

VAN'S AIRCRAFT, INC.

P. O. BOX 160 • NORTH PLAINS, OREGON 97133 • (503) 647-5117

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Aug. 22, 1996

Dear RV-3 Pilots, Owners, and Builders,

This letter is a follow up to one sent several months ago which contained details of RV-3 wing separations and results of wing static load testing. Though part of this letter is repetitive, please read through carefully so that you can better understand the situation.

Results of the static test performed in late 1995 (which we will refer to as Wing #1) were very startling and disturbing. Failure occurred at a load considerably lower than indicated by multiple calculations and by prior static testing conducted in 1982. It was also at a lower level than had been reported by some pilots, and at a lower level than I had experienced in flight tests of the prototype RV-3. Why the difference? It took a couple weeks of serious reflection before an apparent answer became evident.

Failure mode had been compression buckling of the upper spar caps (bars). It is not a particularly unusual failure mode, but why the difference between the earlier and more recent static tests? Fortunately, the wing which had been tested to destruction in 1982 was still available; leaning up against the outside wall of the shop. The spar in this wing had been fabricated using an optional construction technique in which the 1/8 inch thick spar cap bars had been bonded together with epoxy adhesive. The purpose of using the adhesive was as a jiggling feature; to bond the bar together for the purpose of drilling and riveting as a single unit rather than a stack of bars. Because aluminum bonding (in the home workshop) is at best an inexact science, no strength benefit was expected; it was just a technique used in an attempt to simplify construction.

Apparently the epoxy adhesive bonded the bars together sufficiently to cause them to react under compression as if they were a solid bar. This offers a possible explanation of why the test result differed between the satisfactory 1982 test (with adhesive) and the unsatisfactory 1995 test (without adhesive). This helps in explaining the "why" of the difference, but not the "how" of resolving the problem which had now been identified.

Because of variations in spar design (1/8" and 3/16" bars), construction (use or non-use of adhesive), and options (wing fuel or fuselage fuel), it is possible that some RV-3 wings are stronger than others. For static test purposes, we selected the original spar configuration with 1/8" bars, no adhesive, and no wing fuel tanks. This is the variation which to our current knowledge would support the least load. Our objective was to re-enforce this spar to meet aerobatic strength minimums. If we could achieve this, then all other variations should be more than adequate and would not need to be individually tested.

Since failure had occurred through compression buckling of the spar flange bars, some means of holding these bars straight (to better

utilize their full compression strength) must be devised. To do this as a retro-fit, we chose to bolt aluminum angle extrusions to upper spar bars. (shown on the sketches included) The width provided by the opposite leg of the angle enhances the buckling resistance of the spar cap.

We altered an already built wing in the same manner that we anticipated an RV-3 owner would be able to do in retro-fitting this alteration to his aircraft. Tests on this wing, which we will call #2, showed a definite improvement in strength, but was still short of the 9 G ultimate strength goal. Failure occurred at station 20, or more generally, in the wing walk area between the first and second wing main wing rib where two additional ribs are located to provide the wing walk support. We had not added stiffener angle in this area because the close spacing of the ribs provide stiffening to the spar flange strips. (and makes installation of the angle difficult)

Wing #3 was built up specifically for the test and used the current spar design with 3/16" thick spar bars, 3/16" rivets, and no adhesive. This spar is the same as has been supplied with kits since 1982. We had not in the past tested a wing which used this spar, and we are not aware of any problems occurring on RV-3s with this spar configuration. Testing showed that this spar was stronger, by approx. 1 G, than an otherwise identical wing with a spar constructed with 1/8" spar bars. But, it was still short of the 9 G (ultimate strength) goal.

Wing #4 was another panel built up for the purpose of static testing, and used the lowest strength configuration with 1/8" bars and no adhesive. This wing differed from #2 in that stiffener angles were installed in the first rib section (wing walk area) and extended into the fuselage up to the steel splice plates. Referring back to wing #2, upper cap buckling had occurred in this area. Thus, our intent was to strengthen the area which had yielded. Testing this wing surprised us. It yielded in a different way. The rivets holding the lower spar bars to the spar web sheared off. The top bars and attached stiffener angles were still intact, but the load was still short of the 9 G goal.

We conducted yet another test, in an effort to help validate the static test data.

