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RV-3 SAFETY ALERT:

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Dear RV-3 owner/pilot:

In a letter sent to all known RV-3 and RV-3A owners in November 1995, I mentioned that the RV-3 wings had been stress analyzed for a design load of 6 G's (9 Gs Ultimate), had been flight tested to 6 G's, and had been static tested (in 1982) to failure at 9 G's. Recently, we performed a static load test on another RV-3 wing and found that it failed at less than 9 G's; about 7.3 G's. Still well above the 6 G design limit, but below the desired 9 G's which provides for a 50% over-strength margin. Failure occurred between the first and second main wing ribs, between stations 14 and 22.75. Failure mode was an apparent compression buckling of the spar upper flange bar laminate. Since the wings used in both the 1982 and 1996 tests shared the same main spar construction, the difference in test results was at first a mystery.

After further consideration, I believe that I have the answer. Testing is continuing to substantiate my conclusions and to determine whether or not all RV-3s are affected. However, since the most recent test has shown failure to occur below the calculated ultimate load, we are recommending that, effective immediately, RV-3s not be flown in aerobatic flight, and that flight conditions be limited to utility category. (4.4 Gs)

HISTORY:

Both of the wings tested (in 1982 and 1986) utilized the original spar construction; that supplied between the years of 1973 and 1984. This spar consisted of a .040 aluminum channel web with a build up of seven 1/8 x 1/4 inch bars riveted on to form the upper and lower caps. The original spar assembly procedure specified that an epoxy structural adhesive could be used to bond the seven aluminum bars together as a single unit before drilling and riveting them to the spar web. The epoxy adhesive was intended to bond the bars together as a single unit to minimize the drilling and clean-up effort required during spar assembly. The epoxy adhesive was not intended to contribute to the spar strength, and was not factored into the spar strength calculations. Thus, it was an optional procedure.

The wing tested in 1982 had been fabricated using the epoxy adhesive to "jig" the spar bars together. The wing tested in 1996 had been built without the adhesive. Apparently the adhesive, while not used for the purpose of adding strength, had provided sufficient inter-bar shear strength to provide enhanced column strength. Put another way, it appears that the bonded assembly acted more like a solid thick bar rather than a laminated build up of narrow bars. Thus the epoxy adhesive possibly enhanced the spar's column strength.

After the testing of the wing with original spar construction using 1/8" bars fabricated without the use of epoxy adhesive, we modified the spar in an otherwise identical RV-3 wing panel. The modification consisted of bolting sections of aluminum angle extrusion to the upper spar cap strips over the inboard half of the wing. This was done to improve the spar compression buckling strength. The test results showed an improvement of 24% in load carrying ability and resulted in a failure at a calculated 9.25 G load.

Addition of the extrusions to the upper spar caps is in itself a relatively easy task and adds only 2 lbs per wing panel. However, in order to perform this task, one must have access to the spar which means that the wing must be opened up. This requires that the bottom inboard wing skin must be removed, or at least enough rivets must be drilled out to permit the skin to be peeled up and back, to permit access to the spar.

The use of epoxy adhesive during the construction of RV-3 spar was not intended to provide a structural benefit. Epoxy bonding of aluminum, under home workshop conditions, will not provide reliable, predictable, long term results. While it appears that the spar used in our 1982 test benefited from the spar laminate bonding, it should not be assumed that all "bonded" spars will show the same benefits. The spar tested in 1982 had been built within a few years prior to the test. One of the difficulties of aluminum bonding is aging; the bond usually deteriorates over time. Most RV-3s with the original spar design were built over 10 years ago, and for this reason alone, it should be assumed that there is no benefit from any adhesive which may have been used in spar construction.

In 1984 the RV-3 wing design was modified to include a re-designed spar. Among other things, this spar utilized 5 bars of 3/16 x 1 1/4 inch aluminum rather than the 7 each 1/8" thick bars originally specified. While the stress analysis showed this design to be of equal or slightly improved strength, the purpose for the change was to facilitate easier construction. Because of the lesser number of bars involved, and because experience had shown a questionable construction-phase benefit of bonding the bars together, the bonding process was no longer mentioned in the building instructions.

In retrospect, the 3/16" bar construction should offer more resistance to compression buckling, in addition to simplifying construction.

At the time of this writing, we have tested to failure three RV-3 wings, all of which used the earlier design 1/8" bars in the spar. We are now fabricating, for the purpose of static load testing, an RV-3 wing with 3/16" spar bars. To our knowledge, no RV-3 using the 3/16" bars in spar construction has experienced wing failure. However, until we are able to perform a static test of a wing with this spar variation, we do not assume any superiority for it.

We plan to test the current (post 1984) RV-3 wing spar within the next 30 days to determine the ultimate strength of this spar using the 3/16" spar cap bars. From this we hope to determine if we can again recommend aerobatic flight for the RV-3s with this spar construction.

We are in the process of designing a spar modification to enhance its compression buckling strength, and are preparing drawings and instructions for this. These will be forwarded to you as soon as they are ready. We will also be preparing a materials kit for the spar modification which we will provide at no cost to RV-3 owners and builders.

RECOMMENDATION:

Until the spar modification is performed, we recommend that RV-3 pilots immediately limit their flight G loads to a maximum 4.4 Gs; utility category. Based on our test results of an ultimate load of 7.3 Gs, a 50% over-strength margin would permit a flight limit load of 4.9 Gs at a gross weight of 1050 lbs. Since 4.9 Gs is below the 6 G specification for aerobatic category, no aerobatic maneuvers should be performed. Dropping back farther to utility category flight will offer an additional margin of safety.

Sincerely,


President

P.S. - RV-4 and RV-6 wings use spars of similar design concept, but entirely different dimensions than the RV-3. Their spar caps consist of laminated bar, but the bars are 1/4" rather than 1/8" thickness. We are not aware that any structural problems have ever been encountered on RV-4 or RV-6 wings. However, as a general precaution, we plan further testing of these. At this time we would like to re-state the obvious; that all RV-4 and RV-6 pilots observe the recommended aircraft flight operating limits regarding G loads, red-line speeds, maneuvering speeds, etc. Any questions concerning these limits should be directed to Van's Aircraft.