MANDATORY WING SPAR MODIFICATION FOR AEROBATIC FLIGHT

Document: CHANGE NOTICE #2 TYPE I (CN-2-I)

Model: RV-3, RV-3A

BACKGROUND:

When first designed, the RV-3 wing spar was mathematically stress analyzed to a design limit of 6 Gs at an aerobatic gross weight of 1050 lbs.

The RV-3 prototype was flight tested to 6.5 Gs on several occasions, and was used extensively for sport aerobatics and flown in many of airshow aerobatic demonstrations over an 8 year period.

The majority of RV-3s built from plans and kits have been used for sport aerobatic flying, and some have been flown in aerobatic competitions and airshow aerobatic demonstrations.

In the late 1970s and early 1980s, several RV-3s were lost to wing separation accidents.

In 1982 static load testing of a set of RV-3 wings revealed that failure occurred under a static load equivalent to a flight load of 9 Gs. (6 Gs design x 1.5 safety factor) This test appeared to verify the RV-3s wing strength.

In response to a 1995 RV-3 wing separation accident, another wing was static load tested in early 1996. This test revealed failure below the 9 G ultimate load level of the 1982 test. Careful checking showed that the wing tested in 1982, while its spar was made to the same size and of the same materials, had used epoxy adhesive bonding of the spar cap laminates. The epoxy adhesive, specified in the 1973 through 1984 building instructions, was an optional procedure used to bond the spar cap laminations together prior to drilling and riveting them to the spar web channel. The use of the epoxy adhesive was intended only as a means of holding the laminations together to simplify spar construction. No strength benefit was assumed because of the uncertain long term bond quality, and because calculations showed sufficient spar strength without use of the adhesive.

The spar in the wing which was static tested in 1996 had been assembled without the optional adhesive. Failure had occurred as a result of compression buckling of the upper spar cap. It was speculated that the spar of the wing tested in 1982 withstood a greater load because the bonded laminations of the spar caps had a greater buckling resistance. It became necessary to design, test, and implement a method of strengthening all completed and under construction RV-3 wing spars. Because of the uncertainty of the benefits of bonded spar caps, it was decided that a strengthening of all RV-3 wings, whether or not epoxy adhesive was used, was needed if they were to be deemed suitable for aerobatic flight.

Further testing has been conducted on 6 additional RV-3 wings, using various means of spar strengthening.

In 1984 the RV-3 structure underwent minor re-design as a means of upgrading kits to include features and construction techniques learned in the 11 years since its market introduction. Included among these was a change in the size and number of aluminum bars used for the spar caps. The change was made primarily to improve construction time and quality. No significant difference in spar strength was sought because none was deemed necessary at that time.

Static testing done in 1996 revealed that the post 1984 spar design is stronger than the original spar design. Because of the differences in the design, construction, and strength of the RV-3 spar variants, they have now been designated TYPE I for the original 1973 through 1983 plans and kits, and TYPE II for the post 1983 kits.

Type I spars are distinguished by their use of 0.125 x 1.25 inch 2024-T4 bars as spar caps. (TYPE II spars use 0.1875 x 1.25 inch bars) Van's Aircraft Inc. is not aware that any TYPE II RV-3 spar ever experienced an in-flight structural failure. However, static testing of a TYPE II wing in 1996 revealed a failure below the calculated ultimate load of 9 Gs (design load of 6 Gs x 1.5 safety factor). Based on this test result, Van's Aircraft Inc. notified all known owners and builders of these findings and suggested that all RV-3 pilots amend their operating limitations to exclude aerobatic flight and to limit G loads to Utility Category limits of 4.4 Gs positive and 2 Gs negative.

Subsequent testing of a Type II spar modified to the CN-2-II configuration, found that it successfully supported a load calculated to simulate a 9 G flight load (design load of 6 Gs x 1.5 safety factor). On this basis, spar modification kits and instructions were prepared and sent to owners and builders of RV-3s with TYPE II spars.

In Oct. 1996, another static load test was performed on a TYPE I wing modified in accord with CN-2-I. Test results showed that it sustained a load equal to a 9 G positive load. Therefore, modification kits and instructions have been prepared and are now available to owners and builders of TYPE I RV-3s and RV-3As.

It would appear that any RV-3 using a TYPE I spar, built with aircraft Quality materials and practices, and altered to conform to CN-2-I configuration, is suited to perform aerobatic maneuvers not to exceed 6 G positive and 3 G negative loads when operated at or below a 1050 pound aerobatic gross weight. (or, 1050 lbs. plus wing fuel)

It is the recommendation of Van's Aircraft Inc. that RV-3 aircraft using standard TYPE I spars which have not been modified in accordance with CN-2-I, be limited to non-aerobatic flight, be operated within Utility Category limits of 4.4 Gs positive and 2 Gs negative, and have a placard prominently displayed on the instrument panel indicating this limitation.

