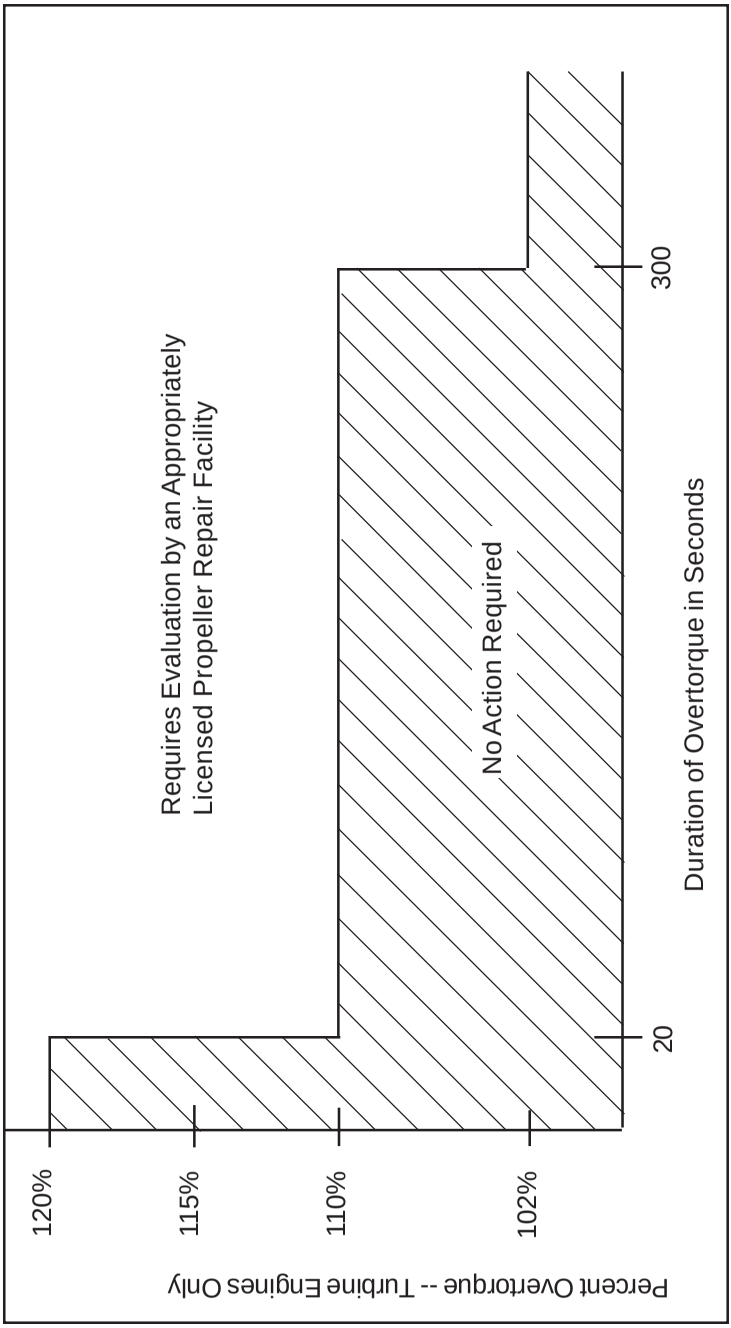
Inspect the spinner for cracks, missing hardware, or other damage. Refer to an appropriately licensed propeller repair facility for spinner damage acceptance and repair information. Contact the local airworthiness authority for repair approval.

K. Electric De-ice System

Refer to the Anti-ice and De-ice Systems chapter of this manual for inspection procedures.



Turbine Engine Overspeed Limits
Figure 5-3



Turbine Engine Overtorque Limits
Figure 5-4

5. Special Inspections

A. Overspeed/Overtorque

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.

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

(1) When a propeller installed on a turbine engine has an overspeed event, refer to the Turbine Engine Overspeed Limits (Refer to Figure 5-3) to determine the corrective action to be taken.

(2) When a propeller installed on a turbine engine has an overtorque event, refer to the Turbine Engine Overtorque Limits (Refer to Figure 5-4) to determine the corrective action to be taken.

(3) Make a log book entry to document the overspeed/overtorque event.

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 Product Support to confirm actual overtorque percentage.

B. Propeller Ground Idle Operating Restrictions

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) The information in this section is intended to emphasize the critical importance of correct propeller ground idle RPM on certain turboprop installations. It also defines the appropriate corrective action required when a propeller has been operated within this restricted RPM region.

(b) 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.

(c) Four, five and six blade propellers 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.

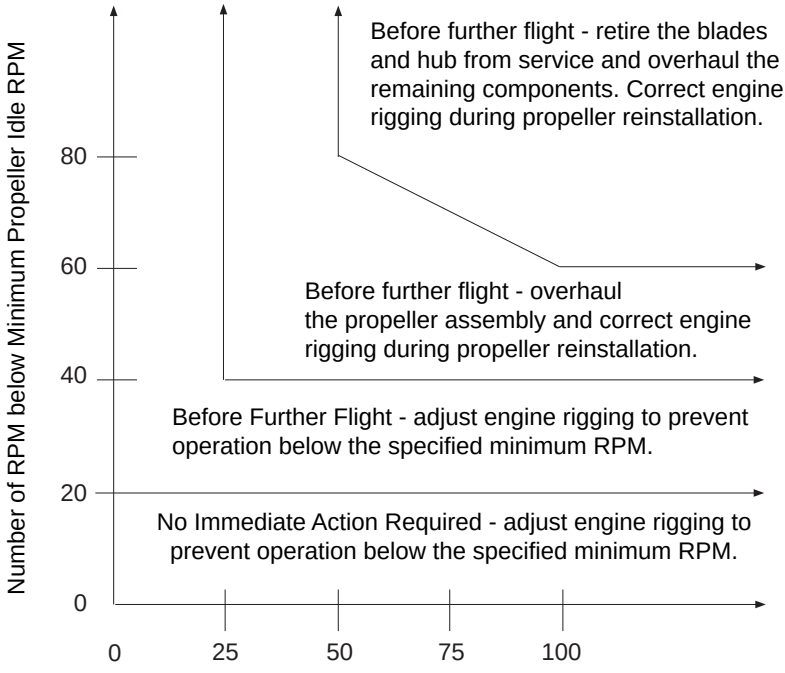
(d) This minimum propeller idle RPM operating restriction is the result of a specific vibratory resonant condition known as "reactionless mode". During operation in these conditions the flight crew cannot feel the resulting high propeller vibration. Ground operation at or near an RPM that can create 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.

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 since it was rigged	**75 hours**

Figure 5-6 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 an Evaluation of Ground Idle RPM Check
Figure 5-5



To determine Corrective Action, refer to Figure 5-5.

Corrective Action Required
Figure 5-6

(2) Periodic Ground Idle RPM Check

(a) Perform the RPM check, especially following engine rigging/idle RPM adjustments.

(b) Refer to the Airplane Flight Manual or Airplane Flight Manual Supplement to determine if there are any propeller RPM restrictions or limitations.

(c) Check the accuracy of the tachometer. Refer to the section Tachometer Inspection in this chapter.

(d) 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.

(e) If the propeller cannot be operated below the minimum specified propeller idle RPM, no further action is required.

(f) If the propeller can be operated below the minimum specified propeller idle RPM:

1 Refer to Figure 5-6 for corrective action. Refer to Figure 5-5 for help when using Figure 5-6.

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 5-6 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.

3 The corrective action may vary from no action required to scrapping of the blades and the hub.

4 Refer to Figure 5-6 for the required corrective action.

5 Contact Hartzell if further clarification is required.

6 If a propeller restriction other than those described in Figure 5-6 has been violated, contact Hartzell Propeller Inc.

a The chart in Figure 5-6 applies only to operation below the minimum idle RPM.

b The chart in Figure 5-6 does not apply to other propeller restrictions that are above the minimum idle RPM.

7 If the corrective action requires a propeller overhaul, overhaul the propeller in accordance with the applicable propeller overhaul manuals.

8 If the corrective action requires that the blades and the hub be retired from service, retire these components from service in accordance with the Part Retirement Procedures chapter of Hartzell Standard Practices Manual 202A (61-01-02).

9 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.

10 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.

11 Contact Hartzell Product Support Department to report the findings.

Hartzell Propeller Inc.
One Propeller Place
Piqua, Ohio 45356-2634 USA
Phone: 937.778.4379
Fax: 937.778.4391
techsupport@hartzellprop.com

C. Lightning Strike

CAUTION 1: ALSO CONSULT AIRFRAME MANUFACTURER'S MANUALS. THERE MAY BE ADDITIONAL REQUIREMENTS, SUCH AS DE-ICE SYSTEM CHECKS, TO PERFORM IN THE EVENT OF PROPELLER LIGHTNING STRIKE.

CAUTION 2: A COMPOSITE BLADE SUSPECTED 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

In the event of a propeller lightning strike, an inspection is required before further flight.

It may be permissible to operate a propeller for an additional ten (10) hours of operation if the propeller is not severely damaged and meets the requirements in Procedures for Temporary Operation in this section. Regardless of the outcome of the initial inspection, the propeller must eventually be removed from the aircraft, disassembled, evaluated, and/or repaired by an appropriately licensed propeller service facility.

(2) Procedure for Temporary Operation

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

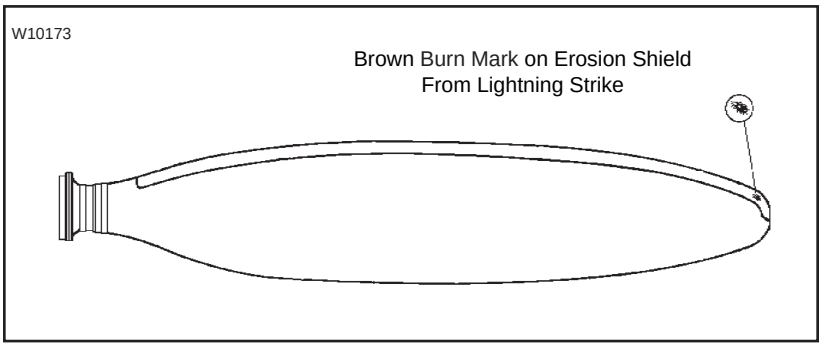
(a) Remove spinner dome and perform visual inspection of propeller, spinner, and de-ice system for evidence of significant damage that would require repair before flight (such as broken de-ice wires or arcing damage to propeller hub).

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

(b) Perform a thorough visual inspection of the blades, looking for the indications of a lightning strike. If lightning strike damage is present, a brown burned mark and possible pitting, usually in proximity to the tip and at the most inboard end of the metal erosion shield, will be noticeable. Refer to Figure 5-7.

If the blade has a de-ice boot installed, it may be debonded from the erosion shield due to the strike. In any case, the de-ice system may be damaged.

Lightning strikes may also cause one or all of the following: debonding, lifting and buckling of the metal erosion shield, and delamination and splitting of the laminate.



Evidence of Lightning Strike Damage to Composite Blade
Figure 5-7

(c) Perform a coin-tap inspection of the composite blades that have indications of arcing. If the only evident damage is minor arcing and all other criteria do not exceed airworthy damage limits, stated in the Maintenance Practices chapter, then operation for ten (10) hours is acceptable before disassembly and inspection.

(d) Before further flight following a propeller lightning strike, Hartzell recommends replacement of the MOV Module. Replacement should be done in accordance with AMM procedures.

NOTE: The MOV Module is an airframe controlled part installed to protect aircraft wiring from damage in the event of a propeller lightning strike. The MOV Module may be damaged during a lightning strike.

(e) Perform a functional check of the propeller de-ice system (if installed) in accordance with aircraft maintenance manual procedures.

(f) Regardless of the degree of damage, make a log book entry to document the lightning strike.

(g) The propeller must be removed from the aircraft, disassembled, evaluated, and/or repaired by an appropriately licensed propeller service facility for flight beyond the temporary operation limits granted above.

D. Foreign Object Strike

(1) General

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

(b) A foreign object strike is defined as:

1 Any incident, whether or not the engine is operating, that requires repair to the propeller other than minor dressing of the blades. Examples of foreign object strike include situations where an aircraft is stationary and the landing gear collapses causing one or more blades to be significantly damaged, or where a hangar door (or other object) strikes the propeller blade. These cases should be handled as foreign object strikes because of potentially severe side loading on the propeller hub, blades and retention bearings.

2 Any incident during engine operation in which the propeller impacts a solid object that causes a drop in revolutions per minute (RPM) and also requires structural repair of the propeller (incidents requiring only paint touch-up are not included). This is not restricted to propeller strikes against the ground.

3 A sudden RPM drop while impacting water, tall grass, or similar yielding medium, where propeller blade damage is not normally incurred.

(2) Procedure

(a) In the event of a foreign object strike, an inspection is required before further flight. If the inspection reveals one or more of the following indications, the propeller must be removed from the aircraft, disassembled, and overhauled in accordance with the applicable propeller and blade maintenance manuals:

1 A loose blade in the hub.

2 Any noticeable or **suspected** damage to the pitch change mechanism.

3 A bent blade (out of track or angle).

4 Any blade diameter reduction.

5 A bent, cracked, or failed engine shaft.

6 Vibration during operation that was not present before the event.

(b) For composite blades, perform a thorough visual and coin tap inspection of the exposed portion (de-ice boot removal not required) of each blade including the metal erosion shield (leading edge). Refer to the Composite Blade Maintenance section in the Maintenance Practices chapter of this manual. If the blade damage is beyond airworthy limits, the blade must be repaired before further flight. If the blade damage is beyond major repair limits, the blade must either be returned to the factory for evaluation or removed from service.

(c) For engine mounted accessories (for example, governors, pumps, and propeller control units) manufactured by Hartzell, if the foreign object strike resulted in a sudden stop of the engine, the unit must be disassembled and inspected in accordance with the applicable maintenance manual.

(d) Regardless of the degree of damage, make a log book entry to document the foreign object strike incident and any corrective action(s) taken.

E. Fire Damage or Heat Damage

WARNING 1: EXPOSING COMPOSITE BLADES TO HIGH TEMPERATURES MAY LEAD TO FAILURE THAT MAY CAUSE PERSONAL INJURY AND DEATH. COMPOSITE BLADES ARE SUBJECT TO DELAMINATIONS DUE TO HIGH TEMPERATURES.

WARNING 2: HUBS ARE MANUFACTURED FROM HEAT TREATED FORGINGS AND ARE SHOT PEENED. EXPOSURE TO HIGH TEMPERATURES CAN DESTROY THE FATIGUE RESISTANCE BENEFITS OBTAINED FROM THESE PROCESSES.

