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Information Manual for Experimental Aircraft

Volume 3

Application Information for Van's Aircraft

Hartzell Propeller Inc.

One Propeller Place

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

Phone: 937.778.4200

Fax: 937.778.4215

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IMPORTANT MESSAGE

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

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

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

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

For operators of uncertified or experimental aircraft an even greater level of vigilance is required in the maintenance and inspection of the propeller. Experimental installations often use propeller-engine combinations that have not been tested and approved. In these cases, the stress on the propeller and, therefore, its safety margin is unknown. If a failure occurs, it could be as severe as a 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/maintain horsepower output with a reduction in fuel flow. These modifications affect the vibration output of the engine and the stress levels on the propeller. Significant propeller life reduction and failure are real possibilities.

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

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

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RECORD OF REVISIONS

This is a record of all revisions to this manual.

ATTENTION: Always use the current revision of this manual. The current revision is available on the Hartzell website at www.hartzellprop.com.

Revision Number	Issue Date	Revision Number	Issue Date
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1. Introduction and Applicability

A. Introduction

Hartzell Manual 193 consists of multiple Volumes that describe the commonly used propeller configurations and options for experimental aircraft including discussions of installation guidelines, engine/propeller compatibility, and considerations for selecting a Hartzell Propeller for an experimental aircraft. These documents provide a summary/overview, and are not intended to be a replacement for guidance from the aircraft, engine, and/or propeller manufacturers about the appropriate propeller selection. When in doubt, please consult Hartzell Propeller Owner's manuals and/or the appropriate aircraft kit manuals. Additionally, you may contact Hartzell and/or the aircraft designer directly for guidance.

B. Applicability

Guidance in this manual is intended to enhance the safety and efficiency surrounding the use and integration of propellers on experimental aircraft. Government regulations, specifically 14 CFR Parts 23, 33, and 35, may not have regulatory requirements applicable to the aircraft in question. However, the builder/operator/integrator of an experimental aircraft, regardless of whether it is newly built or a modified version of an existing aircraft, should consider the same governmental regulations, policy, and guidance materials when developing and testing their aircraft. These topics regularly address physical concepts that apply regardless of airworthiness category. The ultimate responsibility for determining the proper integration of the propeller and aircraft lies with the aircraft owner/operator.

2. Propeller/Blade Model Designation

A. Model Number Designation System

Hartzell Propeller Inc. uses a model number designation system to identify specific propeller and blade assemblies. The propeller model number and blade model number are separated by a slash (/).

Example: *propeller model number / blade model number*
(e.g. HC-C2YR-1BFPX/F7497X)

Parentheses shown in the propeller/blade model number in this, or any other Hartzell publication, indicate that there are characters (letters or numbers) that, depending on the specific configuration, may or may not be present.

For additional information about the propeller/blade model designation system, refer to the applicable Hartzell propeller owner's manual and/or the applicable Type Certificate Data Sheet (TCDS).

3. WARNINGS and CAUTIONS

WARNING 1: THIS DOCUMENT, IN CONJUNCTION WITH THE PROPELLER OWNER'S MANUAL, PROVIDES IMPORTANT INFORMATION AND WARNINGS REGARDING THE INSTALLATION, OPERATION, AND PERFORMANCE OF YOUR PROPELLER.

WARNING 2: DETERMINING THE PROPER INTEGRATION OF THE PROPELLER AND AIRCRAFT IS THE RESPONSIBILITY OF THE AIRCRAFT INTEGRATOR. HARTZELL PROPELLER INC. SUPPLIES A PROPELLER BASED ON INFORMATION PROVIDED BY THE AIRCRAFT INTEGRATOR THAT HARTZELL CANNOT AND MAY NOT BE ABLE TO VERIFY. NEW PROPELLER APPLICATIONS REQUIRE CAREFUL TESTING AND EVALUATION. TESTING OR OPERATION OF THE PROPELLER, THEREFORE, CARRIES WITH IT A RISK OF SERIOUS INJURY, DEATH, AND/OR SIGNIFICANT PROPERTY DAMAGE.

