DESIGN ANALYSIS

A CRITICAL ANALYSIS OF THE KR-2

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Introduction

What is written here is from one man's viewpoint, although the author has discussed these things with a number of KR builder/pilots. In fact, as many as will give him some time. The result is a combination of many inputs, but biased somewhat toward his own opinions, judgments, experience (with N81NB) and critical engineering analysis. For additional information, see the author's articles, **Engine Installation In A Sportplane,** March 1986 Sport Aviation, and **Light Is Better,** December 1986 Sport Aviation.

The reason for doing this treatise is simple. The author has come to the conclusion, after reading and/or listening to many flight reports, that all too many times the real facts of test flights never come out. How can a man expose himself to criticism after just coming off two-plus years of hard work, itchy hands and a defunct wallet? It is infinitely easier to thank his wife (if he still has one), Aunt Mildred and Uncle Fred for their help, and conclude by saying, "What an airplane!" — "It flies great!" Even those who want to be objective and helpful and share their innermost thoughts find it so difficult, they seldom do. How does one explain that he almost lost it on the first landing because his skills at the stick in a quick little taildragger were not razor-sharp? It's just not easy to admit that!

Many years ago in a university physics lab, a student instructor taught the author a valuable truth. He said, "There are no liars in the lab. Take down the data the way it happened. You may not be able to interpret the data, nor your professor. But if it's valid data, someone, sometime is going to thank you for it."

Conclusions/Recommendations

In an ad that appeared on page 81 of the February 1976 issue of Sport Aviation, Ken Rand advertised this about the KR-2:

EMPTY WEIGHT — 420 lbs.
GROSS WEIGHT — 800 lbs.
ENGINE — VW 1600
FUEL CAPACITY — 12 gals.
TOP SPEED — 150 mph
CRUISE SPEED — 140 mph
SEATS — 2, side by side

If every KR-2 builder had stayed with those numbers and built his plane correctly, there would be no bad flying KR-2s! Further, there would be a lot less low-time KRs for sale.

But, no, we can't do that. We take this little jewel of a design, change it here and there, add everything but the kitchen autopilot and wind up with 640 lbs. empty! Then, since it has two seats, we stuff another 170 lbs. of humanity in the right seat and with 24 gallons of fuel go out and attempt to bore a hole in the sky!

All kinds of things happen. First, by now the loaded weight is 1124 lbs., 39% over gross. It seems a little shifty and doesn't fly all that well, had a little trouble getting her down right. So we say, "Got to have more power." We add another 25 or 30 lbs. getting to a bigger engine, when all along it is not raw power that makes an airplane fly well, it is the **entire aerodynamic design**.

There are very few faults in Ken's original design. What few there are are tweaks and adjustments to the design, some of which are subjective instead of objective, i.e., personal wants. Some are valid and if Ken had not died he probably could have been nudged into incorporating most of them.

Discussion/Analysis

Flyability

Let's start with what an airplane is supposed to do — fly. If it doesn't do that well it is something less than an airplane, maybe a rock, rocket or a barn door. All will fly, with enough power, if one is willing to accept the risks and flight management tasks.

Admittedly, it is very difficult, if not impossible, to build a 420 lb. KR-2. But it is possible to build a 450 lb. KR-2, and that should be **the** goal.

When it was inferred in the introduction that the KR-2 aerodynamic design would not accept more than an 800 lb. gross, it must be understood that this is a **design parameter** and as with most design parameters there are tolerances. But the limit of these tolerances is never infinite and seldom more than 10%.

If we were to apply the 10% rule to some of Ken Rand's numbers, we get these for upper limits:

Empty weight: $420 \times 1.1 = 462$ lbs.

Gross weight: $800 \times 1.1 = 880$ lbs.

Now, let's take a real-life scenario using these numbers. The author's KR-2 (N81NB) weighed in at 620 lbs. when certified in July 1985. After a drastic surgical procedure during the winter of '85-'86, he was able to get her empty weight down to 539 lbs. as she stands today. She is still 90 lbs. overweight but flies, oh, so much better.

In fact, at the old 620 lbs., with a full 24.5 gallons of gas and another person, the airplane was so overgross that it did not fly well at all. Not only did it not fly well, it was just plain unstable and unsafe even though the CG was within the design limits. A few rides were given, but it was not encouraged. The passenger usually did not sense that anything was wrong, but the pilot did. Enough so that he'll guarantee that if you build too heavy you'll be disappointed, for it will not be the fun airplane it can be.