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

6. Long Term Storage

A. Parts shipped from the Hartzell factory are not shipped or packaged in a container that is designed for long term storage.

B. Long term storage procedures may be obtained by contacting a Hartzell distributor, or the Hartzell factory via the product support number listed in the Introduction chapter of this manual. Storage information is also detailed in Hartzell Manual 202A (61-01-02).

C. Information regarding the return of a propeller assembly to service after long term storage may be obtained by contacting a Hartzell distributor, or the Hartzell factory via the Product Support number listed in the Introduction chapter of this manual. This information is also detailed in Hartzell Manual 202A (61-01-02).

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1. Cleaning

CAUTION: DO NOT USE PRESSURE WASHING EQUIPMENT TO CLEAN THE PROPELLER OR CONTROL COMPONENTS. PRESSURE WASHING CAN FORCE WATER AND/OR CLEANING SOLVENTS PAST SEALS, AND 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) Wash the propeller with a noncorrosive soap solution.

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

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

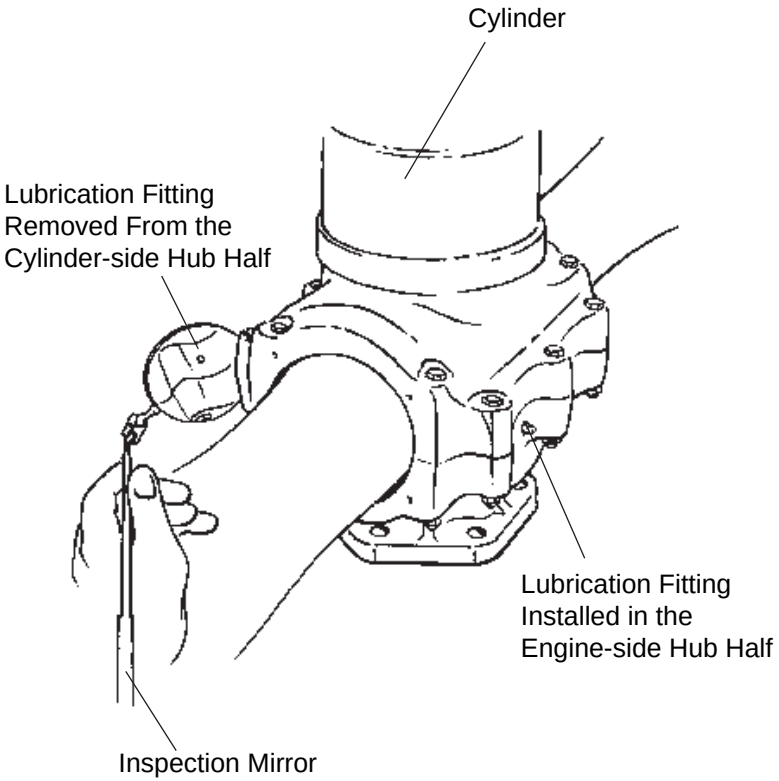
(3) Thoroughly rinse in water and allow the part to dry.

B. Spinner Cleaning and Polishing

(1) Clean the spinner using the General Cleaning procedures in this section.

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

TI-00102



NOTE: A 2-blade propeller is shown for illustration purposes only.

Lubrication Fitting
Figure 6-1

2. Lubrication

A. Lubrication Intervals

(1) The propeller must be lubricated at intervals not to exceed 400 hours or 12 calendar months, whichever occurs first, except as listed.

(a) For the HC-E5A-2( ) propeller installed on Pilatus PC-21 aircraft only: Lubricate the propeller at 450 hour intervals or at twelve (12) calendar months, whichever occurs first.

(b) If annual operation is significantly less than 400 hours, calendar lubrication intervals should be reduced to six months.

(c) 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.

(d) If more frequent propeller lubrication is desired, it is highly recommended that compliance with Hartzell Service Letter HC-SL-61-241 be in place to prevent over servicing.

(2) Owners of high use aircraft may wish to extend their lubrication intervals. Lubrication interval may be gradually extended after evaluation of previous propeller overhauls with regard to bearing wear and internal corrosion.

(3) Hartzell recommends that new or newly overhauled propellers be lubricated after the first one or two hours of operation, because centrifugal loads will pack and redistribute grease, which may 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

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

(1) Remove the propeller spinner.

(2) Refer to Figure 6-1. Each blade socket has two lubrication f ttings. Remove the lubrication f tting caps from the lubrication f ttings. Remove the lubrication f ttings from either the engine side or the cylinder side of the hub assembly.

NOTE: It is preferable to apply grease to the f tting located nearest the leading edge of the blade on a tractor installation, or nearest the trailing edge on a pusher installation. Lubricating at this location reduces the possibility of grease bypassing the bearing area and entering the hub cavity.

(a) Some propellers use an internal blade seal that prevents grease from entering the hub cavity. Because this seal is very eff cient, it is important to remove the opposite lubrication f tting. Pitch control diff culty could result if the propeller is not correctly lubricated.

(b) A 45 degree lubrication f tting (Hartzell P/N C-6349) may be installed on the engine-side or cylinder-side of the propeller in any location where a straight lubrication f tting (Hartzell P/N A-279) was originally installed. The 45 degree lubrication f tting simplif es lubrication.

(c) The lubrication f ttings installed on the engine-side or cylinder-side must be either all straight (Hartzell P/N A-279) or all 45 degree (Hartzell P/N C-6349).

(3) Using a piece of safety wire to loosen any blockage or hardened grease at the threaded holes where the lubrication f tting was removed.

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

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

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

(5) A label (Hartzell P/N A-3494) is normally applied to the propeller to indicate the type of grease previously used (Figure 6-2).

(a) This grease type should be used during re-lubrication unless the propeller has been disassembled and the old grease removed.

(b) Purging of old grease through lubrication fittings is only about 30 percent effective.

(c) To completely replace one grease with another, the propeller must be disassembled in accordance with the applicable overhaul manual.

CAUTION 1: 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.

CAUTION 2: IF A PNEUMATIC GREASE GUN IS USED, EXTRA CARE MUST BE TAKEN TO AVOID EXCESSIVE PRESSURE BUILDUP.

CAUTION 3: GREASE MUST BE APPLIED TO ALL BLADES OF A PROPELLER ASSEMBLY AT THE TIME OF LUBRICATION.

(6) Pump 1 fl. oz. (30 ml) grease into each engine-side lubrication fitting, or until grease emerges from the hole where the lubrication fitting was removed - whichever occurs first.

NOTE: 1 fl. oz. (30 ml) is approximately 6 pumps with a hand-operated grease gun.

(7) Reinstall the removed lubrication fittings. Tighten until snug.

(a) Make sure that the ball of each lubrication fitting is properly seated.

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

C. Approved Lubricants

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

Aeroshell 6 - Recommended "all purpose" grease. Used in most new production propellers since 1989. Higher leakage/oil separation than Aeroshell 5 at higher temperatures.

Aeroshell 5 - Good high temperature qualities, very little oil separation or leakage. Cannot be used in temperatures colder than -40°F (-40°C). Aircraft serviced with this grease must be placarded to indicate that flight is prohibited if the outside air temperature is less than -40°F (-40°C).

Aeroshell 7 - Good low temperature grease, but high leakage/oil separation at higher temperatures. This grease has been associated with sporadic problems involving seal swelling.

Aeroshell 22 - Qualities similar to Aeroshell 7.

Royco 22CF - Not widely used. Qualities similar to Aeroshell 22.

NOTE: A label (Refer to Figure 6-2) indicating the type of grease used for previous lubrication is installed on the propeller cylinder. If the propeller must be lubricated with another type of grease, the propeller must be disassembled and cleaned of old grease before relubricating.

3. Carbon Block Assemblies

A. Inspection

The clearance between the yoke pin and the corresponding linkage (beta lever bushing) can become too close because of 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, low stop collar, and beta linkage.

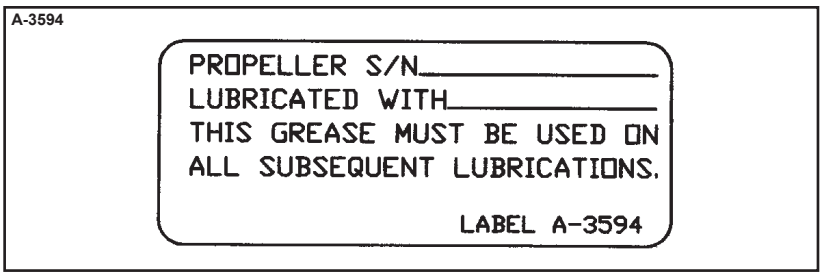
(1) Inspect the beta lever and carbon block interface for free movement. If there is binding, do the following:

(a) Disconnect the beta linkage and remove the carbon block assemblies from the beta ring.

(b) Polish the yoke pin to provide adequate clearance and eliminate binding.

(c) Reinstall the carbon block assembly into the beta ring.

(d) Install, adjust and safety the beta linkage per the airframe manufacturer's instructions.



Lubrication Label
Figure 6-2

B. Replacement of the A-3026 Carbon Block Unit in the A-3044 Carbon Block Assembly

Replace an A-3026 carbon block unit if the side clearance between the beta ring and carbon block exceeds 0.010 inch (0.25 mm).

(1) Remove the cotter pin from the end of the clevis pin.

(2) Slide the pin from the assembly and remove and discard the carbon block unit.

(3) Inspect the yoke for wear or cracks. Replace the yoke if necessary.

(4) Install a new carbon block unit and slide a new clevis pin into place.

(5) Secure the clevis pin with a T-head cotter pin. Refer to Figure 3-7.

(6) Refit the carbon block. Refer to Figure 3-6.

(a) Establish the required clearance by sanding the sides of the carbon block as needed.

C. Installation of the A-3044 Carbon Block Assembly

Refer to the Installation and Removal Chapter of this manual for installation instructions.

4. Composite Blade Maintenance

A. Component Life and Service

(1) Blade Life

(a) Blade life is expressed, and shall be tracked in the Propeller Log Book as the following periods indicate:

1 Time Since New (TSN)

2 Time Between Overhauls (TBO)

3 Hours of Service Since Overhaul (TSO, or Time Since Overhaul).

4 Flight Hours (FH)

(b) Both TSN and TSO references are necessary in defining the life of the component. Some parts are "life limited" which means that they must be replaced after a specified amount of use (TSN). TBO is usually stated as an allowable time that may accumulate prior to the performance of a function, i.e., overhaul or replacement.

(c) When a component or assembly undergoes an overhaul, the TSO is returned to zero hours. TSN can never be returned to zero.

NOTE: Repair without overhaul does not affect TBO or TSO.

(2) Overhaul or Major Periodic Inspection (MPI)

(a) Overhaul, or MPI, is the periodic disassembly, inspection, repair, refinish, and reassembly of the composite blade assembly.

NOTE: The term "overhaul" is used throughout the text of this manual.

(b) At such specified periods, the blade assemblies are completely disassembled and inspected for cracks, wear, corrosion, and other unusual or abnormal conditions. As specified, some blades are refinished, and other blades are replaced. The blades can then be reassembled and balanced.

(c) Overhaul must be accomplished in accordance with the latest revision of Hartzell Composite Blade Manual 135F (61-13-35) and other applicable publications.

B. Composite Blade Inspection Requirements

CAUTION: MAINTAINING A GOOD LOG BOOK RECORD IS PARTICULARLY IMPORTANT FOR COMPOSITE PROPELLER BLADES. DAMAGE AND/OR REPAIRS MAY SUFFER FURTHER DEGRADATION AFTER CONTINUED USE. SUCH DEGRADATION MAY BE EASILY OVERLOOKED. IT IS IMPORTANT FOR INSPECTORS TO HAVE ACCESS TO ACCURATE HISTORICAL DATA WHEN PERFORMING SUBSEQUENT INSPECTIONS.

(1) Required Record-Keeping

Composite blade damage and a description of its repair must be recorded in the composite blade log book.

(2) Maintenance Inspections

Inspection procedures must be performed in accordance with this manual.

(a) Review the blade log book records and carefully inspect areas of airworthy damage and previously repaired areas for growth. If the damaged areas have grown larger, estimate if they will exceed airworthy damage limits before the next overhaul. If this is the case, make arrangements to repair the damage at the earliest practical time to prevent further damage to the blade.

(b) Defects or damage discovered during scheduled inspections must be evaluated in accordance with allowables outlined later in this section, to determine if repairs are required before further flight. Although repair of "airworthy damage" is not essential before further flight, such damage should always be repaired as soon as possible, to avoid further degradation. In most cases, "unairworthy damage" must be repaired before further flight.

(3) Record the details of all damage and/or repairs in the propeller log book.

C. Coin-Tap Test

Composite blades can be inspected for delaminations and debonds by tapping the blade or cuff (if applicable) with a "metal washer."

(1) Procedure

Use a washer-shaped metal tapper, approximately 2.50 inches (63.5 mm) OD x 1.25 inches (31.8 mm) ID x 0.25 inch (6.4 mm) thick, and weighing no less than 3 ounces (85 gm). Tap the surface. If an audible change is apparent, sounding hollow or dead, a debond or delamination is likely (Figure 6-3).

(2) Mapping

"Mapping" of the area to be coin-tapped is desirable to assure that the entire surface is adequately inspected. Coin-tap within an imaginary grid or matrix consisting of 2 inch (51 mm) squares during scheduled aircraft inspections.

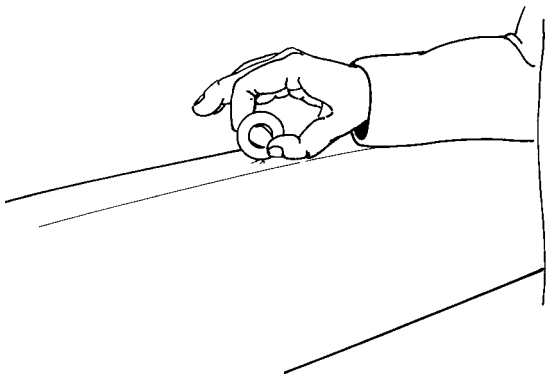
(a) A more thorough coin-tapping of the erosion shield is desirable due to its size and shape. Tap in a smaller grid pattern up and down the length of the erosion shield. Slight deformations in the erosion shield may be noticed with careful visual and manual (touch) inspection. Such deformations may be the result of a debond, and should be given a careful coin-tap inspection.

(b) If a suspected delamination or debond is discovered, a localized, thorough coin-tap inspection is required to define the precise area of delamination or debond.