WARNING 3: THERE IS A RISK OF SERIOUS INJURY, DEATH, AND/OR SIGNIFICANT PROPERTY DAMAGE IF THE PROPELLER HAS NOT BEEN TESTED AND SHOWN TO BE COMPATIBLE WITH THE ENGINE AND AIRCRAFT INSTALLATION, OR IF IT IS OPERATED IN A MANNER THAT EXCEEDS THE ESTABLISHED LIMITS FOR THE PROPELLER. IN THESE INSTANCES, VIBRATION LOADS CAN EXCEED THE DESIGN LIMITATIONS AND CAN RESULT IN PROPELLER OR BLADE SEPARATION FROM THE AIRCRAFT.

WARNING 4: STABILIZED 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.

4. Trademarks and Disclaimers

A. Designers/Kit Manufacturers

This manual mentions various suppliers of aircraft kits, designs, engines, and aftermarket products. The information contained herein is not endorsed, or approved by, any of these entities.

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1. Recommended Hartzell Propellers for Van's Aircraft Models

A. Propeller Options by Aircraft Model/Engine Type

The table below lists the recommended Hartzell propeller(s) based on the Aircraft Model, Engine, and Blade Material. Engine models listed here are not necessarily those approved by Van's Aircraft for use on the RV models listed; please contact Van's for applicable engine information. The engine combinations described here are general engine series, for specific information on vibrational compatibility of specific propeller and engine combinations, refer to Manual 193, Volume 1. For topics regarding the integration of the propeller onto the airframe, refer to Manual 193, Volume 2. The details in these volumes may influence your propeller selection and configuration.

While these are our recommendations based on the best information we have, your build may have unique requirements and there may be multiple configurations of the "same" propeller available. These configurations are described by variations in the propeller model (refer to the section, "Propeller/Blade Model Designation" in this manual, and Manual 193, Volume 2). When configured for a specific installation, a model is assigned a specific part number; most available configurations and part numbers are listed under "Van's" in Hartzell Manual 159. As the integrator, it's up to you to consider all the factors involved in selecting the configuration for your application.

For detailed information about the recommended propeller, click on the hyperlinked text, or refer to the applicable propeller in the "Propeller Details" section of this chapter.

Recommended Propellers by Aircraft/Engine Model

Aircraft Model(s)	Engine(s)	Blade Material	No. of Blades	Recommended Propeller(s)	Marketing Designation
RV-3 RV-4 RV-6(A) RV-7(A) RV-8(A) RV-9(A)	320	Aluminum	2	HC-C2YL-1BFX / F7663-4X	N/A
Composite		3	3C1-L430A1X() / 76C(S)03-(2,4,7)X2	Explorer	
RV-4* RV-6(A)* RV-7(A) RV-8(A) RV-14(A)	360-390	Aluminum	2	(B)HC-(C,M)2YR-1BFPX / F7497(-2)X	Blended Airfoil
Composite		2	HC-(C,G,M)2YR-1N(W)X / N7605(W)-(2,4)X	N/A	
		3	3C1-R(430, 675)A1X() / 76C(S)03-(2,4)X2	Explorer	
RV-10	540	Aluminum	2	HC-C2YR-1BFPX / F8068DX	Super Scimitar
		Composite	3	HC-(C,G)3Y(1)R-1N(W)X / N7605C(W)X	N/A
			3	3C1-R430A1X() / 76C(S)04X2	Explorer
RV-15	360-390	Composite	2	HC-C2YR-1NX / NG8301-3X1	Trailblazer
			3	3C1-R430A1X() / 80C(S)01(X)	Pathfinder

* These models are known to have engine displacement limitations.

2. Van's RV Aircraft Modifications

NOTE: Some modifications to "stock" RV models may affect propeller choices.

A. RV-3 and RV-4 Models

RV-3 and RV-4 models with cowlings before ~1995 use a smaller 12" spinner. This small spinner may or may not fit around Hartzell constant speed propeller hubs; we know that people have used Hartzell propellers on aircraft of this vintage but Hartzell cannot verify the modifications or procedures necessary. Hartzell does not currently have any spinners that size for these aircraft.

