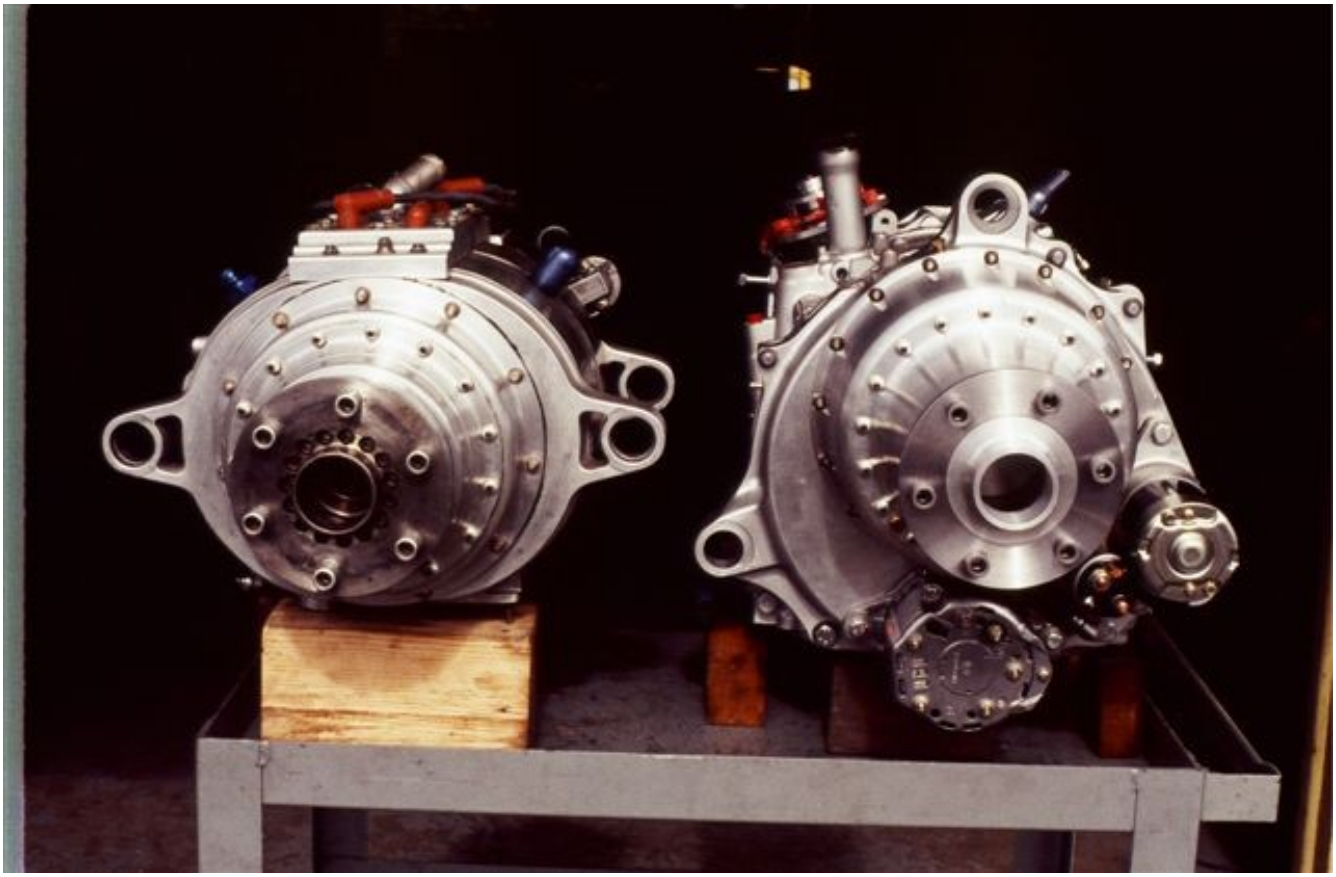
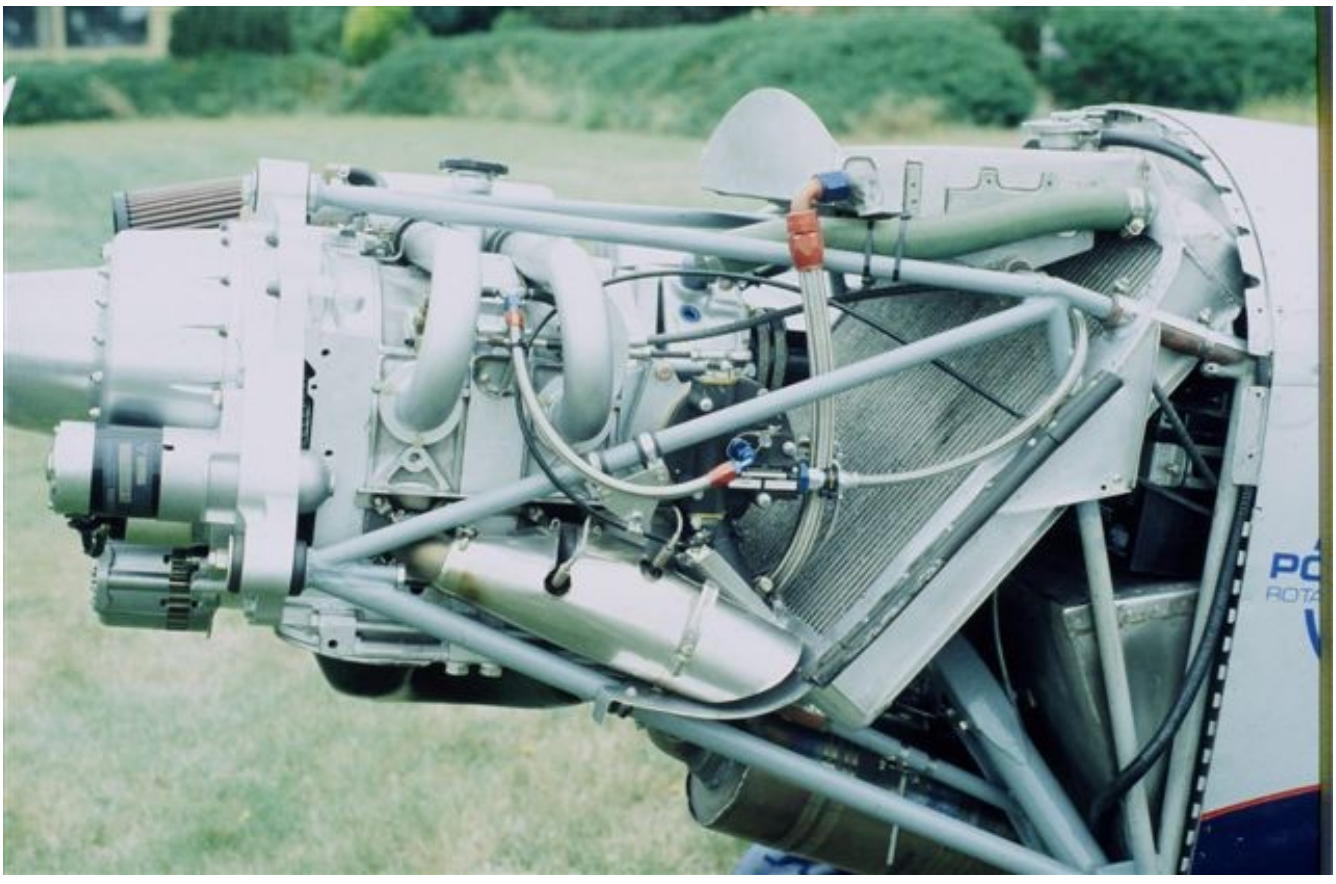
Brian and Paul--regarding weights of our SuperLight engines in the context of discussions related to the weight of your new bird and Mike's RV-4, here are some notes. There were more than one SuperLight configurations so different weights. The notes include a comparison of the SuperLights to the last prototype--a conversion Mazda PS200, as well as the empty weight of the airplanes with the different engines installed. The last prototype had most of the systems of the SuperLight on a power section using all stockMazda side housings.