Back to the real-life scenario. Here is how it works out now that we're lighter:

Empty weight — 539 lbs.
Full fuel (14 gals.) — 84 lbs.
Pilot — 175 lbs.
Total — 798 lbs.

The empty weight, per se, really means nothing when talking about "flyability". It is the loaded weight in relation to the designer's specified gross weight that is of concern (in this case 798 lbs. vs 800 lbs.).

To continue the scenario, on September 6, 1986, at a local fly-in, the author flew the show line and recorded these data:

Air temp — 85 degrees F
Field elevation — 4330 ft. msl
A/C load — 798 lbs.
Engine — 80 hp Limbach, L2000EO1
Prop — 53x52 Warnke Almost Constant Speed
Wind — Light and variable
Cruise/2950 rpm — 166 mph, true
Top speed/3300 rpm — 186 mph, true

In a high speed low pass, 20 feet above the deck, from 1500 ft. AGL:

Speed at 3500 rpm — 245 mph, true

Now, let's examine these flights and compare these data with those from Ken's ad. When he published his data he was probably conservative. He had a VW 1600 which was good for about 55 hp. In the author's case, he was flying 80 hp which yielded a cruise speed 26 mph greater than Ken's, which is better than one mph per hp which hardly correlates with the rule of thumb that says one must triple the hp to double the speed.

Nevertheless, it does point up what additional horsepower **will** do and that is increase speed. Note, however, that the author was flying within two lbs. of Ken's original recommended gross for the airplane.

The author's flights were within the limits of the airplane and were very manageable. Even at 245 mph (which is really smokin') the KR was manageable, which serves to introduce the next subject.

Wing Loading

It is interesting to examine the wing loading on different popular aircraft:

Boeing 737 — 80+ lbs./ft.^{2}
Beech King Air — 30+ lbs./ft.^{2}
Glasair RG — 22 lbs./ft.^{2}
Cessna 152 — 12 lbs./ft.^{2}
KR-2 (at 800 lbs. gross) — 9.21 lbs./ft.^{2}

Where we make a big mistake is expecting a KR to ride like a 737, and it won't!

Time for an opinion: One has to examine his desire for speed in these little craft and balance that against the number of times he'll fly at those speeds. Most of the time he'll find himself coming back on the throttle to 140-145 mph cruise to settle the comfort level of the ride, even though he has the capability of cruising at 165 mph. This is due to the very substantial effect of even mild turbulence.

The author has tried low passes at over 200 mph in what could be considered mild turbulence and it is worrisome. At those speeds he was all over the sky and didn't get very close to the deck.

The opinion is — 60 hp is enough for a properly built KR-2 and anything beyond 80 hp is not only foolish but downright dangerous in the wrong hands. If the builder wants an aircraft that will carry more than 300 lbs. of humanity at speeds above 140 mph for long trips, he should choose another design. It is that simple.

On the other hand, if he wants a sweet little utility aircraft that will thrill him to his very toes everytime he takes her out, and do a lot of affordable "sport flying" for a long time, he will do well to decide on the KR design. For the buck, it's still the best deal around, even 10 plus years after she was born!

Thinkable Modifications

1. The KR-2 is quick! The author has claimed repeatedly that the average Cessna or Piper driver is guaranteed to get a wing tip, prop strike, unscheduled trip into the boonies, or all three (if not worse), if he tries to fly the KR the first time without some concentrated taildragger instruction.

There are a couple of things that Ken would probably have agreed with that can be done to reduce the quickness a tad without coming even close to "docile".

The most sensitive control of all is pitch. Many, if not most, KR pilots get into early difficulty with this, and way too much porpoising takes place. It's many times as sensitive as a C-152 or Cherokee.

To ease this problem, two things can and should be done:

a. Get the **tail feathers back some**. The author added 13.5 inches, 24 would be about right. This lengthens the tail moment arm about 17% and really helps.

Note: While we are here, let's insert something on a subject we'll talk about in more detail later — weight and balance. Increasing the length of the fuselage puts the weight of the tail feathers (plus the weight of the added material) further back from the MAC (Mean Aerodynamic Center) and shifts the final center of gravity aft. It has quite a pronounced effect because the moment arm is large. Some builders might need to add weight to the tail to bring their CG in, and this mod will help them. But if they don't then the engine will need to move forward some to bring the final CG to where it should be.

b. If using a center stick, per plans, a **good armrest** needs to be put in so that the airplane can be flown by wrist action. If dual sticks are installed, they should be as long as possible and shaped so that the forearm rests comfortably on the pilot's upper thigh. The KR is defnitely not a Cub or Champ where "inches" are required. It is estimated that 95% of maneuvering of the KR is done with less than an inch of total stick travel (1/2 inch radius of movement). Full stall, three point landings being one exception.

