TOTAL PERFORMANCE
VAN'S AIRCRAFT
14401 Keil Road NE, Aurora, Oregon, USA 97002
PHONE 503-678-6545 • FAX 503-678-6560 • www.vansaircraft.com • info@vansaircraft.com
Service Letters and Bulletins: www.vansaircraft.com/public/service.htm

DOCUMENTATION INVOLVED:

Page 02-02 REV 1: Added "Selecting an engine for the RV-14/14A" section.

SECTION 2: DESIGN PHILOSOPHY

INTRODUCTION

Before getting into the construction details of your RV-14, let's take a look at the design philosophy and goals that are the basis for this airplane. The goal was to achieve the maximum overall performance, flying enjoyment, ease of construction, building and flying economy, ease of maintenance, and pleasing appearance possible for a two-place airplane. Understanding how this was achieved might help you better appreciate many features of the RV-14 as you encounter them during construction.

The formula for achieving maximum overall performance is amazingly simple: Maximize thrust, minimize drag; maximize lift, minimize weight. The implementation of this formula is a bit more complex, however. Thrust, for a given HP engine, has been maximized through use of a good propeller, streamlining of the engine cowl, and directing the engine outlet rearward. Drag was minimized by keeping the aircraft frontal area to a minimum and shaping all airframe components to reduce aerodynamic drag. Lift was maximized through use of a wing with adequate area and good airfoil. Weight is minimized by careful structural design, by using the best airframe materials, and by installation of only essential instrumentation and equipment.

Most of the literally hundreds of features which comprise the overall RV-14 package have been determined in the design stage and involve no choices for the builder unless he chooses to make major modifications. There is little that a builder is likely to do which will have much effect on either thrust or lift of his RV. However, construction techniques and additional installed equipment can have noticeable effects on both drag and weight - the archenemies of performance.

RV-14 DESIGN OBJECTIVES

The design of the RV-14 was able to draw upon over 40 years experience designing, flying, and manufacturing a series of kit aircraft that have become industry leaders. While the above general principles can be applied to new conceptual designs, Van's engineers had the advantage of building upon a line of airplanes that had already evolved through application of these principles. Our two place side-by-side (SBS) seating models, the RV-6, RV-7 and RV-9 have enjoyed the greatest success of any kit aircraft models ever developed. The RV-10 four-seat airplane has also enjoyed popularity because of its cabin roominess and baggage capacity. Two seat SBS aircraft were increasingly being used primarily for cross country flying, pilots often opined that more cabin space and useful load limits would make such airplanes even more enjoyable and practical. Conceptually, Van's envisioned the next airplane as an RV-7/7A enhanced by some of the RV-10's amenities. Primarily, these were increased cabin size and increased useful load.

In basic form the RV-14 is a super-sized RV-7 fuselage mated to a downsized RV-10 wing. Utilizing the RV-10 wing provided an improved aspect ratio for better load carrying, along with a slotted flap to provide more lift for achieving moderate landing speeds. The RV-10 wing also provided a deep spar to achieve the strength needed for aerobatic flight. The horizontal tail was adapted from the RV-9, strengthened as necessary for the RV-14's higher weight and aerobatic strength requirements.

However, it would not be accurate to describe the RV-14 as a cobbled together collection of previously used airframe parts. More accurately, it is the culmination of many years of airframe component evolution, combined and refined to arrive at this next-generation two-seat airplane. This design development process also included the opportunity to simplify assembly, assure accuracy, and improve quality. Literally hundreds of component changes and structural upgrades were incorporated in the creation of the RV-14. The result, a truly new design.

RV-14 DESIGN FEATURES

The RV's "traditional" configuration - tractor engine, monoplane, stabilizer in the rear, is an exercise in logic and not simply a concession to convention. There are many good reasons why light planes have been built this way for decades, other than the often-heard arguments of "entrenched design mentality" from those seeking "technological breakthroughs". The reality is that this configuration has proven to offer the best compromise resulting in the best all around functional airplane. Why try to re-invent the wheel?

Designers often use the term "Mission Profile" which simply refers to the function an airplane is designed to perform---what will it be used for---what kind of flying will it do. The RV-14's mission profile is rather broad -- it is intended to fill nearly all sport flying needs; excellent flying qualities, high cruise speeds, sport aerobatics, modest stall speed, outstanding visibility, easy assembly for the home-bulider, economical to own and operate. Meeting all these needs required a design "balancing act". Favoring one capability can adversely affect others.