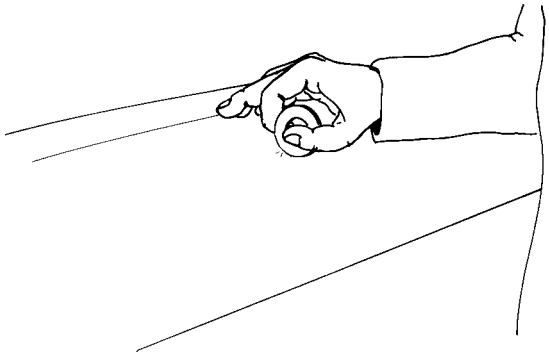
(3) Recording Damage

Outline the suspect area with a grease pencil to determine the approximate size of the damage. Record the damage/repairs in the propeller log book.

APS0325
APS0319A



"Coin-tap" along entire surface of erosion shield checks for debond



"Coin-tap" on composite blade surface checks for delamination

"Coin-Tap" Test to Check for Debond and Delamination
Figure 6-3

D. Composite Blade Airworthy Damage

CAUTION: ALTHOUGH A BLADE MAY CONTINUE IN SERVICE WITH AIRWORTHY DAMAGE, THIS TYPE OF DAMAGE SHOULD BE MONITORED AND REPAIRED AT THE EARLIEST PRACTICAL TIME TO PREVENT FURTHER DAMAGE TO THE BLADE.

Airworthy damage is damage that does not exceed the following limits. This type of damage will not affect the safety or flight characteristics of the propeller.

NOTE: Due to the infinite types of damage possible, not all types of damage that can be considered airworthy are covered in this manual. If there is any doubt as to airworthiness of the blade, contact Hartzell Propeller Inc.

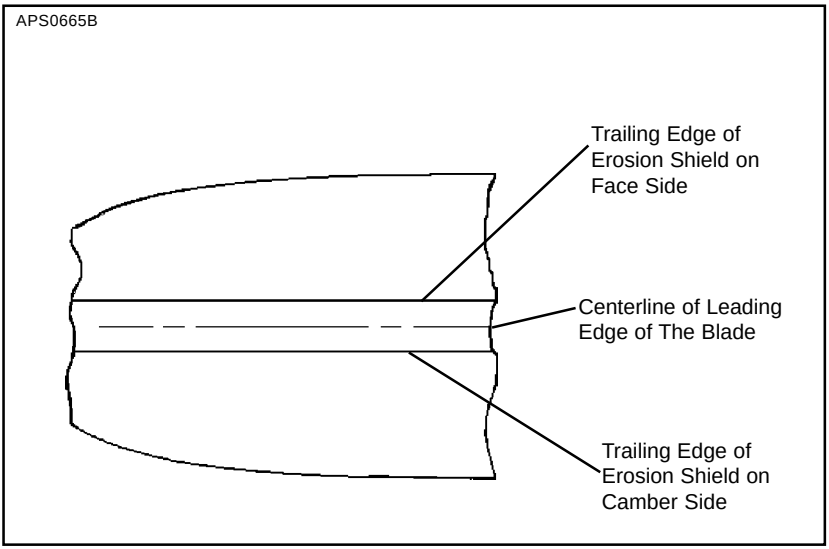
(1) Airworthy Damage Limits

(a) Nickel Erosion Shield

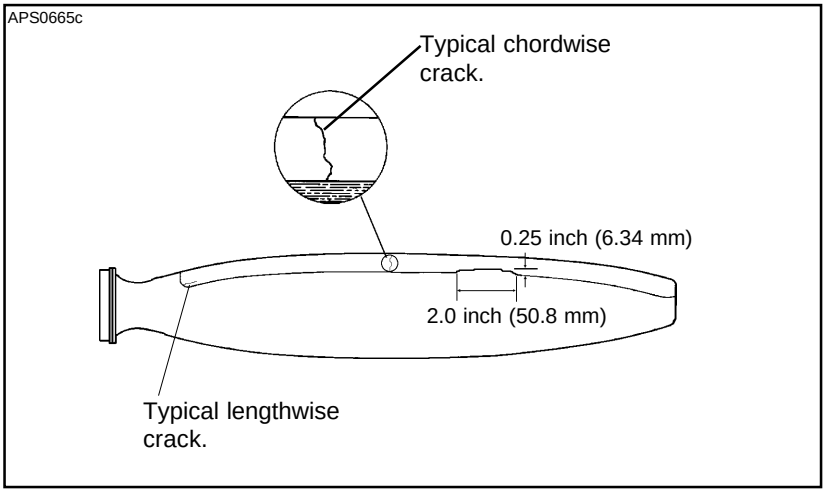
NOTE: When calculating the area of damage and the proximity to other damage, the erosion shield should be viewed as a two dimensional shape, as if it were unfolded and laid flat where the face and camber sides of the blade could be viewed at the same time. Refer to Figure 6-4 for the interpretation of the view of the erosion shield.

1 The following limits apply to the entire erosion shield:

a Minor deformations due to impact damage and erosion that do not greatly affect the airfoil shape or penetrate through the shield are acceptable.



Interpretation of Erosion Shield Damage
Figure 6-4



Missing Portion of the Erosion Shield (Trailing Edge)
Figure 6-5

b Gouges through the erosion shield up to 0.25 square inch (161.3 square mm) are acceptable. Although this damage is acceptable, it must be repaired as soon as practical to prevent further damage to the blade. Damage to the blade surface beneath the erosion shield cannot be more than 0.02 inch (0.5 mm) deep. This represents two layers of fibrous material.

c Portions of the trailing edge of the erosion shield may be missing due to erosion or sanding performed during the erosion shield installation procedure. The maximum allowable missing area is 0.25 x 2.0 inch (0.6 x 50.8 mm). Refer to Figure 6-5 for an example of allowable missing material.

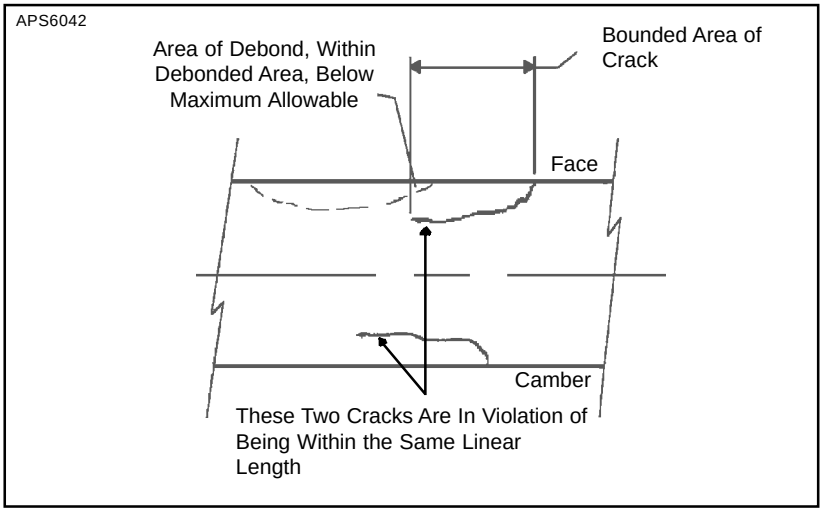
2 The following limits apply to all sections of the erosion shield not covered by a de-ice system:

a No more than 20 percent of the erosion shield may be debonded in any 6.0 inch (15 cm) length of the erosion shield.

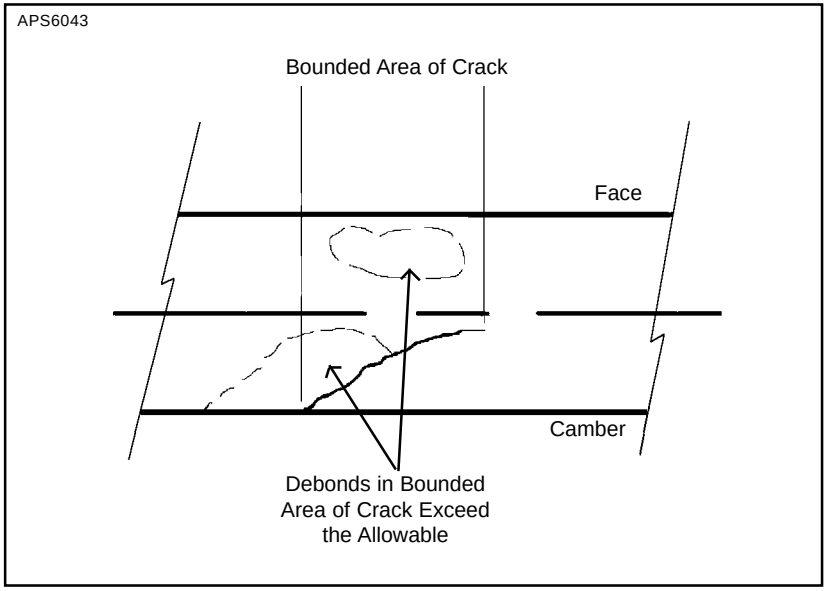
b No two full width, chordwise cracks may occur within 6.0 inches (152 mm) of each other.

c No lengthwise crack may exceed 2.0 inches (50.8 mm) in length.

d No two lengthwise cracks may be within the same linear length of the erosion shield. This includes cracks on opposite sides of the blade. Refer to Figure 6-6 for an example in violation of this limit. Note that the cracks are on opposite sides of the blade.



Acceptable Erosion Shield Damage and Non-acceptable Crack Location Examples
Figure 6-6



Debonds in Excess of Allowable Limits
Figure 6-7

e No more than 20 percent of the area bounded by a lengthwise crack and the trailing edge of the erosion shield may be debonded. Figure 6-6 shows an example within this tolerance limit. Figure 6-7 shows an example of a debonded area that exceeds the 20 percent maximum allowable.

NOTE: The bounded area of a crack extends to both edges of the erosion shield.

(b) Blade Damage

1 Gouges or Loss of Material

a Gouges or loss of composite material less than 0.50 inch (12.7 mm) diameter or equivalent area (0.20 square inch or 129.0 square mm) and no more than 2.5 inches (63.5 mm) long and less than 0.02 inch (5.1 mm) deep anywhere on the outboard half of the blade.

b Gouges, loss of composite material, or delaminations on the **inboard** half of the blade must be referred to an authorized repair facility for evaluation.

2 Delamination

Delamination on the outboard half of the blade totaling less than 2.0 square inches (1290 square mm) with no dark brown or black stain (indicating the presence of grease).

3 Paint Erosion

Exposure of less than 5.0 sq. inch (3225 square mm) of the composite material and/or the primer filler. This allowable does not refer to primer sealer.

NOTE: Propellers that have blades that exhibit paint erosion exceeding the above limits may continue operation for an additional 250 hours or one (1) month, whichever occurs first. Refer to the Painting of Composite Blades section of this chapter.

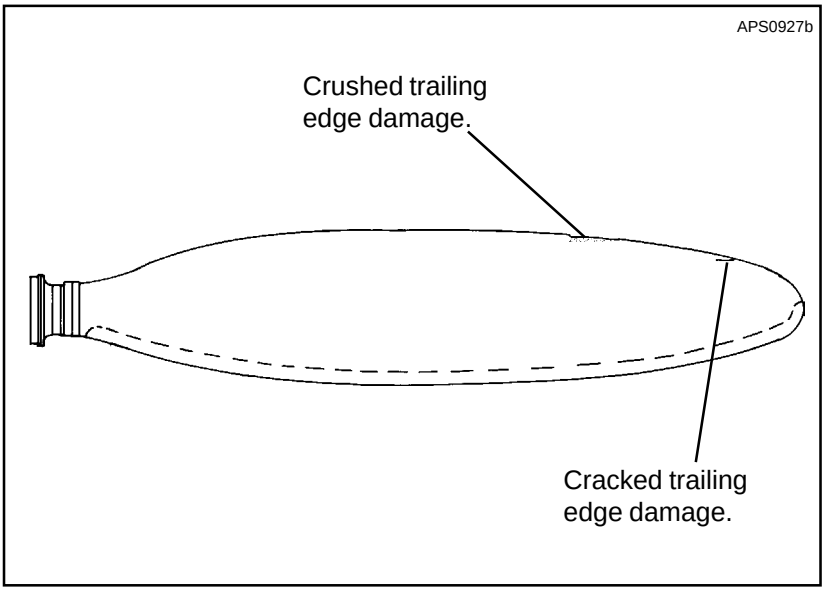
4 Crushed or Cracked Trailing Edge for E12902( ) Design Only. Refer toFigure 6-8.

Crushed or cracked area no larger than 0.25 in. deep x 2.0 in. long (6.4 x 50.8 mm) on the outer half of the blade.

5 Crushed or Cracked Trailing Edge for E10950P( ) Design Only. Refer to Figure 6-8.

a From the 15.0 to 20.0 inch (38.1 to 50.8 cm) stations, crushed or cracked area no larger than 0.125 inch deep x 1.0 inch long (6.35 mm x 25.4 mm).

b From the 20.0 inch (50.8 mm) station to the tip, crushed or cracked area no larger than 0.25 in. deep x 3.0 in. long (6.35 mm x 76.2 mm).



Crushed and Cracked Trailing Edge
Figure 6-8

6 Split Trailing Edge for E12902( ) Design Only

Split area no larger than 0.5 in. deep x 6.0 in. long (12.7 x 152.4 cm) with no fiber damage or exposed foam.

7 Split Trailing Edge for E10950P( ) Design Only

a From the 14.0 to the 20.0 in. (35.6 to 50.8 cm) station, split area no larger than 0.5 in. deep x 6.0 in. long (1.27 x 15.24 mm).

b From the 20.0 in. (50.8 cm) station to the tip, split area no larger than 0.75 in. deep x 8.0 inches long (19.1 x 203.0 mm).

c No damaged fibers or exposed foam permitted.

(c) Erosion Screen (Model E10950P[ ])

CAUTION: IF DAMAGE IS TOO SEVERE, RISK OF RENDERING THE BLADE UNAIRWORTHY IS POSSIBLE.

The erosion screen is located on the tip of the blade (face and camber sides) for the purpose of erosion protection.

Although no specific airworthy limits exist for the erosion screen, if the screen or part of the screen becomes loose from the blade, remove the loose piece(s) to prevent possible blade damage from occurring.

The limits of erosion screen damage that would require replacement at overhaul are given in Hartzell Composite Blade Overhaul Manual 135F (61-13-35).