2. Another mod worth considering is going to a fixed conventional landing gear. Rand/Robinson has a good design.

There are many valid reasons for this, in the author's opinion. He thinks the retract is a pain in the neck. Here's why:

a. At the very time when shoulder constraints are needed the most, i.e., during take-off, they have to be left loose so the pilot can reach up and push the retract lever forward (to the floor). Not a good situation. Some have struggled hard to redesign the gear retract system and ease the problem, but they have also added weight, cost and build time.

b. How many guys have skinned the belly and lost a prop by forgetting to let the gear down? You say, "Why not add a horn or light?" The answer is — when a low-time pilot is distracted you could hit him over the head with a horn or light and he would miss it!

c. The retract doesn't buy you that much in drag reduction when compared to a well-designed gear leg and tight fitting wheel pant.

An example of this is the guy a few months ago who wanted the nose gear (training wheels) on his fixed-gear Glasair. He took his taildragger and modified it by moving the mains back and adding the nose gear. To his and most everybody's great surprise he didn't affect his 225 mph cruise a bit, because he was careful in his design of the gear leg fairing and wheel pant. Besides, the KR wheels still stick down about 3-1/2 inches. Even though they are faired in some, there is still a lot of drag around the gaps in the wheel wells.

In net, the mechanically operated retractable gear doesn't make a lot of objective sense in the KR. But if a guy has just got to have it (subjective or emotional choice), then let him go for it.

Anyway, that is a lot of extra mechanism that complicates the brake system design and adds **many** hours to the build time of the aircraft. As it turns out, after a hundred hours on the author's retract, the lock-down latches are so worn that they need to be removed, rebuilt and refitted. There must be a 1/2 inch of play out at the tire. Real interesting when applying hard braking and the drums aren't exactly round.

3. There is another mod that makes a lot of sense to the author. Narrow the fuselage! Yes, you heard right. If there were a "next time", the author's KR-2 would be a KR, period. It would have one seat, a center stick and the fuselage width would be held at the firewall width back to the baggage compartment, then tapered to the tail. That's about 30 inches, plenty of room for even a 200 lb. pilot. This would be a happy pilot because he'd never have to worry about overgrossing, banging his head on the stock canopy in rough air or flying a squirrel (he'd always be under Ken's 800 lbs. if he built it right). It is the author's opinion that whatever may be lost in fixed gear drag would more than be made up for in fuselage width drag reduction, and the plane wouldn't look as much like a polywog from the second story.

4. An additional mod Ken talked about was balancing the elevator and rudder like the ailerons. In fact, he stated that the redline speed of the KR-2 was 200 mph if the tailfeathers were not balanced.

Some have flown their KR's over 200 mph with unbalanced elevator and rudder, but that is flirting with disaster. Flutter is a dynamic phenomenon, triggered by complex forces. It's possible that no one alive knows exactly where "his" KR control surfaces will go into flutter (resonance). What is known, however, is that one only has about three seconds to disintegration of the control surface and that accurate balancing pushes the resonant points up out of any reasonable flight envelope.

Weight and Balance

Over the years, the author has seen some bad-flying airplanes, some modified "Wichita Spam Cans" and some homebuilts. Of these, none have shown more "squirrelly" characteristics than the ones where the rules of weight and balance have been ignored or broken.

Simply stated, there is an "envelope" or range under all configurations of loading into which the final (loaded) CG must fall. In the case of the KR-2, it is from a point 4 inches in front of the rear surface of the main spar, to a point 4 inches to the rear of this surface, or a total envelope length of 8 inches.

As one approaches the forward limit of the envelope, his aircraft will become more and more pitch-stable. It requires more and more pitch trim to achieve hands-off level flight. As the aft end of the envelope is approached, the aircraft becomes less pitch-stable and more pitch input sensitive. Lesser amounts of elevator trim are required to achieve hands-off level flight. Pilots like to favor the aft portion of the envelope saying that they can fly faster at a given power setting because the aircraft is fighting less trim (drag).

Some aircraft have very narrow envelopes leading to very critical loading problems. One single seat canard design has only 1-1/2 inches. The KR-2, on the other hand, has an advertised envelope of 8 inches.