B. James Aircraft Cowlings

James Aircraft extended cowlings use an M hub extension for the compact series of propellers, and a 675 extension for the Raptor series. The "shorty" cowlings take the same extension as the stock aircraft, except when using a propeller with N7605() blades.

C. Showplanes Cowlings

Showplanes extended cowling for the RV-8(A) uses an M hub extension for the compact series of propellers; configuration for the Raptor-series has not yet been defined. The Showplanes cowlings use a larger diameter spinner, Hartzell typically supplies a C-3533-1(P) spinner for two blade, compact hub propellers. One builder report indicates that the combination of an HC-G3Y1R-1NX/N7605CX propeller and D-7709(P) spinner worked well with the Showplanes RV-10 cowling; we recommend verifying this will work for your application if you intend to replicate it.

3. Spinner Assemblies

A. Kit Spinners

Hartzell has provided information to Van's for adapting the kit components to Hartzell hubs.

ATTENTION: Hartzell offers the following spinners for RV models as an alternative to the kit components. Adjustment distances are provided for reference to aid the builder in selecting, where appropriate, the correct spinner and hub extension (refer to Manual 193, Volume 2 for information on hub extensions) combination for their installation. Clearance is not assured, therefore must be measured. Blade design and spinner blade cutout may impact adjustment range; the 7663 blade in particular is limited.

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B. D-4798(P)

An aluminum, optionally polished (P), spinner used with two blade G hub compact propellers and the N7605() blade to generate adequate blade trail edge to cowling clearance.

D-4798(P) Attributes

Attribute	Value
Outside Diameter	~12.7 in.
Length	~17.4 in.
Weight	~4.5 lbf.
Max. Adjustment Aft of Blade Centerline	3.255 in.
Min. Adjustment Aft of Blade Centerline	3.190 in.

C. C-3533-1(P)

An aluminum, optionally polished (P), spinner used with two blade compact propellers and Showplanes cowlings. The 7663, if used with this spinner, has no adjustment beyond max aft.

C-3533-1(P) Attributes

Attribute	Value
Outside Diameter	~14.8 in.
Length	~20.1 in.
Weight	~5.6 lbf.
Max. Adjustment Aft of Blade Centerline	3.461 in.
Min. Adjustment Aft of Blade Centerline	3.212 in.

D. C-4582(-P)

An aluminum, optionally polished (P), spinner used with three blade compact propellers; typically used for the RV-10.

C-4582(-P) Attributes

Attribute	Value
Outside Diameter	~13.2 in.
Length	~17.4 in.
Weight	~3.9 lbf.
Max. Adjustment Aft of Blade Centerline	3.201 in.
Min. Adjustment Aft of Blade Centerline	2.889 in.

E. 107186(P)

An aluminum, optionally polished (P), spinner for three blade Raptor propellers. This spinner will fit new builds, when the cowling is matched to the spinner, but may not offer enough fore/aft adjustment to be used with retrofit installations; cowling fit should be checked first.

107186(P) Attributes

Attribute	Value
Outside Diameter	~13.2 in.
Length	~17.3 in.
Weight	~4.2 lbf.
Max. Adjustment Aft of Blade Centerline	2.933 in.
Min. Adjustment Aft of Blade Centerline	2.744 in.

F. 107974(F1,F2)

A hybrid spinner utilizing a composite dome with an aluminum bulkhead for three blade Raptor propellers. Offered in primer (no suffix), Matterhorn White (F1), and Sterling Silver Metallic (F2). Check cowling fit for retrofits.

107974(F1,F2) Attributes

Attribute	Value
Outside Diameter	~13.5 in.
Length	~17.3 in.
Weight	~3.5 lbf.
Max. Adjustment Aft of Blade Centerline	2.630 in.* 2.836 in.**
Min. Adjustment Aft of Blade Centerline	2.318 in.
<i>* NOTE: With standard spinner mounting kit bolts. ** NOTE: With alternate spinner mounting kit using longer bolts.</i>	

G. D-7709(P)

An aluminum, optionally polished (P), spinner used with three blade compact propellers; used for the RV-10 with a Showplanes Cowling.