An example would be that of utilizing a larger wing to achieve a lower landing speed and shorter runway requirements. A by-product would be reduced cruise speed and roll rate. Thus, wing size has been optimized to provide more than adequate take-off, landing, and climb performance for operation from all reasonably anticipated airports, and still yield high cruise speeds.

The constant chord wing planform chosen for the RV-14 offers the ultimate in construction ease, aerodynamic stability, and lifting ability. The possible drag and aesthetic penalties for the rectangular wing, vs. a tapered wing planform are negligible in light of its advantages. The airfoil used is an *SSV-2315*, the proprietary airfoil section which had been used on RV-10 with great success.

Seating arrangements vary between the RV designs, depending on the primary mission envisioned. Side-by-side seating was chosen for the RV-14 because this arrangement is generally preferred for its primary mission: cross-country travel and sport flying. Specific advantages of the side-by-side (SBS) configuration include equal visibility for both occupants, more easily achieved dual control capability, an abundance of instrument panel space, minimized CG travel for various loading conditions, and a full width cowling which offers more space for engine accessories and plumbing.

The RV-14 design incorporates a deeper cabin than other side-by-side RV designs. This positions the pilots higher relative to the engine and wings and thus improves the field of view. The RV-14's field of view is further enhanced because the canopy has lower sides, improving the forward/downward view.

Compared with Van's previous SBS aircraft, the RV-14 incorporates a cabin that is larger in all respects.

KIT CONSTRUCTION PHILOSOPHY

In addition to all of the steps in the path to reach the destination--a great airplane--the design of the RV-14 required much thought and planning to make the "journey" as easy and enjoyable as possible. The journey, figuratively, is that undertaken by the builder who is tasked with transforming a pile of kit parts into an airworthy airplane. Because the RV-14 was designed for amateur construction, every component in its structure was designed with amateur construction and assembly in mind. Also, because the RV-14 kit was developed to be licensed in the USA as Experimental Amateur-Built, it needed to comply with FAA rules which require that the amateur builder fabricate and assemble the major portion; more than 50%, of the aircraft.

The factors considered included appraising skills possessed by or easily gained by the median anticipated builder and the tool owned by or readily available to that builder. To the greatest degree possible, the factory manufactured components that required large expensive machinery. Conversely, components that could be fabricated or finish with simple hand tools were assigned to the builder.

The design of every component required careful thought to determine how much of the work should be done by the factory or by the builder. Obviously, the factory could probably manufacture all components more efficiently than could the builder. This approach would not meet the FAA Major Portion requirement, and would not result in an affordable kit.

Overall finished aircraft cost versus kit cost. If low kit cost were the goal we would be providing only a basic materials kit or even plans-only, but in crafting your kit we have considered the expense to you to have "rubber on the ramp"; a ready to fly and enjoy finished aircraft.

In summation, the builder accomplishes plenty of the work without needing to spend excessively on specialized tools, and Van's is able to offer an affordable kit, yet include high-tech and high quality pre-fabricated parts where they are most appropriate.

We feel that an RV-14 in its basic form with constant speed prop, modest instrumentation & avionics, and 210 hp Lycoming IO-390 engine represents the best compromise.

SELECTING AN ENGINE FOR THE RV-14/14A:

The RV-14/14A was designed and vetted using the following engines:

-Lycoming IO-390-A3B6 -Lycoming IO-360-A1D6

The IO-390 engine is comparatively new and is found almost exclusively in the experimental market. It has not had the need or time to mutate into the bewildering variety of versions that older Lycoming designs have achieved. The version Van's Aircraft sells – the IO-390A3B6 – is configured with a standard Lycoming sump, Bendix-style injection, Slick magnetos and a forward mounted propeller governor.

The RV-14 Powerplant Kit will work well with aircraft engines which are:

- Four-cylinder - Horizontally opposed - Horizontally inducted - Fuel injected - Angle valve - Normally aspirated
- Equipped with a forward mounted propeller governor. See Figure 1.
- Equipped with a standard Lycoming style oil sump.
- Rated between 200-220 horsepower.

Some IO-360s have been removed from aerobatic airplanes and are equipped with different sumps and induction systems. Van's Aircraft has not investigated the installation of any such engine. It is recommend that builders contemplating installing one of these engines in an RV-14/14A perform serious research before purchasing.

There are several companies building Lycoming “clones” – engines similar to, but not identical to, the Lycoming. These engines can come in almost any configuration the buyer wishes. Van’s Aircraft has not investigated which, if any, of the many available versions might work in the RV-14/14A.