The use of the word "advertised" was on purpose, for the author would like to take issue with an 8 inch envelope for the KR-2. He believes that going to the aft end of this envelope will guarantee an unstable KR. Worse, in a departure or approach stall situation, a flat spin is likely to quickly develop and recovery would not be easy if even possible. Piper experienced this on the Cherokee 140. There have been cases where the 140 has gone into an unrecoverable stall-spin with the loading close to but still within the aft CG limit. In the author's opinion, the KR design is very similar to the classical Cherokee, except for the stabilator.

The author would never purposely spin his KR, but will, by the same token, never load the plane such that the final loaded CG is further aft than 2 inches to the rear of the main spar aft surface. It has been tried beyond there and the results are not pleasant. Wallowing, undulating and general instability show up back there.

The answer? Consider defining the CG envelope as being only 6 inches long, and drop off the last two inches of the advertised envelope.

A couple more suggestions in relation to weight and balance:

As discussed before, the gross weight limit of the KR-2 should be set, in the author's opinion, at 800 lbs. If one can build to the 450 lb. empty weight goal, limit his fuel to 12 gallons, then he **may have** a two-place airplane. In no case should he carry more than 300 lbs. in the cockpit.

Ken Rand was a small guy, weighing, it is said, 135 lbs. His KR, it is also said, weighed only about 450 lbs. and had a 12 gal. fuel tank. He gave a lot of rides.

Follow this scenario, however: Let's say he had 9 gallons of fuel which would be enough to do a lot of running around the countryside at 3 gallons per hour. Let's also say that he flew the "standard" passenger of 170 lbs. (no baggage).

Aircraft weight — 450 lbs.
Fuel — 54 lbs.
Pilot — 135 lbs.
Passenger — 170 lbs.
Total — 809 lbs.

Sure, Ken undoubtedly took guys heavier than 170 lbs., but he was a heck of a good KR pilot, better than most, and could handle the situation.

But why did the gross weight finally wind up at 900 lbs.? Apparently, in a near sea level situation where the air is dense, the 900 lbs. posed no real problem. That became the published number. In my opinion, however, 800 lbs. is a good number for my altitude. My field elevation is 4222' and my typical operational envelope is from 5800' msl to 10,500' msl. Occasionally we'll go to 12,000' but we won't stay there except to get over a mountain.

A final comment on weight and balance: For heavens sake, have the wheels in retract position and have the tail up so the upper fuselage longerons are level with the world when the CG measurements are taken. If you don't, you ain't got a good number! Both have a significant effect on where the CG falls, and after all, it is the flying attitude that we want to simulate.

Also, when you balance our KR, do it with the engine. That is, build the entire aircraft, including painting, before you hang your engine. Then when you know what that weighs and where its CG is, you can determine the weight and CG of the engine, accessories, prop, prop extension, spinner assembly and everything that hangs on the engine, and hang that where it needs to be to bring the final empty CG where you want it. **The** controlling CG position is the one with your lightest possible pilot, no passenger or baggage and a full tank of fuel. That CG should fall exactly on the front end of your CG envelope, i.e., 4 inches in front of the main spar aft surface. Assuming that your empty weight is close to 450 lbs. and you never exceed the 800 lb. max. gross, all other things being right, you will have one sweet flying airplane.

The last thing to build, using the foregoing procedure, is the motor mount. If you go with the stock mount and have built your KR heavy, like most do, I'll bet a steak dinner you'll be off more than you want to be. Remember that the stock cowling now has an extra 4 inches of material on the rear so that it can be fitted with the engine in a wide range of positions. Don't be afraid to build your own mount. Take the basic configuration out of the plans, go to a good "rag and tube" builder with a Heliarc welding machine and get him to weld you one up to fit your length dimension. Make it from the specified 5/8 dia. x .049 wall, 4130N steel tube and it will be plenty strong even though it may be a couple or three inches longer than the stock mount. With this tubing, the mount is well overdesigned, but it is used because it is easier to weld than the smaller, thin stuff.

Stability On The Ground

In some of the flight reports the author has read about KR's nosing over, or being spun around by a blast from another aircraft's prop. It is true that the KR has very little weight on the tail (how else could we get by with such a miniscule tailwheel?). In fact, the tail on N81NB raises regularly when testing for maximum static rpm. This is true because of the position of the wheels in down position with respect to the CG. By design, the wheel position is close to the front of the CG envelope. If the wheels were positioned farther forward, which would decrease the tendency to nose over when braking hard, there would be an increased tendency for the tail to come around and meet the nose (known as "ground loop") during the transition from taxi to flying and flying to taxi. This due to the greater concentration of mass behind the wheel footprint. This would be especially noticeable in crosswinds. A contributing factor is the lack of rudder authority at these lower speeds.