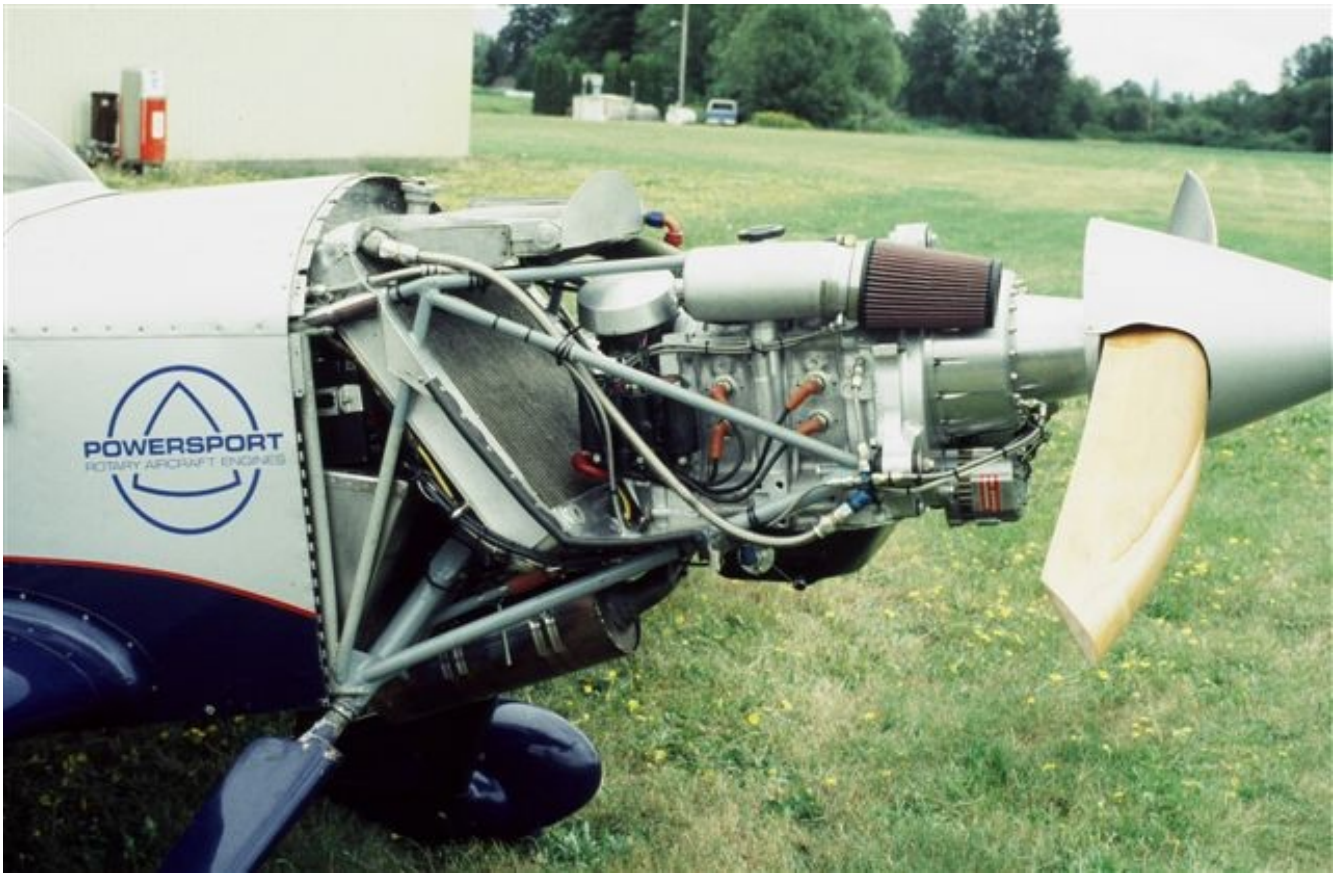


The MK 1 Superlight--
Had a fully assembled weight of 185 pounds, rated at 160 h.p. including alternator, scavenge and pressure dry sump pumps, water pump, ignition complete--everything--with 390 Reynolds aluminum front and rear end housings. We later abandoned the 390 as a wear surface because it was so finicky to lap just right. Switched to flame sprayed housings in 1989. This first engine had a highly modified Mazda iron center housing. The rear aluminum end housing had an 0-200 Continental mount attachment pattern indexed 90 degrees with female conical mount sections cast in. Incorporated into the design was a planetary propeller reduction gear. Installed in the RV-4, the airplane had an empty weight was 856 pounds. Dick VG came down when we weighed it. We later realized the basic airframe was heavier than a standard RV-4 due to some design changes we made. One of these was an open arch section of the lower engine mount which required heavy reinforcent for the arch to transfer loads from each gear leg that is inserted on each side of the mount. We did this to allow us to run a 7" augmenter tube through the lower part of the firewall and bottom fuselage terminating at the wing spar. The augmenter was later abandoned because it was too draggy at speed, but the damned heavy mount remained. Also the airframe didn't have a single lightening hole in any of the wing pieces and the chopped canopy with modified frame ended up too heavy. But the light weight of the engine allowed us to leave off the wing tips to save the weight of the old gel-coated thick stock wing tips and mounting hardware . Wing looked awkward from some angles as a result but stall speed was below 50 mph even with the wing clip. This configuration really improved the roll rate. But the dorsal fin we built and other stuff added some of the weigh. We opted (unnecessarily) for more feathers on the back of the arrow because of the longer cowl and engine so far out front. But despite the slight weight gain of the heavy airframe and way too much heavy paint, at 856 lbs. the airplane was a delight to fly and stalled a click below 50 mph even with the shorter wing span. Other performance was acceptable but a little below goal. It would exceed published RV-4 VNE straight and level and climb well over 2,000 fpm with the original 86" wood prop. And in later limited fuel-burn flight tests side-by-side with Van's RV-4 (Ray Richter in the seat) coming back from Oshkosh, the rotary consumed less fuel at every stop than the 0-320 Lycoming. We gassed at the same pump each stop.