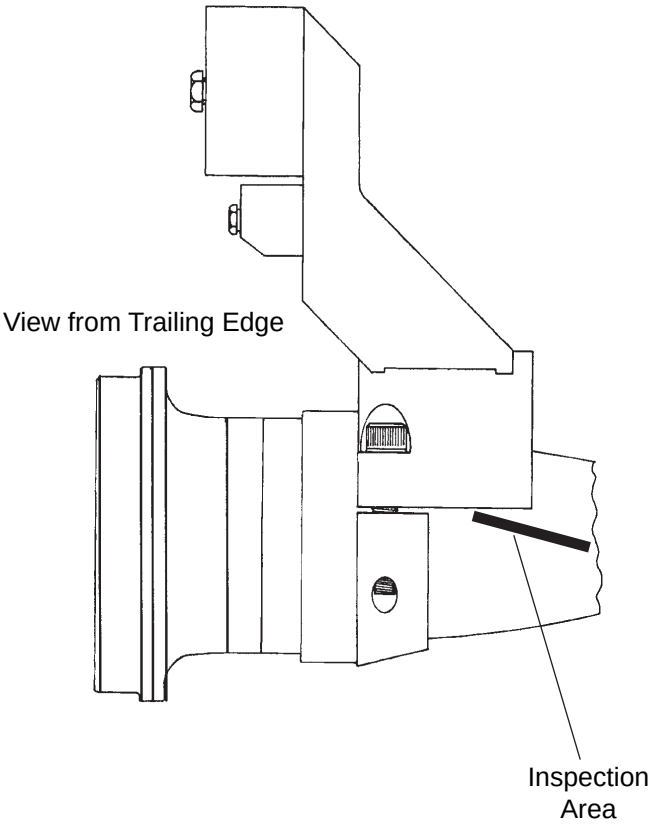
E. Composite Blade Unairworthy Damage

CAUTION: UNAIRWORTHY DAMAGE TO A HARTZELL COMPOSITE BLADE MUST BE REPAIRED BEFORE THE NEXT FLIGHT. UNAIRWORTHY DAMAGE CAN AFFECT THE SAFETY OR FLIGHT CHARACTERISTICS OF THE PROPELLER BLADE.

(1) Definition

Any damage that exceeds the limits of airworthy damage is considered unairworthy.

TI-147001



E12902K Composite Blade Shank Inspection Area
Figure 6-9

F. On Wing Blade Shank Inspection

(1) General

(a) This procedure provides instructions for a visual inspection of composite blade model E12902K for a crack.

(b) This inspection must be performed by an appropriately licensed aircraft mechanic.

(2) Procedure

(a) Remove the spinner. Refer to the Spinner Removal section in the Installation and Removal chapter of this manual.

CAUTION: DO NOT REMOVE THE PAINT BEFORE PERFORMING THE INSPECTION. REMOVING THE PAINT COULD MASK THE PRESENCE OF A CRACK.

(b) Using a clean, dry cloth dampened with Quick Dry Stoddard Solvent or Methyl-Ethyl-Ketone (MEK), wipe the blade shank.

(c) Visually examine the E12902K blade for a crack along the trailing edge of the shank in the general vicinity of the counterweight. Refer to Figure 6-9.

1 If there are no cracks visible:

a Reinstall the spinner. Refer to the Spinner Installation section in the Installation and Removal chapter of this manual.

b Make an entry in the logbook indicating compliance with this inspection and indicate when the next inspection is due.

2 If there is a crack:

a Replace the blade before further flight. Refer to an appropriately licensed propeller service facility.

b Contact Hartzell Propeller Inc. Product Support.

5. Painting After Repair

A. General

(1) Propeller blades are painted with a durable specialized coating that is resistant to abrasion. If this coating becomes eroded over an area of more than 10 square inches (6451.6 square mm), it is necessary to repaint the entire blade to provide proper environmental and erosion protection. Painting should be performed by an appropriately licensed propeller service facility in accordance with Hartzell Standard Practices Manual 202A (61-01-02).

(2) For paint erosion over an area of less than 10 square inches (6451.6 square mm) it is permissible to perform a blade touch-up with aerosol paint in accordance with the procedures in Painting of Composite Blades that follow.

(3) Refer to Table 6-1 for paints approved for blade touch-up.

Vendor	Color/Type	Vendor P/N	Hartzell P/N
Tempo	Epoxy Black	A-150	n/a
Tempo	Epoxy Gray	A-151	n/a
Tempo	Epoxy White (tip stripe)	A-152	n/a
Tempo	Epoxy Red (tip stripe)	A-153	n/a
Tempo	Epoxy Yellow (tip stripe)	A-154	n/a
Sherwin-Williams	Black	F75KXB9958-4311	A-6741-145-1
Sherwin-Williams	Gray	F75KXA10445-4311	A-6741-146-1
Sherwin-Williams	Gray Metallic (Raytheon Beech 1900D aircraft models only)	F75KXM9754-4311	A-6741-148-1
Sherwin-Williams	Silver	F75KXS13564-4311	A-6741-190-1
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

Approved Touch-up Paints
Table 6-1

(4) The paint manufacturers may be contacted via the information below:

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

Sherwin Williams Co.
2390 Arbor Boulevard
Dayton, Ohio
Tel: 937.298.8691
Fax: 937.298.3820
Cage Code: 0W199

B. Painting of Composite Blades

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

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

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

CAUTION: EXCESSIVE SANDING WILL CAUSE "FUZZING" OF THE KEVLAR MATERIAL, RESULTING IN A ROUGH FINISH.

(2) Feather the existing coatings away from the eroded or repaired area with 120 to 180 grit sandpaper.

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

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

(4) Apply masking material for the erosion shield, de-ice boot and tip stripes, as needed.

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

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

(5) Apply sufficient finish coating to achieve 2 to 4 mils thickness when dry. Re-coat before 30 minutes, or after 48 hours. If the paint is allowed to dry longer than four (4) hours it must be lightly sanded before another coat is applied.

(6) Remove the masking from tip stripes and re-mask to allow for the tip stripe refinishing if required.

(7) Apply sufficient tip stripe coating to achieve 2 to 4 mils thickness when dry. Re-coat before 30 minutes, or after 48 hours. If the paint is allowed to dry longer than four (4) hours it must be lightly sanded before another coat is applied.

(8) Remove the masking immediately from the tip stripes and de-ice boot, if required.

(9) Optionally, perform dynamic balancing in accordance with the procedures and limitations specified in the Dynamic Balance section of this chapter.

6. Dynamic Balance

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 on 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 check each propeller blade assembly for evidence of grease leakage.

(c) Visually inspect the inner surface of the spinner dome for evidence of grease leakage.

(2) If there is no evidence of grease leakage, lubricate the propeller in accordance with the Maintenance Practices chapter in this manual. If grease leakage is evident, determine the location of the leak and correct before 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 a propeller repair facility when an overhaul or major repair is performed.

NOTE: If static balancing is not accomplished before dynamic balancing, the propeller may be so severely unbalanced that it may not be possible to achieve dynamic balance.

C. Modifying Spinner Bulkhead to Accommodate Dynamic Balance Weights

CAUTION: ALL HOLE/BALANCE WEIGHT LOCATIONS MUST TAKE INTO CONSIDERATION AND MUST AVOID ANY POSSIBILITY OF INTERFERING WITH THE ADJACENT AIRFRAME, DE-ICE, 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 deice slip ring or bulkhead doubler and inboard of the bend where the bulkhead creates the flange 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 allow 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 acceptable.

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

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) Do not exceed a maximum weight per location of 0.9 oz. (25.5 g).

NOTE: This is approximately equal to six AN970 style washers (0.188 inch ID, 0.875 inch OD, 0.063 inch thickness) (4.76 mm ID, 22.23 mm OD, 1.59 mm thickness).

(5) Install weights using aircraft quality #10-32 or AN-3( ) type screws or bolts.

(6) 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.

NOTE: It may be necessary to alter the number and/or location of static balance weights in order to achieve dynamic balance.

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

(8) Make a record in the logbook of the number and location of dynamic balance weights and static balance weights, if they have been reconfigured.

7. De-ice Systems

Refer to the Anti-ice and De-ice Systems chapter of this manual for de-ice system maintenance information.

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C. De-ice System Functional Tests 7-4
D. De-ice System Inspections 7-4
E. De-ice System Troubleshooting 7-5

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1. Introduction

A. Propeller De-ice System

A propeller de-ice system is a system which removes ice after it forms on the propeller blades. A de-ice system uses electrical heating elements to melt the ice layer next to the blades, allowing the ice to be thrown from the blade by centrifugal force. The de-ice system timer controls the application of current to the blades, alternately heating them and permitting them to cool.

System components include a timer or cycling unit, electrical slip ring(s), brush block assembly, and blade mounted de-ice boots.

B. Description

NOTE: Because of the many differences in various de-ice systems, the following description is general in nature. Consult the airframe manufacturer's manual for a description of your specific de-ice system and controls.

The de-ice system is controlled by the pilot via a cockpit control switch. This switch applies power to the de-ice system, which will operate as long as the switch is in the ON position. Depending upon the system, another set of cockpit controls may be available. One of these controls is a mode selector, which allows the pilot to select two cycling speeds, for heavy or light icing conditions. Some systems on twin engine aircraft have a switch that provides a full de-ice mode, which allows the pilot to de-ice both propellers simultaneously. This switch may only be used for short periods and is used when ice builds up on the propeller before the system is turned on.

(1) An ammeter, which indicates current drawn by the system, is normally located near the de-ice system switches. This meter may indicate total system load, or a separate meter may be supplied for each propeller.

(2) A timer, which is turned off and on by the cockpit control, is used to sequence the de-ice system. This timer turns the de-ice system on and off in proper sequence, controlling the heating interval for each propeller blade and ensuring even de-icing.

(3) A brush block mounted on the engine immediately behind the propeller supplies electric current to the de-ice boot on each propeller blade via a slip ring. The slip ring is normally mounted on the spinner bulkhead.

(4) When the pilot places the de-ice system cockpit control switch in the ON position, the system timer begins to operate. As the timer sequences, power is delivered to a power relay. The power relay delivers high current through the brush block and slip ring to the de-ice boot.

C. De-ice System Functional Tests

CAUTION: DO NOT TURN ON THE DE-ICE SYSTEM UNLESS THE PROPELLER IS ROTATING. DAMAGE TO THE BLADE MAY OCCUR.

Functional tests of the de-ice system should be performed in accordance with the following Hartzell Manuals, which are available on the Hartzell Propeller website at www.hartzellprop.com:

(1) Hartzell Manual No. 181 (30-60-81) - Propeller Ice Protection Component Maintenance Manual

(2) Hartzell Manual No. 182 (61-12-82) - Propeller Electrical De-ice Boot Removal and Installation Manual

D. De-ice System Inspections

(1) Perform inspections in accordance with the following Hartzell Manuals, which are available on the Hartzell Propeller website at www.hartzellprop.com:

(a) Hartzell Manual No. 181 (30-60-81) - Propeller Ice Protection Component Maintenance Manual

(b) Hartzell Manual No. 182 (61-12-82) - Propeller Electrical De-ice Boot Removal and Installation Manual

E. De-ice System Troubleshooting

(1) Perform troubleshooting in accordance with the following Hartzell Manuals, which are available on the Hartzell Propeller website at www.hartzellprop.com:

(a) Hartzell Manual No. 181 (30-60-81) - Propeller Ice Protection Component Maintenance Manual

(b) Hartzell Manual No. 182 (61-12-82) - Propeller Electrical De-ice Boot Removal and Installation Manual

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1. Introduction

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

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

2. Record Keeping

   A. Information to be Recorded

      (1) Information that is required to be recorded is listed in Part 43 of the U.S. Federal Aviation Regulations.

      (2) The log book may also be used to record:

         (a) Propeller position (on aircraft)

         (b) Propeller model

         (c) Propeller serial number

         (d) Blade design number

         (e) Blade serial numbers

         (f) Spinner assembly part number

         (g) Propeller pitch range

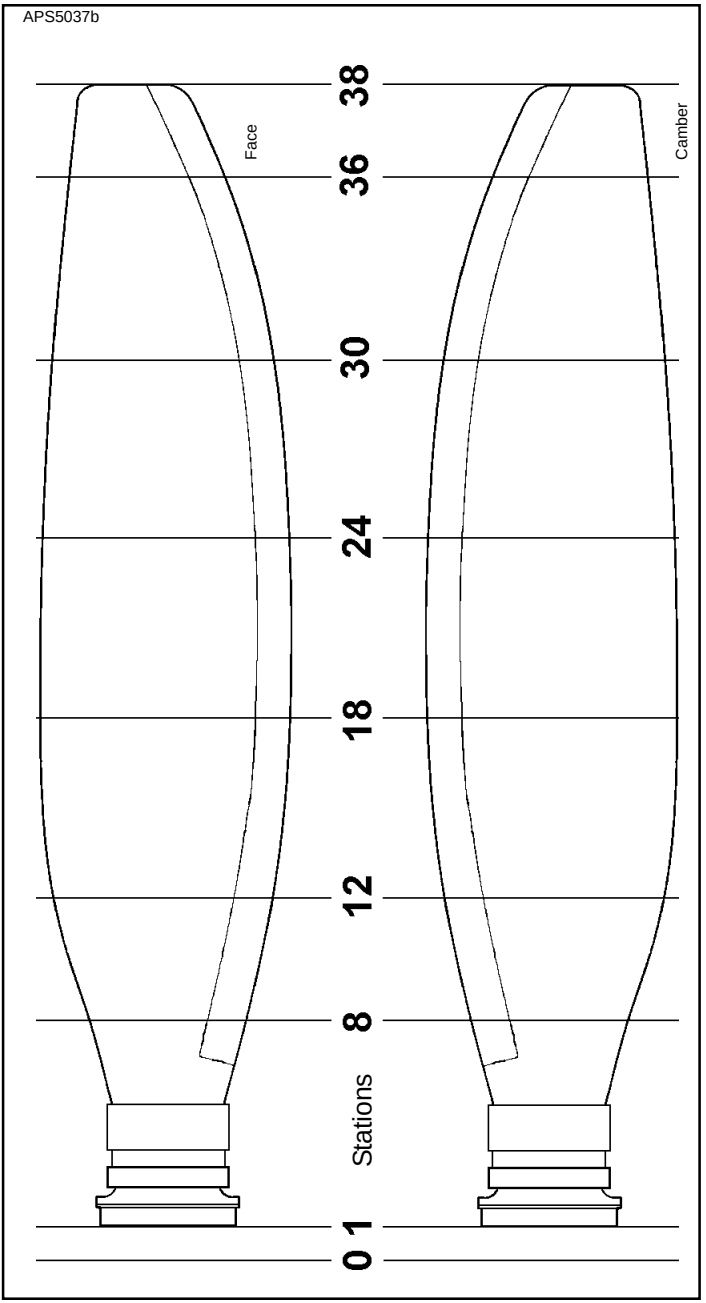
         (h) Aircraft information (aircraft type, model, serial number and registration number)