D-7709(P) Attributes

Attribute	Value
Outside Diameter	~14.6 in.
Length	~19.1 in.
Weight	~5.5 lbf.
Max. Adjustment Aft of Blade Centerline	3.618 in.
Min. Adjustment Aft of Blade Centerline	3.369 in.

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4. Ground Clearance

NOTE: The table below, provides a recommended propeller diameter based on the information available to Hartzell Propeller Inc.
Please contact Van's for direct confirmation of the propeller diameter.

Recommended Diameters for Ground Clearance

Aircraft Model	Tricycle	Tailwheel
RV-3	n/a	70 in.*
RV-4 (std. gear)	n/a	70 in.*
RV-4 (long gear)	n/a	72 in.*
RV-6(A)	74 in.	72 in.
RV-7(A)	74 in.	72 in.
RV-8(A)	74 in.	74 in.
RV-9(A)	74 in.	72 in.
RV-10	80 in.	n/a
RV-12	70 in.	n/a
RV-14(A)	74 in.	72 in.
<i>* NOTE: Reduced confidence in value. Contact Van's.</i>		

5. Propeller Details

This section provides details on specific propeller models, as well as typical, general engine series used with those propellers. For specific information on vibrational compatibility of specific propeller and engine combinations, please refer to Manual 193, Volume 1. Please also see Manual 193, Volume 2 for topics regarding the integration of the propeller onto the airframe. The details in these volumes may influence your propeller selection and configuration.

NOTE: Refer to the section, "Recommended Hartzell Propellers for Van's Aircraft Models" for propeller recommendations by aircraft model and engine.

A. (B)HC-(C,M)2YR-1BFPX/F7497(-2)X

This is a two blade compact propeller with aluminum blades. Widely known as the “Blended Airfoil” prop, or the “BA” prop, this propeller has been, and continues to be, popular on many RV models with 360-390 engines and for good reason. Widely regarded as the fastest prop available, and pretty much the benchmark against which all other RV props are compared due to its wide range of performance and excellent value. This propeller is available in either 74” or 72” diameter and typically configured with a C hub extension. An M hub extension is also available for use with aftermarket extended cowlings. This propeller is also used on other experimental aircraft such as Glasairs, Mustangs, and T-18s, as well as on certified aircraft like the Mooney M20(various), Piper Arrow, and Diamond DA 40. The ()7499() is a life limited version of the ()7497() for applications with more severe engine vibration characteristics.

(B)HC-(C,M)2YR-1BFPX/F7497(-2)X Attributes

Characteristic	Value
Number of Blades	2
Available Diameters	74" / 72"
Typical Extensions	C / M
Weight, C/M hub	58.5 / 63 lbf.
Typical Engine Displacement	360 / 390



(B)HC-(C,M)2YR-1BFPX/F7497(-2)X

B. HC-(C,G,M)2YR-1N(W)X/N7605(-2,-4)(W)X

This is a two blade compact propeller with composite blades, the first ASC-II composite propeller Hartzell introduced to the recip market and is immediately identifiable by its wide chord design. This propeller loses some top end speed compared to the 7497, but saves considerable weight off the nose of the aircraft. Some pilots prefer this propeller for aerobatics due to the increased drag at idle that the big blades can provide. The wide chord, in combination with the high blade angles needed in cruise for fast aircraft like the RV series can lead to interference issues between the cowling and the blade trailing edge. This issue is most common on the RV-8(A), due to it's unique cowling. The G hub extension moves the blades further away from the engine, and the D-4798(P) spinner aligns the cowling further aft than the kit supplied spinner components for proper blade to cowling clearance. An M hub extension is also available for use with aftermarket extended cowlings.