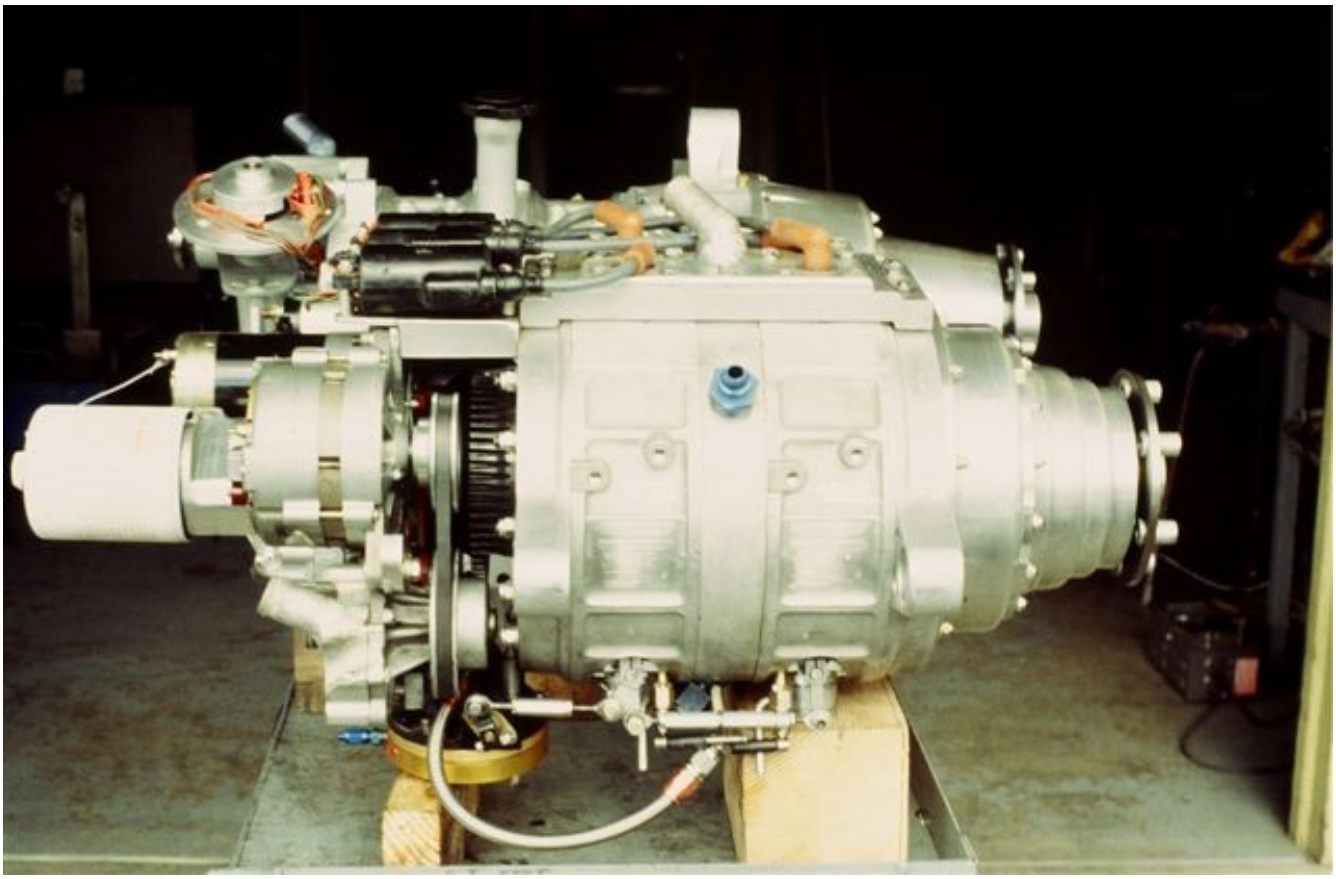


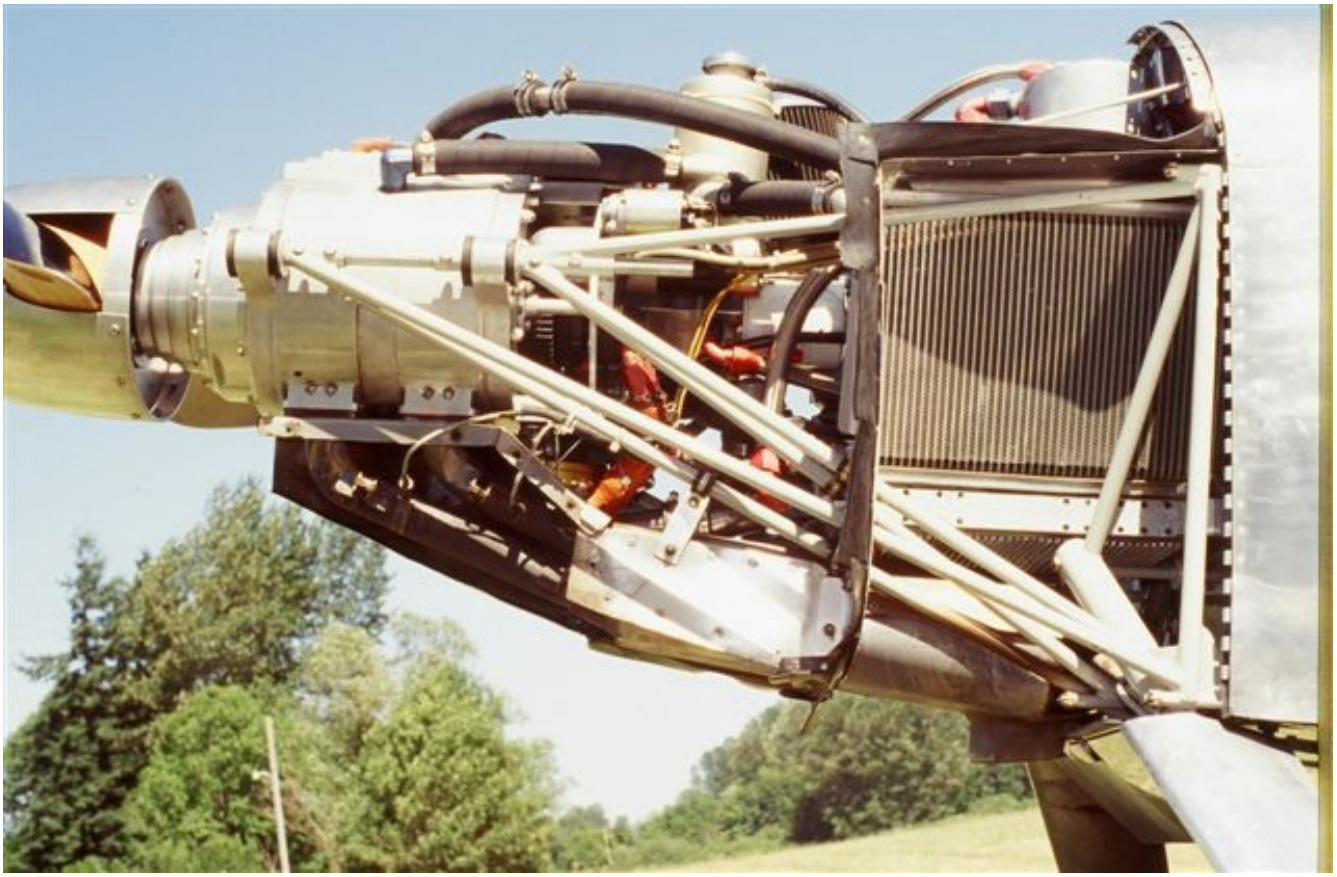


The MK II SuperLight--
This engine was completely different. We designed two conical mounting ears to the side on the eccentric shaft centerline on both the front and rear aluminum end housings to surround the engine cg. This mount is shown on the photo sent to you some time ago mounted in Alan's RV-3 with the one-off mount. It has an provision cast for the propeller reduction gear we also built. It weighed 167 pounds complete including dry sump pumps, ready to fly with everything except exhaust. Everything firewall-forward installed weighed 210 pounds. Pacesetter wood prop. Airframe was unpainted polished aluminum to save weight. We also built the aluminum annular inlet cowl for it ended but it ended up being heavy. But was a huge fire protection advantage for various exhaust configurations tested. My file shows airplane empty weights over the years for various iterations of the RV-3 from 608 lbs to start and finally up to 650 with other stuff including the pendulous torsional vibration absorbers and a big modified Flowmaster muffer with Inconel guts. At that time I think the published weight of a 0-320 Lycoming RV-3 was 750 pounds. Most RV-3's back then, as now, are heavier than Dick's at published weights. We designed absolutely everything on the engine to save weight on this engine including small diameter engine tension studs actually which were smaller diameter to save a few pounds. We would have cut the weight more except we decided magnesium for some of the parts would jack up the cost of production engines planned, and mag creates difficulties with fasteners. A post-scrip to this engine--we leased the engine to Alan for the lofty sum of $1 per year. That is not a typo.



Mazda conversion engine--