It should be remembered that an Amateur Built RV-3 aircraft, as with all aircraft licensed by the FAA in the Experimental Amateur Built category, is the singular product of its builder and offers no assurance of compliance with any FAA Type Certification standards or production quality control standards. The construction and flight test logs, and other specific recorded test data, for an individual RV-3 aircraft constitute the only data from which the airworthiness of that individual aircraft might be determined.

TYPE I WING SPAR MODIFICATION

Testing has shown that TYPE I RV-3 wing spars, when assembled without the use of inter-plate adhesive, fail in compression buckling below aerobatic ultimate load levels. This indicates that greater lateral stiffness of the spar cap laminations is desired. Wing ribs attached to the spar provide lateral stiffness at spanwise intervals averaging about 10 inches. To enhance the lateral stiffness between ribs, aluminum angle extrusions are added to the upper spar cap laminations of the inboard portion of the spar. This spar cap is under a compression load during positive G loading of the airplane. The angle extrusions are attached to the spar using bolts through both existing holes and new holes drilled between existing rivets. Because the angles are not continuous, they do not add to the cross sectional strength of the spar. What they do is provide lateral stiffness or restraint so that the spar cap strips will remain straight under a greater compression load, nearer that of the spar's idealized strength potential. Calculations show that the spar caps are of adequate size to carry the load if buckling can be prevented.

Static testing of RV-3 wings with stiffened upper spar cap laminations revealed that the lower spar cap needed additional rivet strength. This was accomplished by replacing some of the 1/8" lower cap rivets with 3/16" rivets. This was incorporated in the final spar configuration which was tested with satisfactory results, and is a requirement of CN-2-I.

When the wing spar was re-designed to a TYPE II in 1984, the root rib arrangement was one of the features changed. Two additional ribs were added between the root rib and what had been the second rib. (STA. 22.75) These served to support the wing walk and also added torsional stiffness to the wing root area. The close spaced ribs (about 3" spacing) are standard in wings using TYPE II spars. However, it is possible that some older (TYPE I) RV-3 kits might have been constructed using components and features of both TYPE I and TYPE II wings. Inconsistencies in the structure of any RV-3 wings on which the CN-2-I alteration is being performed, should be brought to the attention of Van's Aircraft Inc. Similarly, any other variations which may have been incorporated, intentionally or accidentally, in the spars in your RV-3, should be brought to the attention of the Engineering Staff at Van's Aircraft. (Inspection items are listed later in these instructions.)

In 1984 Van's Aircraft Inc. issued Change Notice #1 (CN-1) which specified re-enforcement of the root rib and rear spar. Instructions issued with CN-1 specified that these changes be made before any further aerobatic flying be conducted.

The CN-2-I modification supplements the CN-1 modification, but does not supersede or replace it. Both are necessary to achieve aerobatic strength. Each addresses a different part of the wing structure. If any RV-3 has not yet been modified in accordance with CN-1, this needs to be performed before or in conjunction with CN-2-I.

Performing the CN-2-I alteration to a TYPE I RV-3 spar is a relatively easy task when the wings are un-skinned. For completed wings, the task becomes more difficult. To perform the spar alteration, it is necessary to have access to at least the rear side of the spar. For a completed wing, a portion of the wing skin must be drilled off to access the spar. For a finished and assembled RV-3, this means that the wings must first be removed from the fuselage.

Portions of the following instructions include two methods of accomplishing the same task because of differing features incorporated in some RV-3 wings and spars. One of the primary differences is that some RV-3s have wing fuel tanks. The wings fuel tanks can and should be removed to permit greater access to the spar, permitting easier procedures to be used for the spar alterations.

Another difference is the wing spar design, of which there are two variations, herein referred to as TYPE I and TYPE II spars.

Type I Spar: The original RV-3 spar (introduced in 1973) was fabricated with flange bars which were 1.25" wide and 0.125" thick. These bars were riveted to the spar web with two rows of 1/8" AN470 rivets.

Type II Spar: In 1984 the RV-3 structure underwent a minor redesign to incorporate innovations which had been learned during the first 11 years of kit production and assembly. One of these was changing the wing spar design to use flange bars of 1.25 width and 0.1875 thickness. A single row of 3/16" AN470 rivets was used to attach the bars to the spar web.

Following is a step by step description of work to be done in performing the CN-2-I alteration.