(B)HC-(C,G,M)2YR-1N(W)X/N7605(-2,-4)(W)X Attributes

Characteristic	Value
Number of Blades	2
Available Diameters	76" / 74" / 72"
Typical Extensions	C / G / M
Weight, C/G/M hub	42 / 43 / 48 lbf.
Typical Engine Displacement	360 / 390



(B)HC-(C,G,M)2YR-1N(W)X/N7605(-2,-4)(W)X

C. HC-C2YR-1BFPX/F8068DX

The best “Bang for the Buck” prop available for the RV-10, this is a two blade compact propeller with aluminum blades. The same blade design is the blade of choice for Rockets, also known as the Super Scimitar blade. Available in 80” diameter and typically configured with a C hub extension.

HC-C2YR-1BFPX/F8068DX Attributes

Characteristic	Value
Number of Blades	2
Available Diameters	80"
Typical Extensions	C
Weight, C hub	54 lbf.
Typical Engine Displacement	540



HC-C2YR-1BFPX/F8068DX

D. HC-(C,G)3Y(1)R-1N(W)X/N7605C(W)X

This is a three blade Compact propeller with composite blades for the RV-10 and is immediately identifiable by its wide chord design. Pilot reports indicate that this prop loses some top end speed compared to the 8068. This propeller is also used on the Cirrus SR22(T). When the propeller model number includes a "1" after the shank designation "Y" (ex. HC-C3Y¹R-1N), this indicates a Lightweight Compact propeller. Lightweight Compact propellers use a lighter hub assembly and are only available with composite blades.

HC-(C,G,M)3Y(1)R-1N(W)X/N7605C(W)X Attributes

Characteristic	Value
Number of Blades	3
Available Diameters	78"
Typical Extensions	C / G
Weight, Lightweight C/G hub	58 / 60 lbf.
Typical Engine Displacement	540



HC-(C,G)3Y(1)R-1N(W)X/N7605C(W)X

E. 3C1-(L,R)(430, 675)A1X()/76C(S)03-(2,4,7)X2

The first Raptor propeller introduced to the RV series, this is a three blade propeller with composite blades; designated with the trade name Explorer. For installations with acceptably low vibratory loads as determined by Hartzell engineers, the blades are configured with a lightweight aluminum shank designated as “C” (e.g. 76C03) to save weight; higher load applications utilize stainless steel shanks, designated as “CS” (e.g. 76CS03) and weigh more as a result. This propeller is currently available in several diameters, currently two diameters for 360s/390s and with a smaller diameter for 320 applications.

3C1-(L,R)(430, 675)A1X()/76C(S)03-(2,4,7)X2 Attributes

Characteristic	Value
Number of Blades	3
Available Diameters	74" / 72" / 69"
Typical Extensions	430 / 675
Weight, 430 hub, Aluminum/Stainless Steel shanks	42 / 50 lbf.
Typical Engine Displacement	320 / 360 / 390



3C1-(L,R)(430)A1X()/76C(S)03-(2,4,7)X2

F. 3C1-R430A1X()/76C(S)04X

A new three blade offering for the RV-10, this is a three blade Raptor propeller; designated with the trade name Explorer. For installations with acceptably low vibratory loads as determined by Hartzell engineers, the blades are configured with a lightweight aluminum shank designated as "C" (e.g. 76C04) to save weight; higher load applications utilize stainless steel shanks, designated as "CS" (e.g. 76CS04) and weigh more as a result. Similar to the three blade configured for the 4 cylinder RVs, this one uses a different laminate design for the 540 engine.

3C1-R430A1X()/76C(S)04X2 Attributes

Characteristic	Value
Number of Blades	3
Available Diameters	76"
Typical Extensions	430
Weight, Aluminum/Stainless Steel shanks	42 / 50 lbf.
Typical Engine Displacement	540

G. HC-C2YL-1BFX/F7663-4X

This is a two blade compact propeller with aluminum blades. This propeller offers inexpensive performance for 320 equipped aircraft; it's not the newest, or the prettiest, but it works well. While careful attention to knicks and damage is always important, it is especially important for this particular blade design because it is thin and therefore unforgiving of neglect.

HC-C2YL-1BFX/F7663-4X Attributes

Characteristic	Value
Number of Blades	2
Available Diameters	72"
Typical Extensions	C
Weight, C hub	50 lbf.
Typical Engine Displacement	320



HC-C2YL-1BFX/F7663-4X