By comparison, this was 90 pounds heavier than the Gen II Superlight. The added weight was due primarily to bone stock Mazda iron side housings and intermediate housing. Mazda provided us some of the early lightweight rotors. The engine had all the systems we developed for the SuperLight engines except we were able to eliminate the heavier dry-sump components and plumbing when we retained the bone-stock Mazda wet sump and stock pan. It had the stock heavy iron water pump body but we did include the rotor housing modifications of the 1988 engines to improve cooling around the sparkplugs. By comparison the MK II Superlight has the water inflow jets into a manifold all around the spark plugs. We wanted to be able to use the stock Mazda front cover and distributor/CAS housing, so we designed a little trigger wheel and electronic ignition modules that fit in the stock distributor housing. This actually ended up a few ounces lighter than the crank-trigger version on SuperLight due to brackets and fasteners required on it. Also, the weight of the new propeller reduction gear was offset because the torsionally stiff internal spur reduction gear allowed the elimination of the expensive pendulous torsional vibration dampers on the SuperLight. In its final configuration, it weighed 268 pounds ready to run.





Summary--For me there are a lot of takeaways from this experience. Regarding Brian and Mike's RV-4 weight discussion, it shows how damned difficult it is to keep weight down. Also shows the advantages of keeping the airframe as close to the original design as possible without extra structures; and added parts count and weight they bring. It is very difficult, if not impossible, to remain fully aware of how much weight is inadvertantly added to an airplane when making changes and/or additional features...down to every bracket, fastener, etc.