While conducting the static tests, we had wired the wings with strain gages. Through these strain gages we are able to measure the stress on the spar caps at any level of loading, particularly at failure load. We also installed strain gages on the spars of our demonstrator RV-3. (has spars with 1/8" bars and no adhesive). The intent of this test was to measure the stress in the spar caps in actual flight at various G-loadings, to be compared with the stress measured under similar static loads. The test apparatus included an electronic G-meter which is more accurate than the normal panel-mount accelerometer, a data collection board, and a lap top computer for recording inputs. We were hoping that in-flight stress-per-G would be lower than that measured through static loading, and thus show the static loading test to be conservative.

Good news and bad news: The inflight stresses we measured in accelerated flight were indeed lower than those measured during static testing. Much lower; only about half that of the stress

measured at a calculated sand-bag load of similar G factor. Unfortunately, this figure is so much different that it had to be discounted. Though we can't find any flaw in our test apparatus or procedure, we cannot accept these figures because they suggest an essentially unbreakable spar. That isn't reasonable.

Where do we go from here?

Since we have not been able to adequately re-enforce the lowest strength spar variation, and thus offer a fix for the entire RV-3 fleet, our next effort is to attempt to develop a fix for a portion of the fleet.

All indicators suggest that the current spar using 3/16" bars and 3/16" rivets, when re-enforced with angle stiffeners, should be acceptable. However, we cannot give the go-ahead for this until we have static tested a wing of this configuration. Construction of this test wing is now underway.

We continue searching for ideas to "fix" the Original spars, those with 1/8" bars and rivets. While we can conceive of means of doing so, they become so involved that building a completely new spar might be easier. This is a drastic step, but will be pursued if nothing else proves successful.

Van's Aircraft Inc. has ceased advertising and sales of RV-3 kits pending a resolution of this problem. We are considering designing a new spar for the purpose of new sales and early-stage construction projects where this substitution would be practical. However, our first priority is a fix for the flying RV-3s and those about to fly.

Meanwhile, we ask you to remain patient. Please continue to observe Utility Category limits (4.4G max) and avoid aerobatic flight. This is a trying and frustrating experience for all of us. Solutions do not always come easily and quickly.

Sincerely,


Richard vanGrunsven
President

VAN'S AIRCRAFT, INC.

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FAX 647-2206



Jan. 20, 1997

Dear RV-3 pilot/builder

Regarding the past letters on the subject of RV-3 wing static testing and spar modification; we now have good news for all. On Oct. 8, 1996, we had announced a spar modification for TYPE II spars which had successfully passed the 9 G ultimate load test (6G design load x 1.5 safety factor). Subsequent testing of a modified TYPE I spar also proved successful. We are now in the final stages of preparing this Wing Spar Alteration kit.

By way of repetition, the wings affected by this alteration are those with spars using 1/8" x 1 1/4" bars for spar caps and using 1/8" rivets. These spar have been designated TYPE I Spars in order to differentiate them from the later (1984 and later) spars which used 3/16" thick bars and 3/16" rivets.

The spar modification instructions have been titled CN-2-1 (Change Notice #2, for TYPE I spars). This modification applies to both wings with and without fuel tanks. Those wings with fuel tanks will be easier to modify because by removing the fuel tanks, easy and open access to the forward side of the spar is made possible. However, the modification instructions have been written so that they can be accomplished on a "dry" wing, with access only to the rear side of the spar. (through partial removal of the bottom inboard skin).

The bill-of-materials for accomplishing the spar modification is modest. However, the skills and tools needed to accomplish the modification will rival those needed for the original construction of the aircraft. Modification work will need to be done with skill and care, to avoid doing serious damage to the spar. If you are not the builder of the RV-3 you own, and may not have acquired a high level of aircraft construction skills, you are encouraged to seek help. A Learn-as-you-go plan could cause irreparable damage.

The CN-2-1 spar modification is intended to provide strength to support a design aerobatic gross weight of 1050 lbs. However, there are some RV-3's who's empty weights are so high that minimum flying weights (with average wt. pilots) exceed the maximum permissible aerobatic gross of 1050 lbs. We know of no way these aircraft can be considered structurally aerobatic. While this (CN-2-1) modification will increase their strength, it will not be sufficient to support the overweight condition at aerobatic G-load limits. We know of no practical means of further improving the spar strength. Those particular (heavier) RV-3s have, at the option of the builder, been constructed and equipped in such manner that they cannot comply with the design limits for aerobatic flight. Sorry!

Enclosed is a response/survey form. Please complete this form and return as soon as possible.

Sincerely,


Richard VanGrunsven
President