   B. Blade Damage Repair Sheets

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

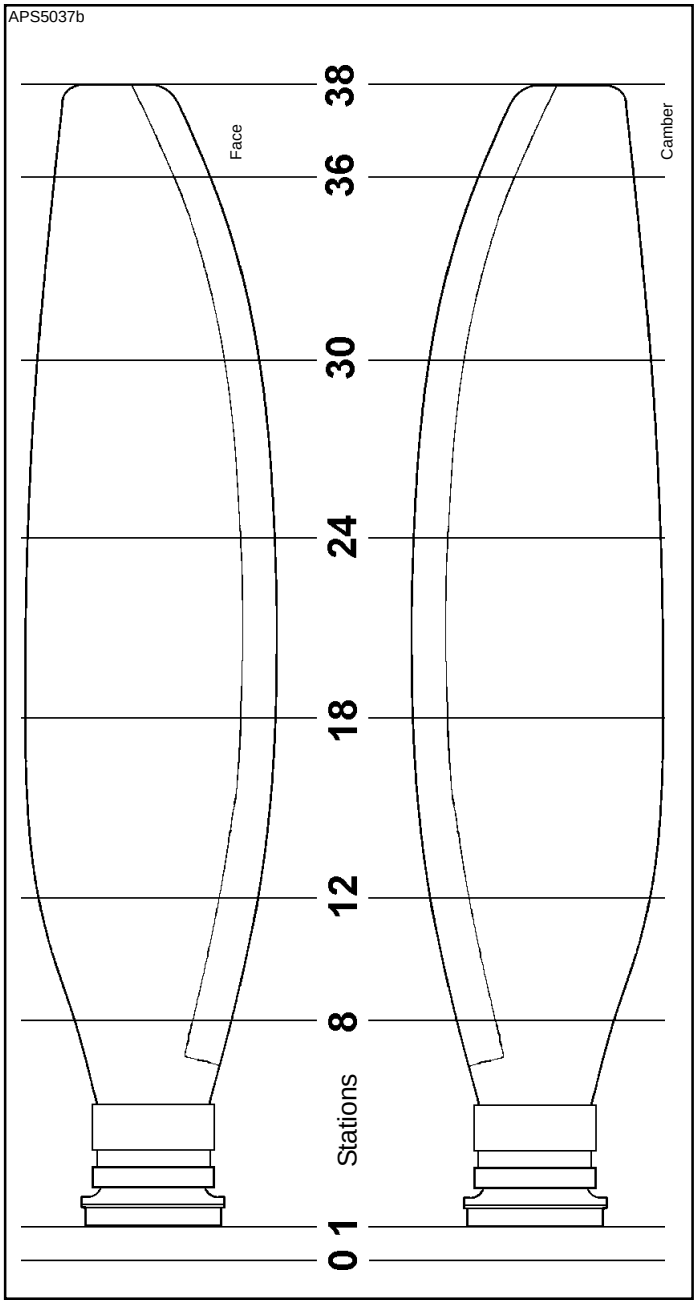
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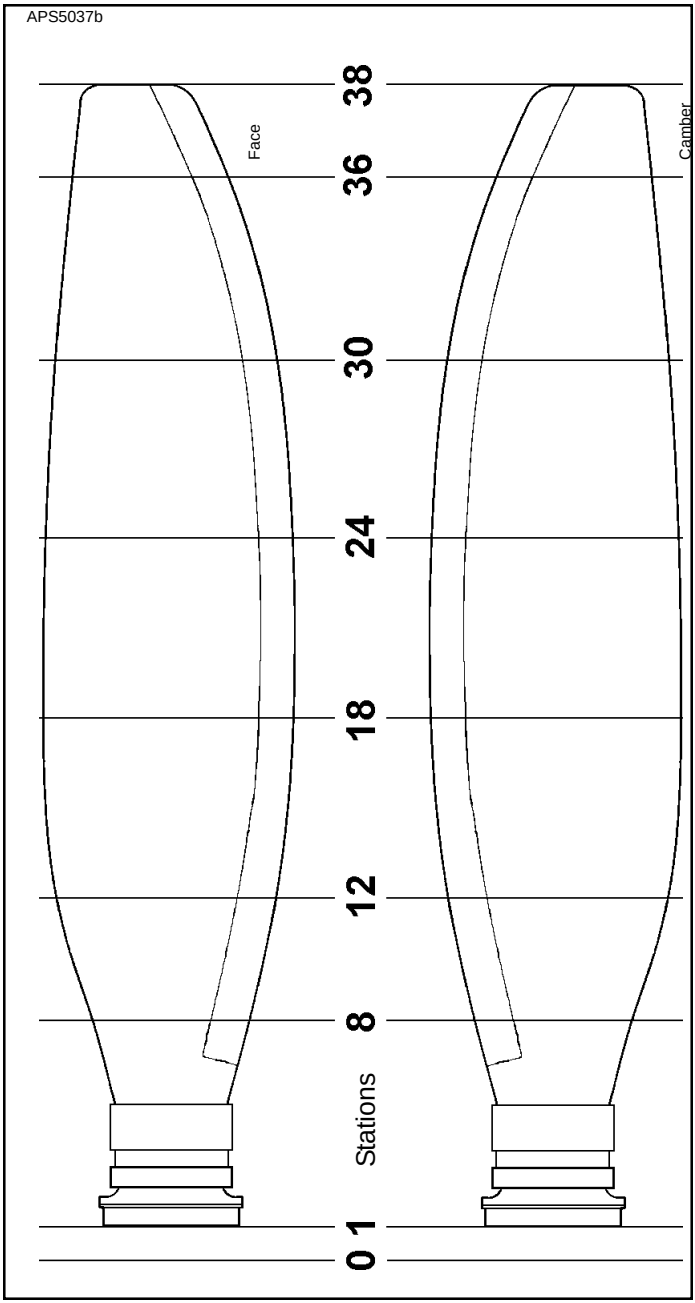
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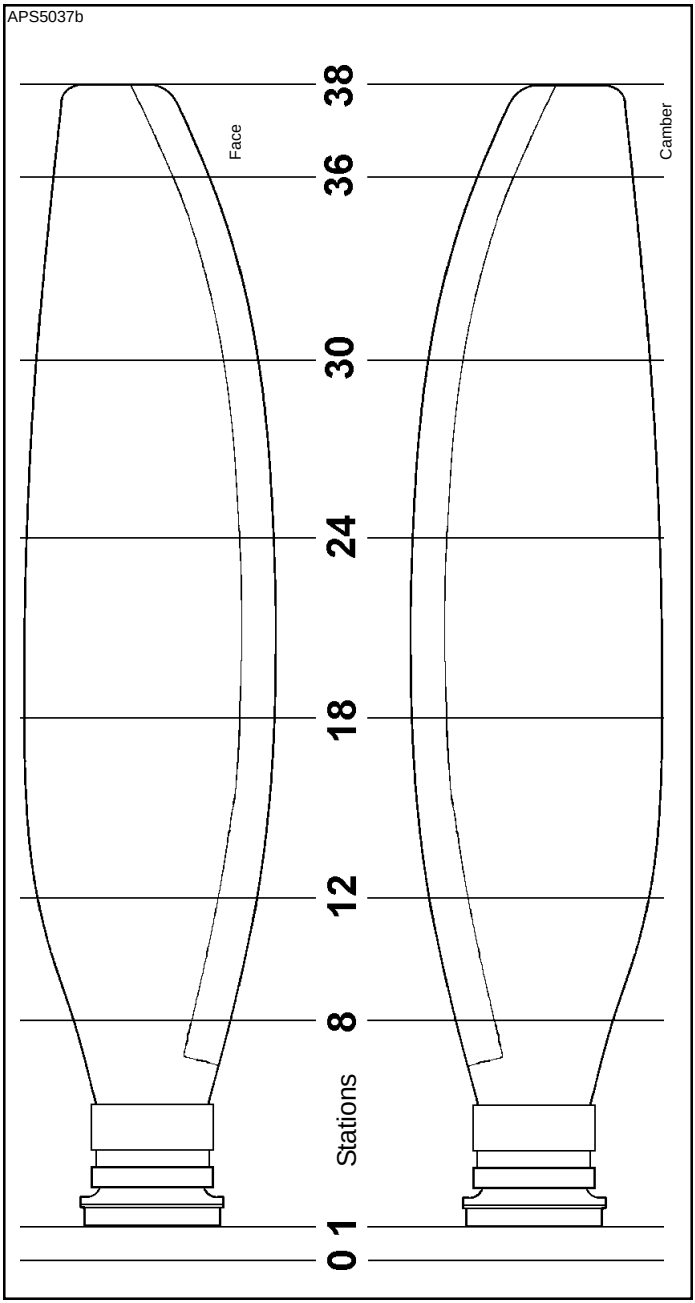
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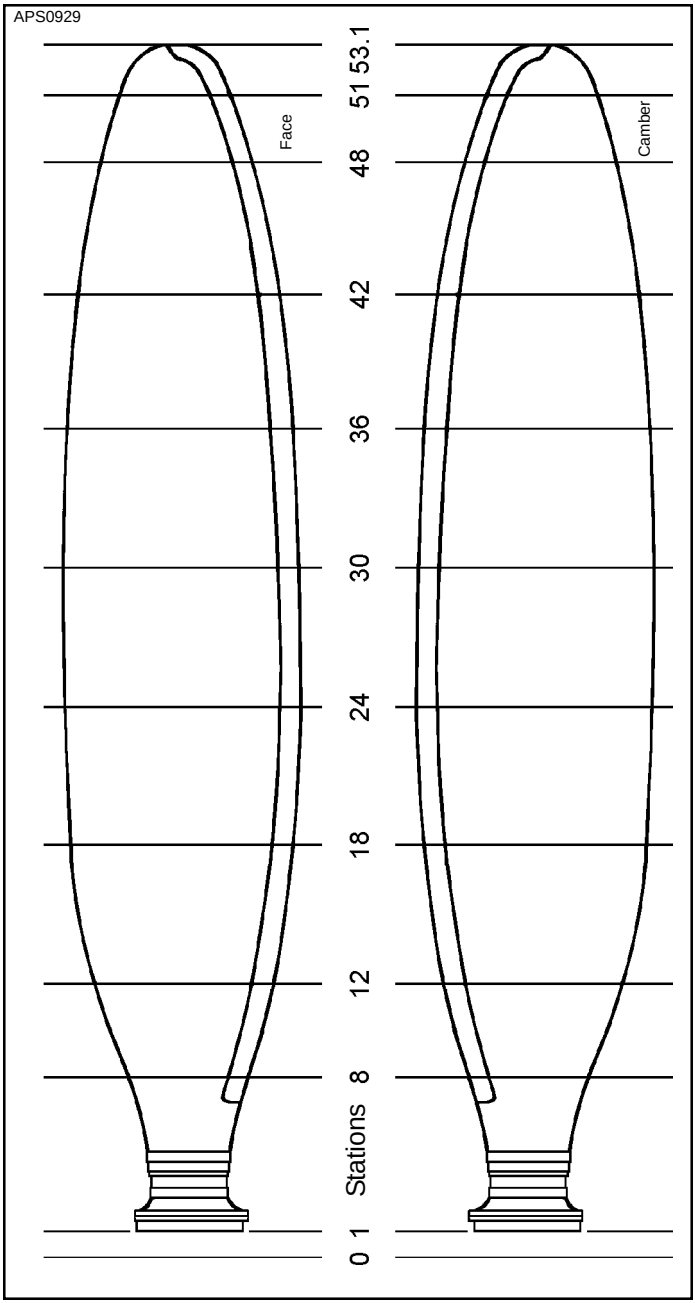
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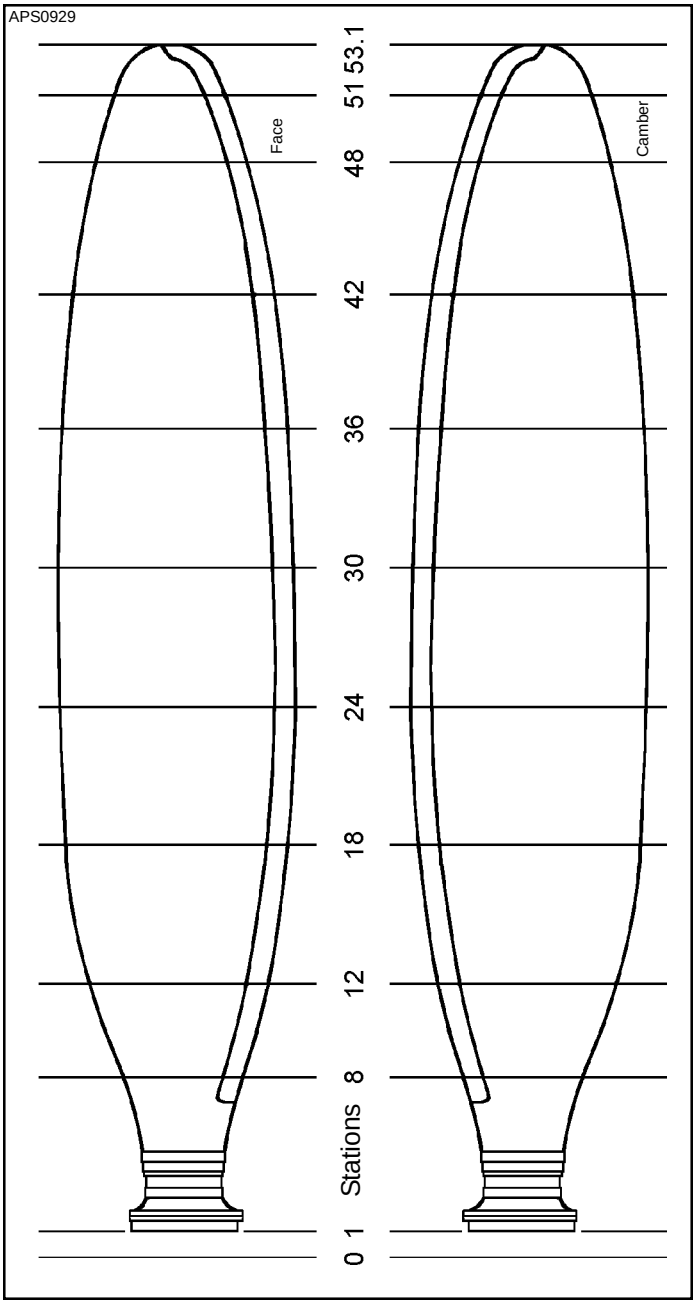
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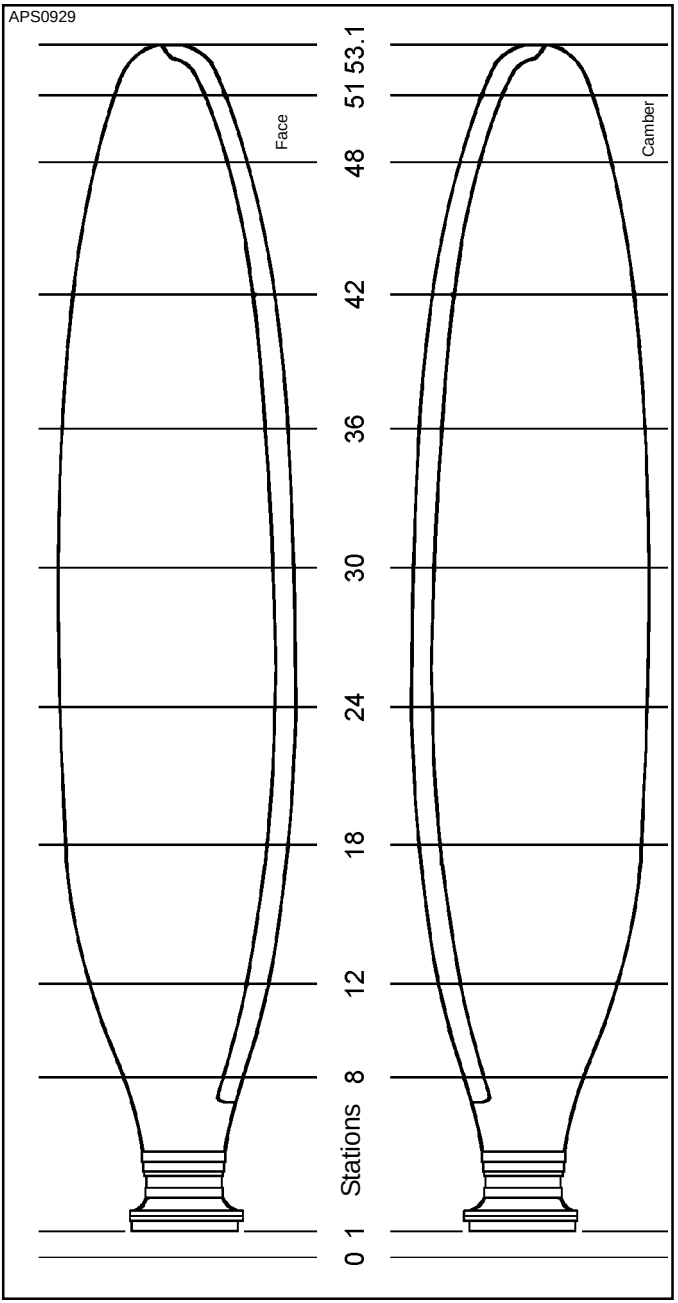
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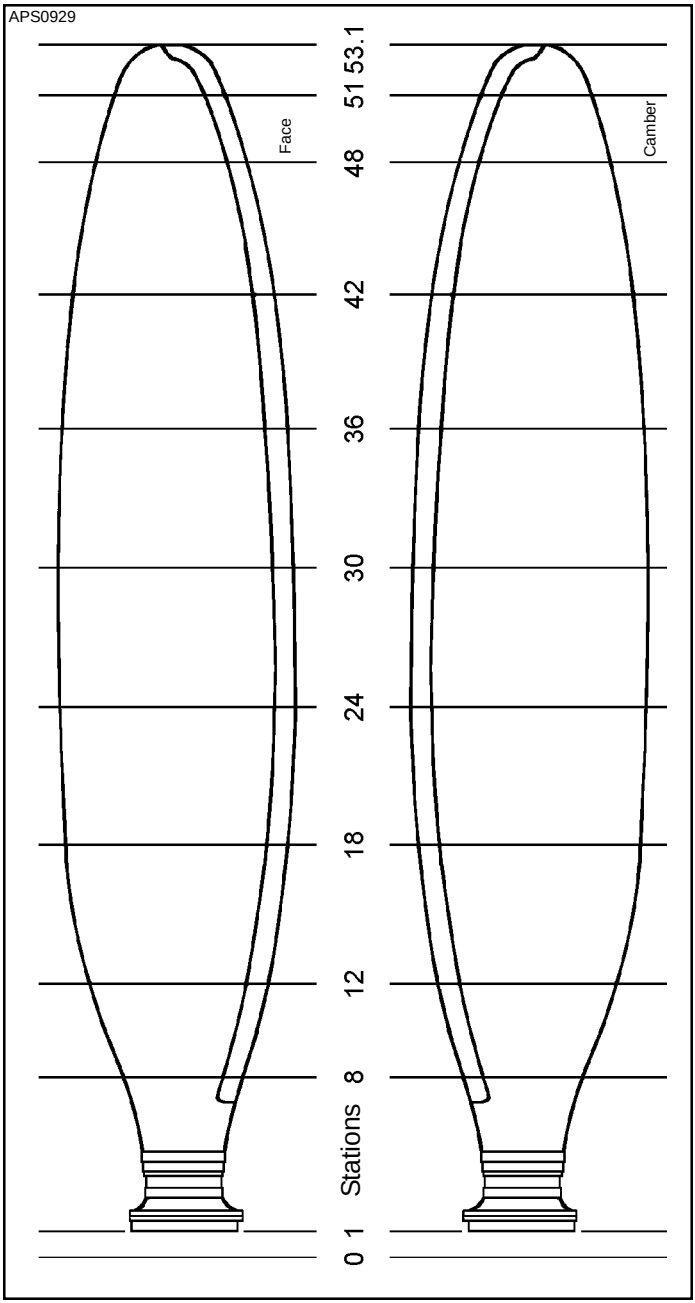