As it is, the KR is quite easy to take off and land in terms of yaw stability. By far the most difficult to manage is pitch, because it is so sensitive.

Calculated Strengths and Stresses

Much discussion has been had between builders, prospective builders and already done builders of the KR-2 about the limiting strengths in the design. The author has done some stress analysis in areas where he felt there might be a problem.

From an analytical standpoint, the retract spring bar is the weak sister. We'll take a look at the numbers a little later.

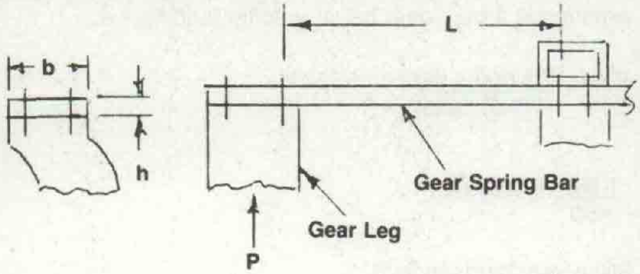
Some have claimed that the empennage would fold first under heavy G loads. Others say the wing attach brackets on the spars, or even the spars themselves, would fail first. But, from the author's analysis, there has not been found a single member, attachment, bolt or joint, when built per latest print, that would fail under +/- 7 G flight loads. This assumes a 900 lb. gross. It is a well designed airplane from a structural standpoint.

The 60 inch gear spring bar gave the author some concern from the beginning, mainly due to the sprawly stance noticed on some of the early KR's at the fly-ins. A couple of things were done on N81NB to preclude this problem:

1. The spring bar was cut to 57 inches instead of 60 inches, which reduced the moment arm from the outer gear bar constraint to the first gear leg bolt centerline from 11.0 to 9.5 inches.

2. Using a 12 ton hydraulic press at a local machine shop, the ends of the gear bar were bent down .200 inch. That is, the center section between the fuselage constraints was left straight while the ends were bent down. This produced a noticeable camber when the plane was raised up off the wheels.

Here are some calculations that helped me make the above decisions:



Mat'l: 7075-T6 Alum. — $h = .75$ in.

$E = 10.4 \times 10^6$ psi. — $P = \frac{900}{2}$ lbs.

Yield = 73,000 psi.

$b = 2.50$ in. — $L = 9.5$ in.

$$I = \frac{bh^3}{12} = \frac{(2.50)(.75)^3}{12} = .088 \text{ in}^4$$

Deflection at 1.0 G (900 lbs. gross):

$$\text{Defl. } Y @ 1.0\,G = \frac{PL^3}{3EI} = \frac{(450)(9.5)^3}{3(10.4)(10)^6(.088)} = .141 \text{ in.}$$

This means that at a gross weight of 900 lbs. there would still be some camber. What kind of landing would bend the gear spring bar flat?

$$P = \frac{3YEI}{L^3} = \frac{3(.200)(10.4)(10)^6(.088)}{(9.5)^3} = 640 \text{ lbs.}$$

$\frac{640}{450} = 1.4$ G's, probably close to a normal landing.

At what loading will the bar deflect enough to take a permanent set?

$$S\gamma = M\frac{c}{I}\,;\ M = PL\,;\ S\gamma = PL\frac{c}{I}\,;\ P = \frac{S\gamma I}{Lc}$$

$S\gamma = 73{,}000$ psi
$c = .375$ in.
$I = .088 \text{ in}^4$
$L = 9.5$ in.

$$P = \frac{(73{,}000)(.088)}{(9.5)(.375)} = 1{,}803 \text{ lbs.}$$

$\frac{1{,}803}{450} = 4$ G's, a very rough landing.

The author has, as mentioned before, seen some bent gear bars, so there have been some pretty hard landings!

If the gear bar were not shortened, the deflection would be:

$$Y = \frac{PL^3}{3EI} = \frac{(450)(11.0)^3}{3(10.4)(10)^6(.088)} = .218 \text{ in.} \quad L = 11.0 \text{ in.}$$

This aircraft, if the gear bar were not pre-bent as on the author's, would have a decided negative camber, and would experience a bent gear bar in a softer landing, i.e.:

$$P = \frac{(73{,}000)(.088)}{(11.0)(.375)} = 1{,}557 \text{ lbs.}$$

$$\frac{1{,}557}{450} = 3.5 \text{ G's}$$

Still a very hard landing!