The only engine that Van’s Aircraft currently sells that meets the RV-14 engine criteria is the IO-390-A3B6.

Builders contemplating buying an engine from some source other than Van’s will be responsible for making sure their engine is suitable. Calling Van’s for information (“I’ve found an IO-360-X4B12?# out of an Egyptian Air Force Malmo-Boero. Will it work?”) **will not help**. Contact Lycoming or an expert engine shop for details of a given model, and insist on seeing photos or examining the engine to determine whether it will work.

CONCLUSION:

Obviously, we could go on and on, covering every design decision, compromise, or concession. However, it should be obvious by now that every feature of the RV-14, whether major or minor, was the end product of much deliberation and design refinement. There is usually more than one "right way" to design and manufacture a part. Choosing the most suitable is not an easy task. In almost all instances, aircraft features are so inter-related that altering one will affect several others; meaning that a builder should not consider making changes unless he is willing and capable of analyzing their overall impact.

NOTE: Van's Aircraft Inc. kits are carefully designed and tested. The airplanes built from these kits will demonstrate performance very close to quoted figures when equipped with the engines and propellers recommended. Van's Aircraft recommends that the kits only be assembled according to the supplied *building instructions*. If the builder chooses to deviate from the plans and install a non-standard engine or to modify the aircraft to a configuration other than what is called out in the *building instructions*, he or she is assuming responsibility for the airworthiness effects caused by that modification. Factory technical support may not be available for modifications that deviate from the building instructions nor for installations that are not specifically recommended by Van's Aircraft.

Another factor to consider is that insurance companies may not be willing to write a policy on an aircraft that has been modified to a configuration other than that recommended by the manufacturer. Prior to modification, the builder should check with their insurance provider regarding this matter.

If a kit is modified in any significant manner, it should not be classified an RV (type) for registration purposes.

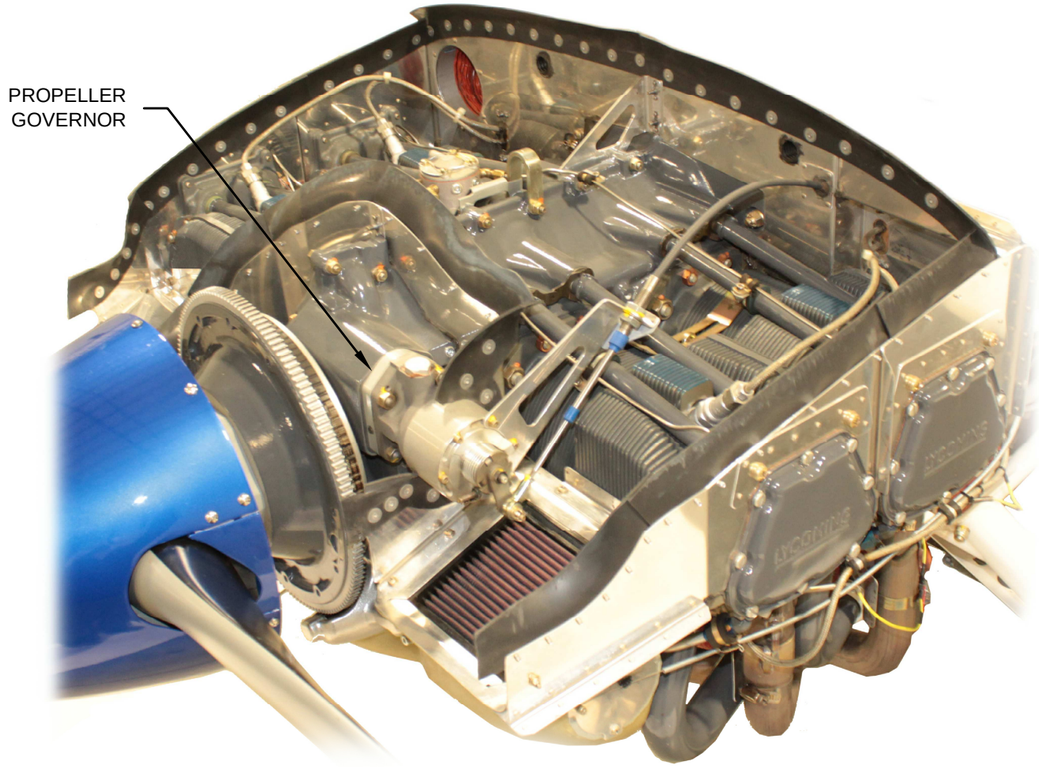

FIGURE 1: FORWARD MOUNTED PROPELLER GOVERNOR