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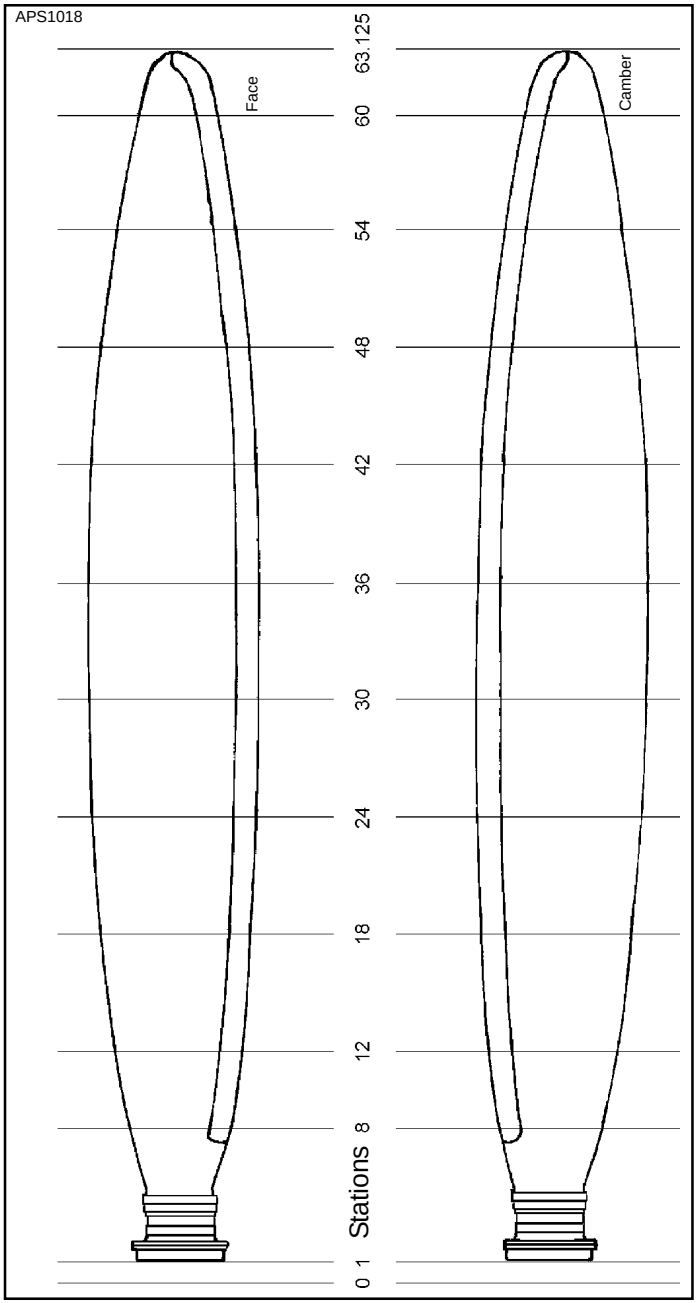
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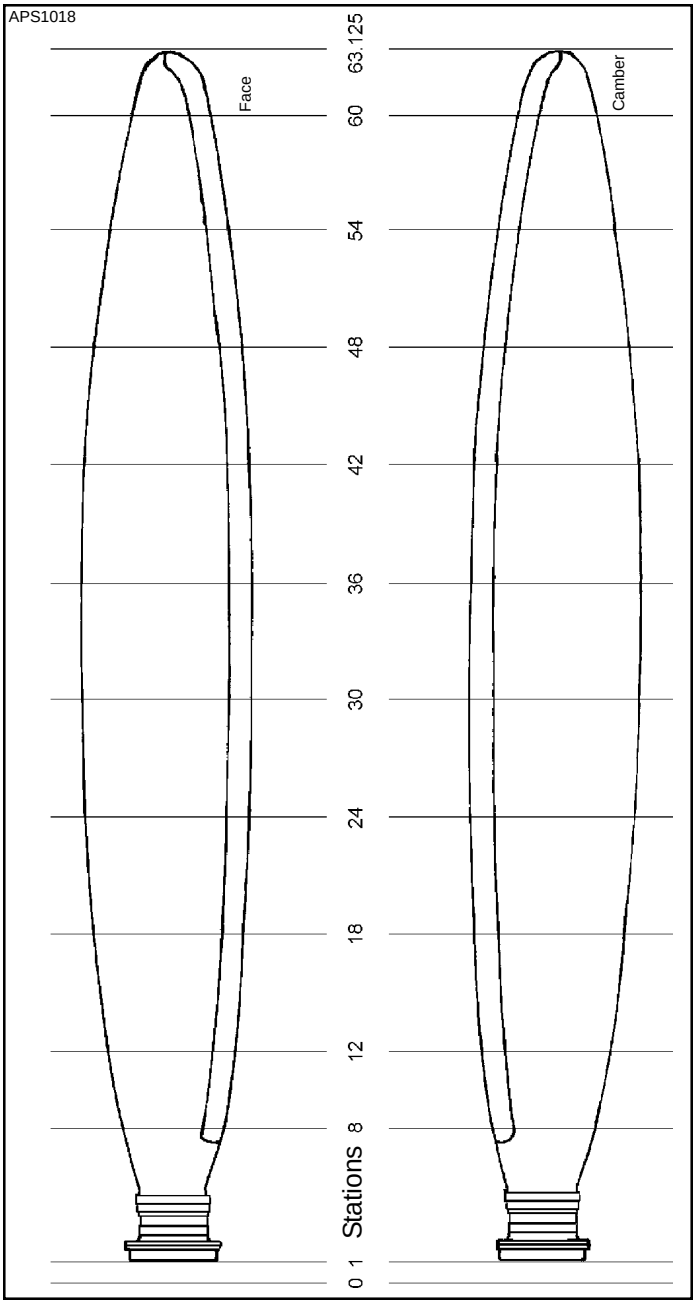
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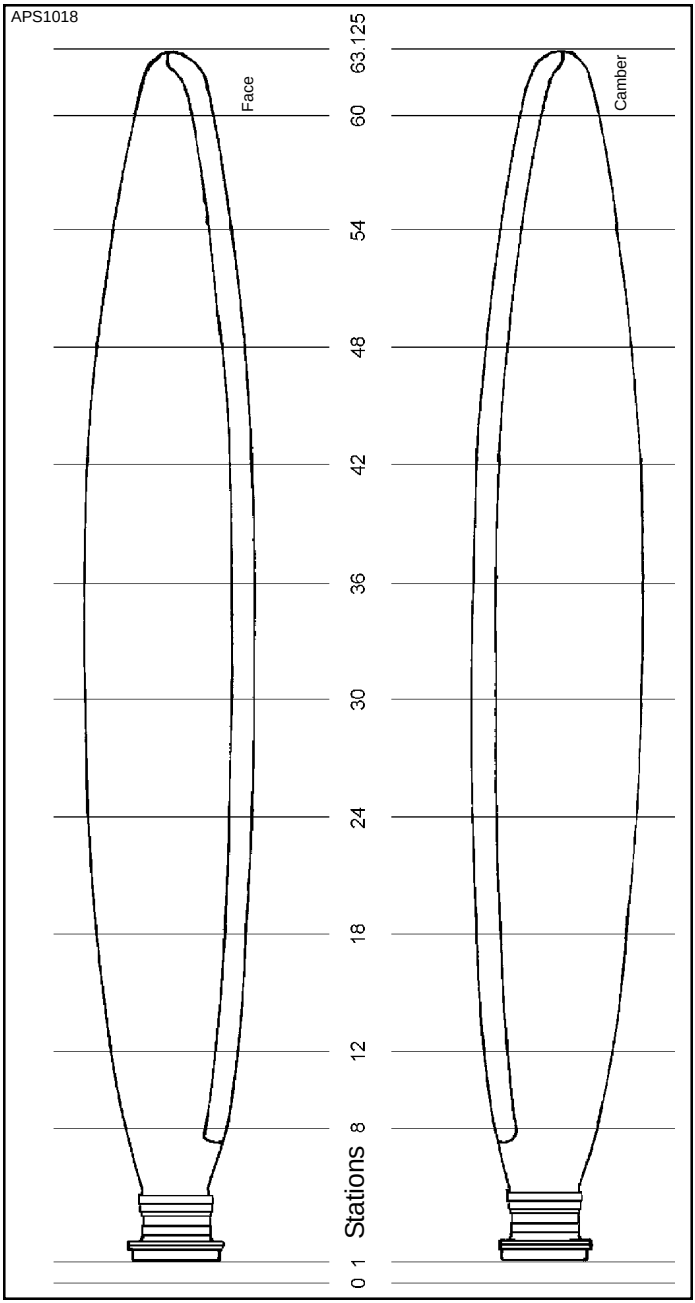
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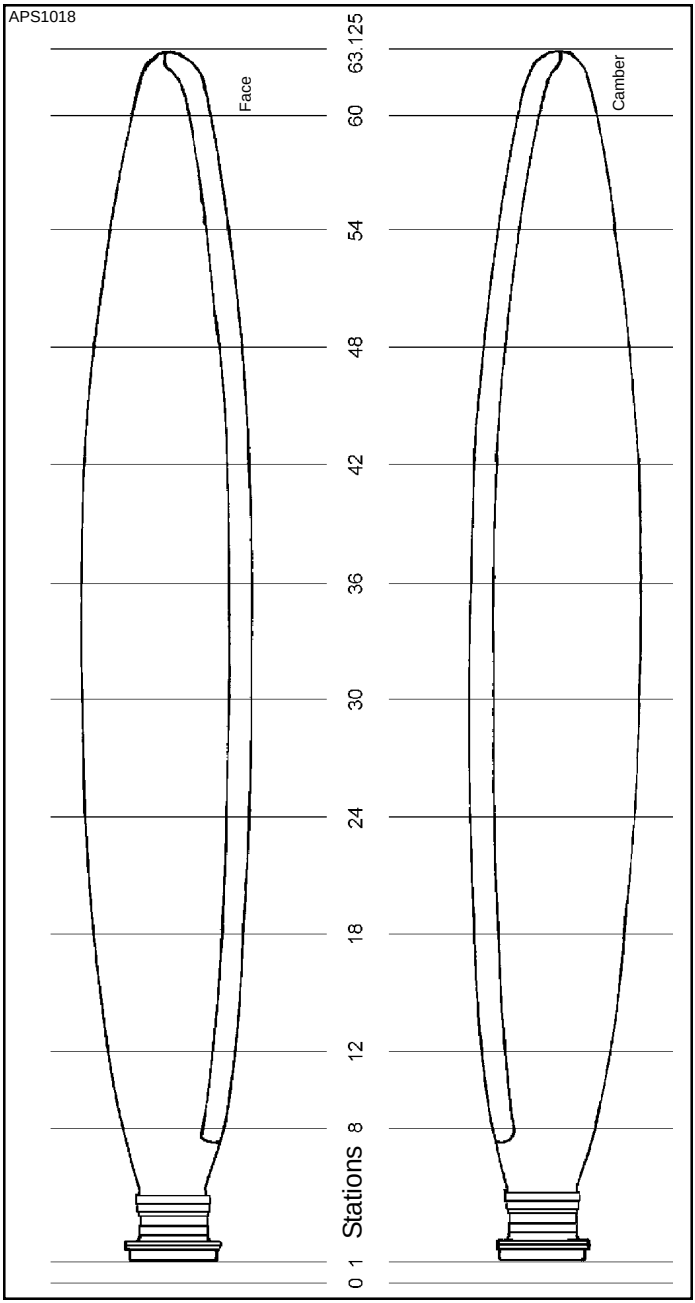
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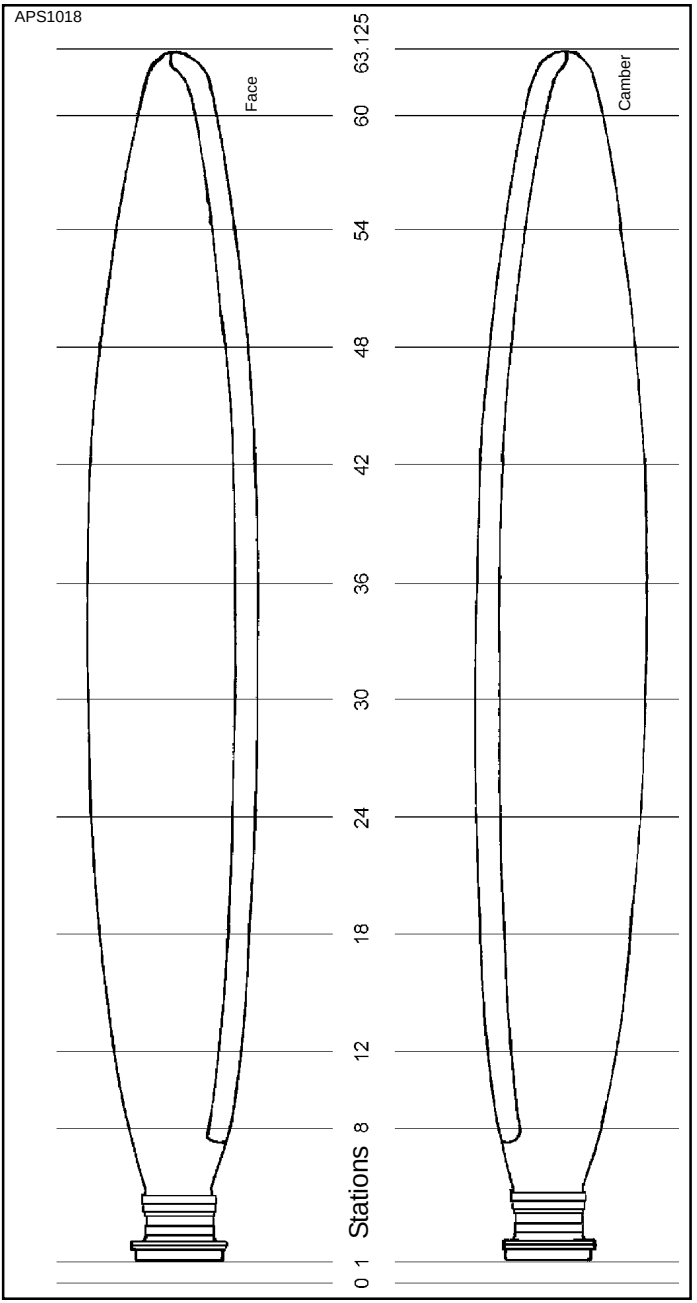
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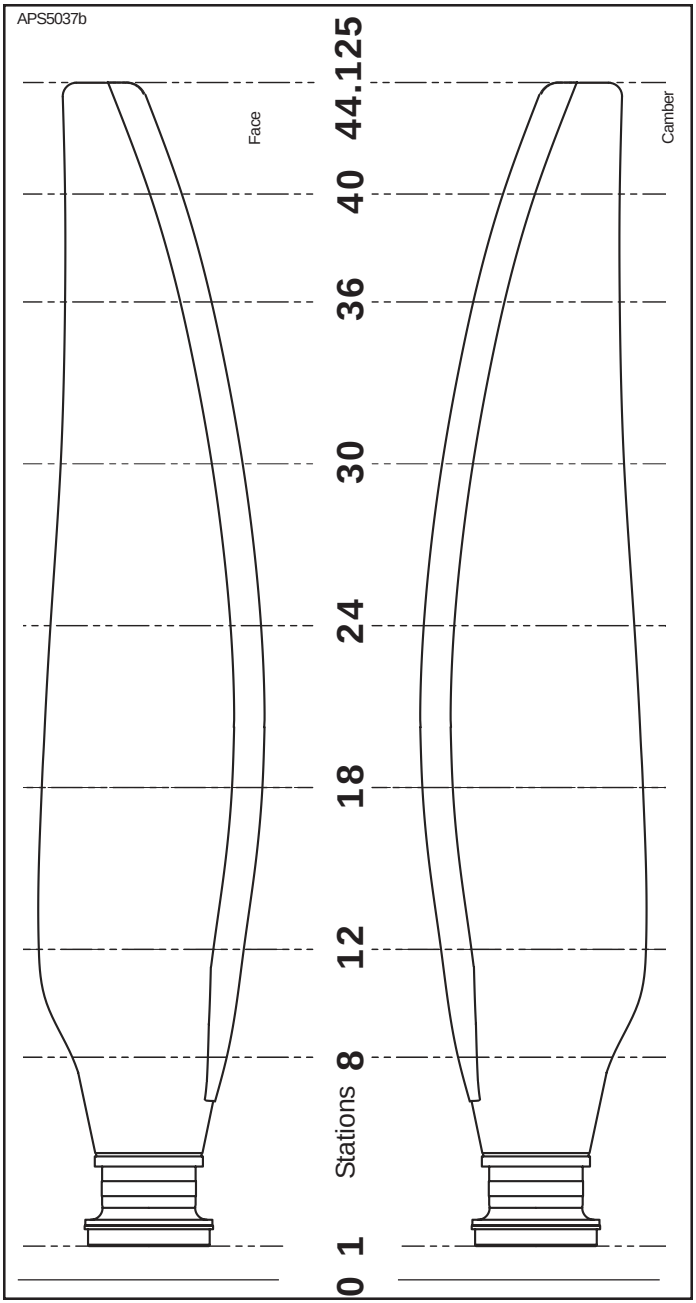
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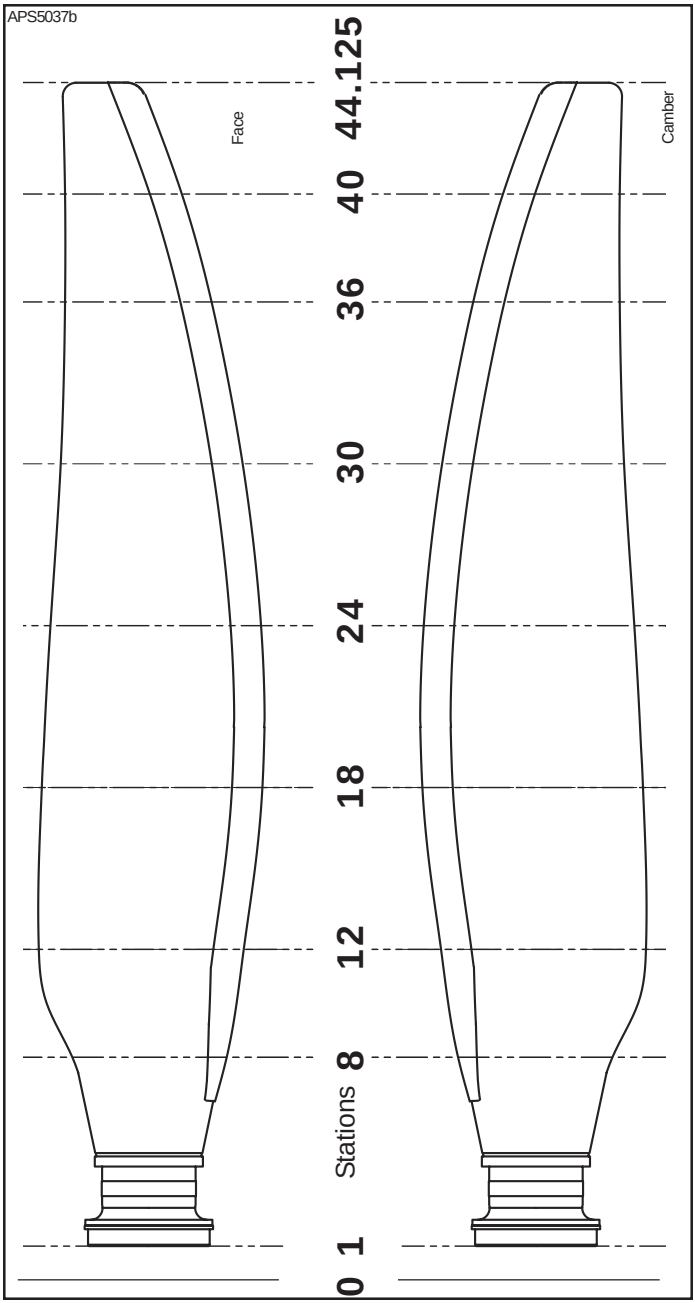
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Blade Serial No. _____