But if the gross weight were allowed to go up to 1150 lbs. like some KR's seen, then:

$$P = \frac{1{,}557}{575} = 2.7 \text{ G's}$$ — still a pretty hard landing.

$$Y_{4g} = \frac{PL^3}{3EI} = \frac{4\,(575)\,(11.0)^3}{3\,(10.4)\,(10)^6\,(.088)} = 1.15 \text{ in!!!}$$

Conclusion: One rough landing would bend the gear bar and a 4 G landing would send the end of the gear bar through the top wing skin. The author has seen a couple of KR's where this has happened.

Engines

Choosing an engine is not the problem the author once thought it was. That was when he felt that 60 hp was not enough. Though it took some thrashing around to find and choose the Limbach, he is very happy he did (he must like them, he owns two). It is a production engine, fully certified in Europe and powers about 95% of the motorgliders built there. This engine is more expensive than some of the stateside VW derived units, but can be had from 1700 cc to 2500 cc (68 to 87 hp). The certified models have one Slick mag. There are dual mag models available, but they are not certified.

Probably the best choice, from a cost and tract record standpoint, would be one of Steve Bennett's models from Great Plains Aircraft. The author and his mechanical engineer cohort, Kris Bowers, plan to install one of the 60 hp units in N81NB in place of the Limbach which will be going into the author's (about to be completed) Baby Lakes biplane.

At any rate, there are at least four good sources for engines for the KR-2:

Great Plains (Steve Bennett), Limbach (Jeri Treager), Revmaster (Joe Horvath) and HAPI (Rex Taylor).

There are others advertised, but the author has had little or no experience with them.

Electrics

Leave them off! It's possible to build a 450 lb. KR-2 for $5000 if you will! Done right, it will fly so well and cost so little, you'll wonder why everybody doesn't do it. Sure, it will be a hand prop, day VFR machine, but that is what it is anyway. We only get into trouble when we try to make it something it was not designed to be.

If you have just "got to have" electric start, lights, strobes, a big radio stack, etc., here's about what you're in for:

Item	Weight	Cost
Nav lights/strobes	6	$ 450
Nav/com (good one)	6	2600
Transponder	5	1300
Switches/breakers	6	75
Battery	15	50
Alternator	9	150
Starter	9	90
	56 lbs	$4715

Now your KR costs twice as much and is probably a single place aircraft, unless the passenger is very small.

Of course, without an electric starter, hand propping is a necessity. But is that a big problem? The author doesn't think so. Of course, he grew up in a time when inside plumbing and such were luxuries. Sometimes he wonders how we ever got along before electric start (darn good, if you want to know!).

Nevertheless, this is how it's done on the Limbach:

Step 1 — Put a simple set of wooden chocks (tied together by a piece of 1/4 in. dia. rope) in front of the mains.

Step 2 — After preflighting the aircraft, step around in front of the left center wing and open the canopy so you can reach the instrument panel.

Step 3 — With mag switch OFF, and throttle in 3/4 inch, pull engine through with left hand 3-5 times. If the day is cold, pull choke out and pull through 3 times.

Step 4 — Close throttle all the way to IDLE, choke all the way in.

Step 5 — Turn mag switch on.

Step 6 — With right foot against left wheel chock and right knee against the wing leading edge, yell "clear" and pull the engine through sharply with left hand, pulling hand back in one clean motion to clear the prop arc. N81NB starts on first pull, usually.

Step 7 — If idle is set at 650 rpm, plane will not move. Pull chocks clear, walk around the left wing tip and climb in.

A Final Note

Well, that's it. If you haven't guessed by now, the author has more fun with his little KR on a regular basis than is morally right for a gray-haired guy pushing 60. But, as said before, done right this little plane is guaranteed to quicken your heart beat and thrill you to your very toes every time you take her out. Try this sometime, if you want to stay young — on a warm summer evening when the air is dead calm and all the gang is standing around the flight office at your little country airport, take off and fly around a bit to warm up the oil and get things comfortable and under control. Come back in a couple hundred feet above pattern altitude. While you are on downwind (make sure you've got the space) call Unicom and announce a low pass to take a good look at the windsock. Roll 'er into a 60 degree abbreviated base leg and onto final. Open the throttle and aim for the numbers. When you level her off at 20 feet above the deck, truing out at 245 mph, ask yourself, "Are we having fun yet?"

When you taxi up to the line with that Cheshire grin, those bums will let you know you are! And you are!