Also, the published weights of an RV-4 are an important reference no doubt but have to be put into perspective. For example, when Dick designed and built his first kit RV-4 used to set the published RV-4 weight, he just alodined the skins and shot low weight filler white Imron--no primer--, along with a very spartan panel, all to save weight. My current RV-4 with the 0-320 Lycoming and Hartzell fixed pitch prop is 971 lbs (up from the original 912 lbs) and I'm always shocked when someone tells me that 971 lbs is considered a respectably light by modern RV-4 standards. But the extra 100+ pounds compared to the first rotary RV-4 with the prototype Superlight rotary engine installed is a stunning affirmation to me of the importance of weight. The thing the RV-4 has going for it is the wing and main spar. It is hell-for-stout. A bridge truss by comparison to the RV-3 wing. The weakest point is the RV-4 lower front fuselage corners. Dick had to beef these up from the original design but even then, numerous heavier RV-4 ended up with wrinkled fuselage skins and bent structure in that area from landings. Those long lever angled-back Wittman gear legs are wonderfully smooth, especially on

the short-legged mounts with a greater angle, so they generate a lot of leverage on the corners and mount. And the RV's have a wide range between stall speed and top speed. It is easy to forget that surprisingly low maneuvering speed in bad weather turbulence. Ditto the need to understand aeroelasticity and flutter. Control surfaces have relatively thin skins and just skin stiffeners not ribs.



And the vast majority of stock RV's have slop in the elevator trim tab linkages. Any speed build-up in excess of VNE should be done only with eyes wide-open as to possible consequence. These wonderful little airplanes can be double sided...the control harmony of the RV's is so sweet, it's easy to over-control.

Brian, you are not that far away. If you don't have a proven RV-4 around up there to log more RV-4 seat time prior to flight tests you are more than welcomed to come on down and we'll fly mine with full tanks.

Steve Beckham