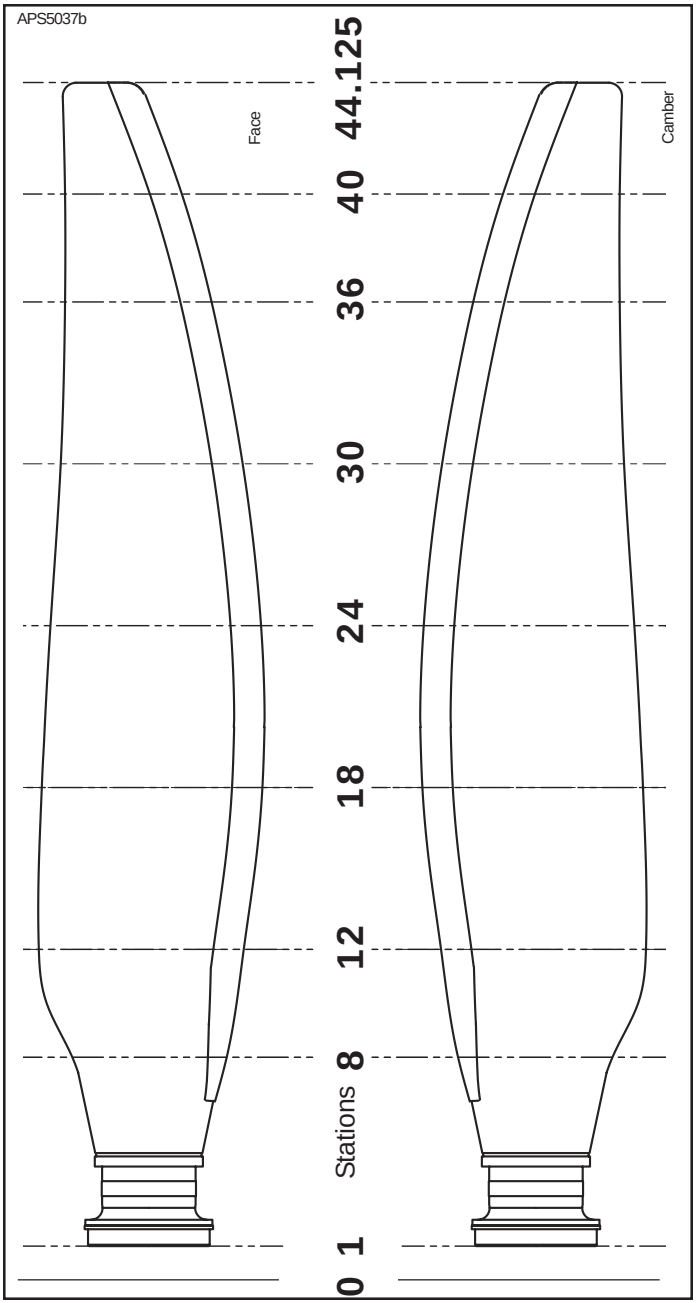
Record of E9193( ) Composite Blade Damage Repair

Blade Serial No. _____



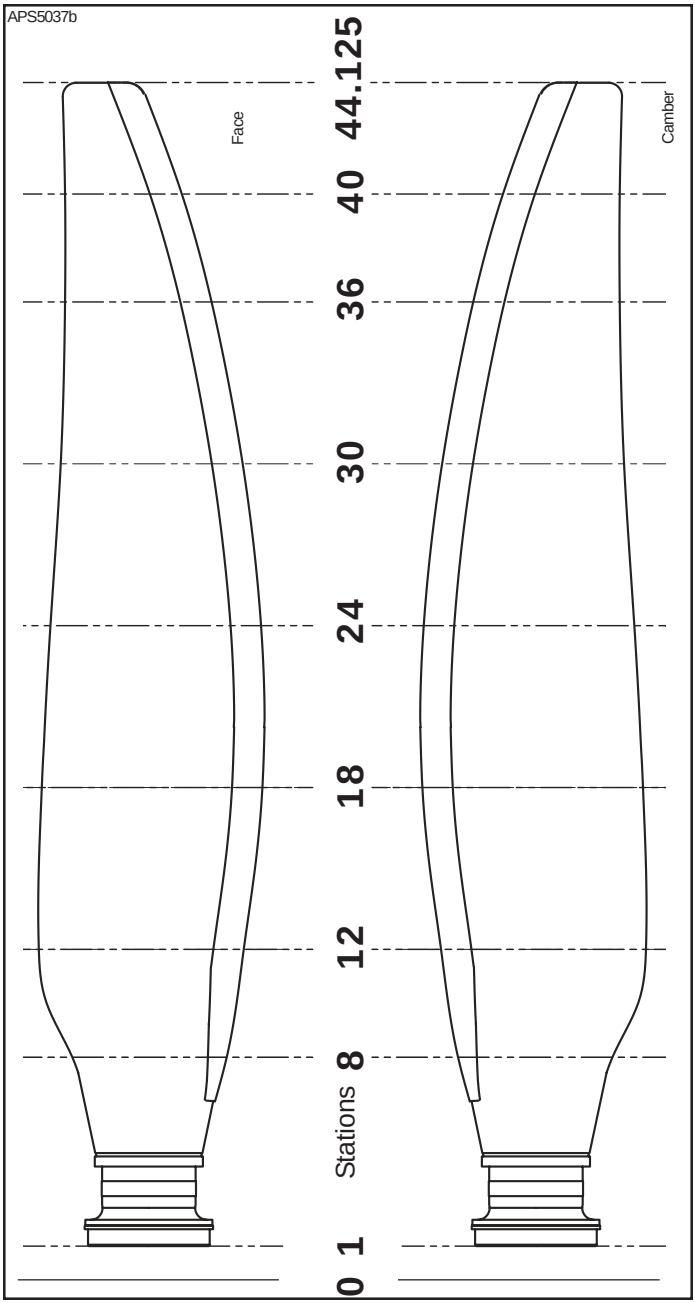
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Blade Serial No. _____



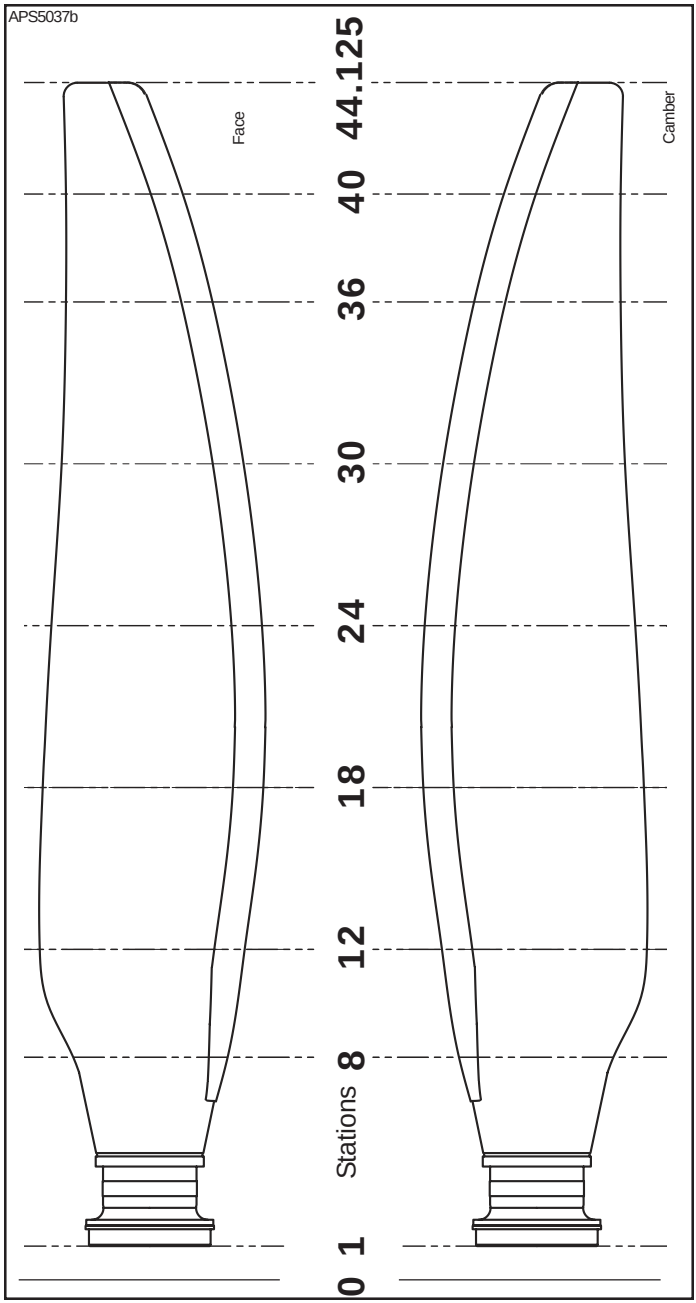
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Blade Serial No. _____



Record of E9193( ) Composite Blade Damage Repair

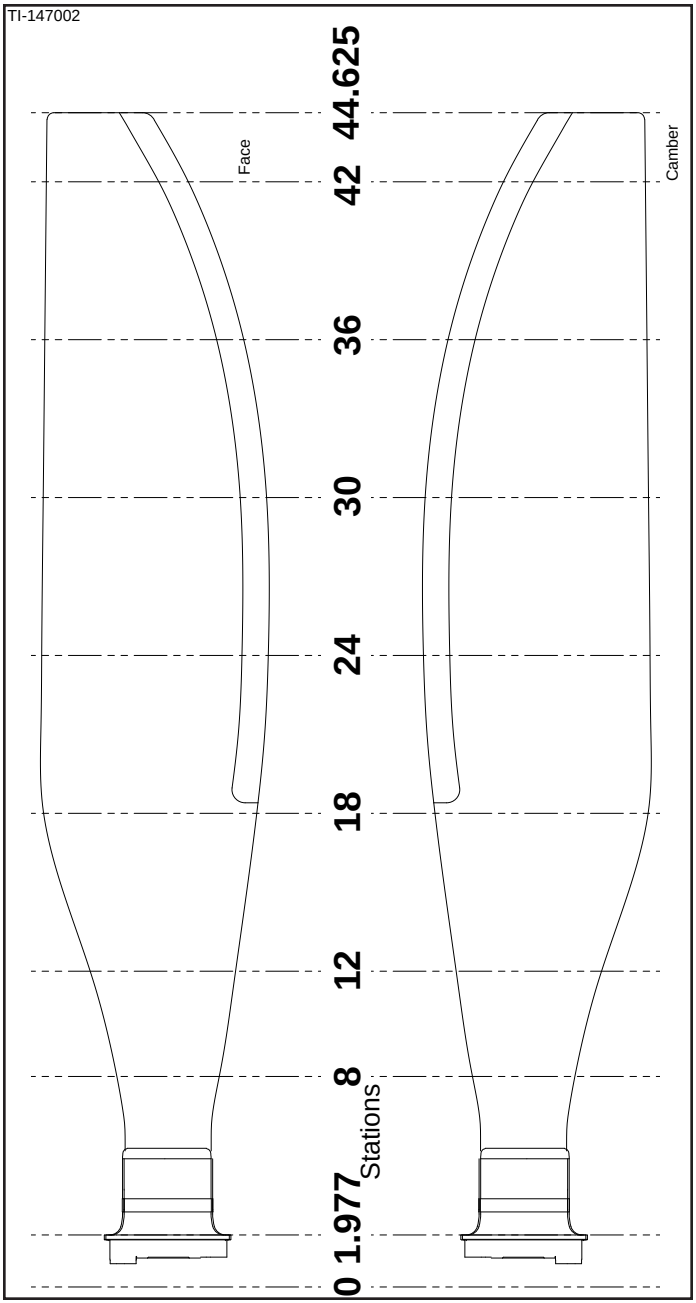
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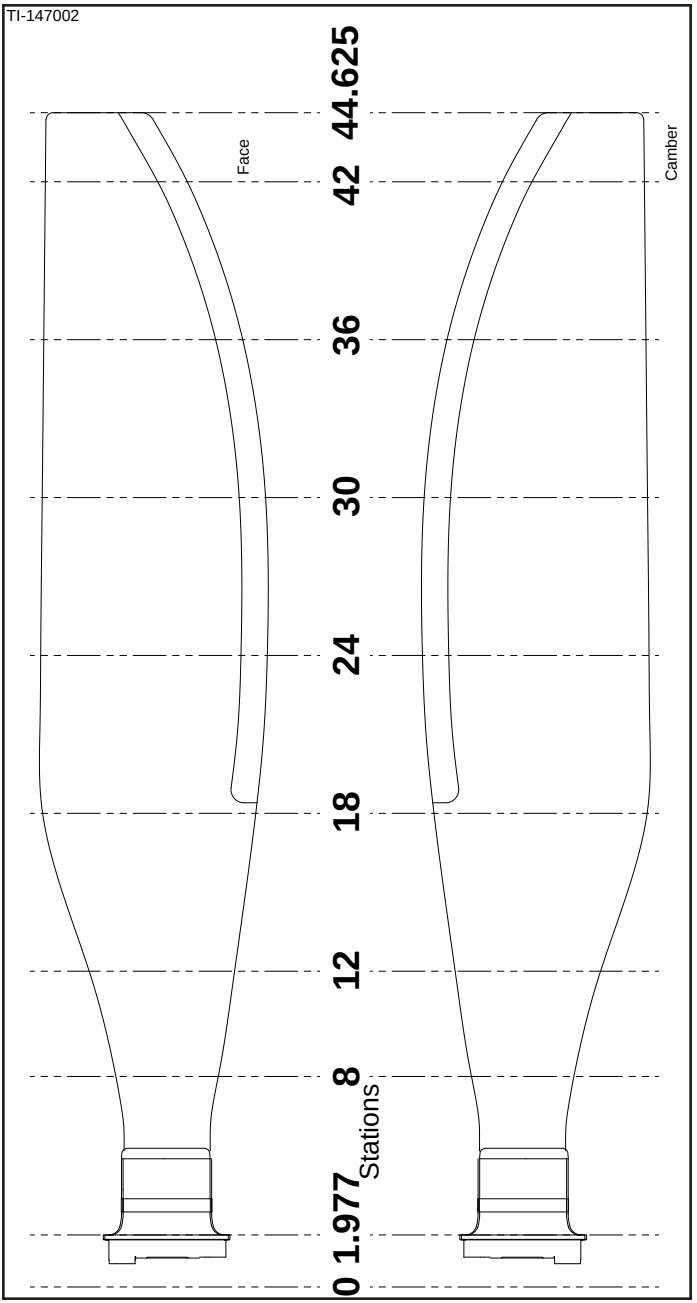
Record of NC9208K Composite Blade Damage Repair

Blade Serial No. _____



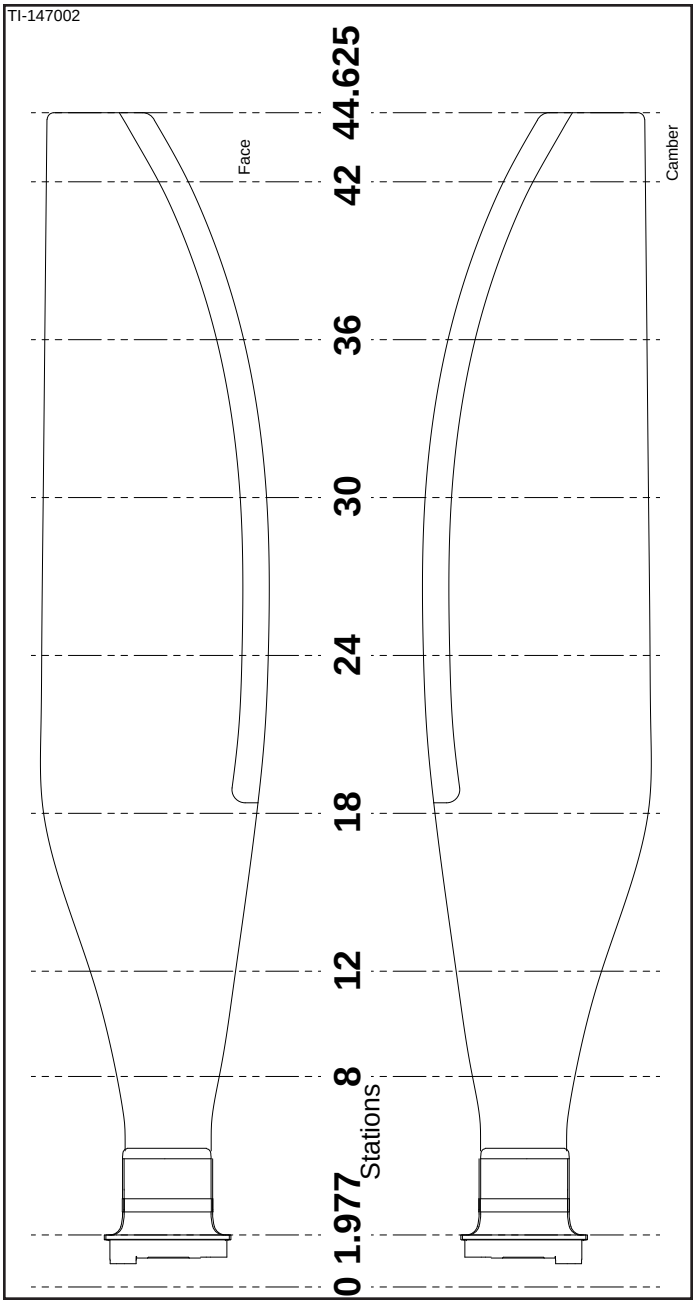
Record of NC9208K Composite Blade Damage Repair

Blade Serial No. _____



Record of NC9208K Composite Blade Damage Repair

Blade Serial No. _____



Record of NC9208K Composite Blade Damage Repair

Blade Serial No. _____