- ***STEP 1.*** Remove wings from airplane. Though it is theoretically possible to perform this alteration with wings in place, it would be extremely difficult and the possibility of error would increase dramatically.
- ***STEP 2.*** Drill out all rivets indicated on Drawing CN-2-10. If paint or surface filler hides the rivet heads, it will be necessary to remove the paint or filler before drilling the rivet. Use care in drilling the rivets so that the drill bit remains centered and does not enlarge the holes. These holes will be re-used when closing the wing after the internal work is finished. Drill out all rivets back approximately 17 inches from the spar.
- ***STEP 3.*** Peel skin up as shown in Photo #I and secure with duct tape, etc. (Optional procedure is to remove the entire skin, either for replacement or re-use. This will make access to the wing spar a bit easier, but will require more effort to drill out about twice as many rivets. The decision to replace the wing skin because of damage or defect is the only valid reason to completely remove it.) To minimize the effort and time needed to accomplish this alteration, partial drilling and peeling back of the skin (rather than complete removal) is recommended.
- ***STEP 4.*** Locate and mark all points where new holes will be drilled in the spar. Refer to drawing CN-2-2. Initially, start on the four inter-rib sections between Rib STA. 22.25 and STA. 61. The most inboard (wing walk area) rib section is more complex and will be covered later.
- ***STEP 5.*** Measure lengths of extrusion angle (1 x 1.25 x 0.125 6061-T6 aluminum) required for each inter-rib section. Cut the angle to lengths for snug fits between ribs. (one method is to cut the angle segment 1/32" to 1/16" too long, and then grind or file to fit) When fitting the angle segments you will find that you cannot fit them up against the spar because the web stiffener angles (mid span between ribs) cause an interference.
- ***STEP 6.*** Use a die grinder to remove a portion of the perpendicular leg of the mid-span spar web stiffeners. See detail on DWG. CN-2-2, and the photos. These spar web stiffeners are a necessary part of the spar and should not be removed in their entirety. Only the portion of these stiffener angles which actually interferes should be removed through die grinding. Even when the ends of the stiffeners have been relieved (ground out), the angle segments will not directly contact the spar but rather will contact the heads of the spar rivets. Thus, shims are used to space the stiffener angles away from the spar so that they clear the rivet heads. These are shown in DWG. CN-2-8. In most places spacers of 1/8" (0.125") thickness will be needed. In some places where bolts coincide with stiffener angle or rib locations, less thickness is needed. Thus, spacers of 0.125", 0.040", and 0.025" thickness have been provided so that you can build the necessary thickness at the various locations.
- ***STEP 7.*** Drill bolt holes in spars:

Each section of stiffener angle is held in by three AN3 bolts. These bolts are to be located where 1/8" rivets had been. In other words, some of the 1/8" rivets will be drilled out and replaced with 3/16" bolts. Drilling out rivets, particularly through thick members, is difficult to do accurately. It is difficult to prevent the somewhat flexible 1/8" drill from wandering off centerline and enlarging the hole. Within limits, slightly elongated or enlarged holes will not cause a problem because these holes need to be enlarged to 3/16" anyway. Thus, a slightly oversize or elongated 1/8" hole can easily be "cleaned up" in the process of enlarging it to 3/16" dia.

It is advisable to start with the most outboard section where the spar flange strips are thinner, so the rivets are shorter and easier to drill out. Thus, you will have the benefit of practice before drilling through the thicker, more difficult, inboard laminations.

RV-3 wings are of two types; those with wing fuel tanks (removable) and those without tanks. Completion of the CN-2-I modification will be easier on the fuel tank wings because the tanks can be removed to permit open access to the front side of the spar. Because of the difference in procedure, each will be described separately.

WINGS WITHOUT FUEL TANKS:

When modifying the spar of a non-fuel wing, spar access is limited to the rear side and is somewhat restricted because the top skin is to remain in place during the modification. For this reason, it is necessary to use a smaller drill motor; preferably an air drill. The object is to drill straight into the rivet, so a smaller drill motor will make better use of the working space. It is also possible to use a 90 deg. angle drill attachment. This should not be necessary and is not recommended because of the increased difficulty of maintaining drill alignment.

Drill out rivets with a 1/8" or #30 drill. Hold the drill motor straight so that the drill will remain centered and remove the rivet without wandering and enlarging the hole excessively. Drill all required holes to 1/8" prior to proceeding to the next step.

Fabricate the hole center marking tool from the MSP-42 Pop-rivets as shown on DWG. CN-2-10. Insert these tools into the three open rivet holes. Position the stiffener angle as shown in photo #5 with the 3/8"x 1/2" spacer blocks. With a plastic hammer, tap the stiffener angle into the marking tools to form hole-centering indentations in the angle. Remove and drill three 1/8" holes in the stiffener angle. Place the angle back in the wing and hold the position by inserting 1/8" drill bits through two of the three hole in the angle and spar. Carefully drill the remaining hole out to 3/16" dia. Insert an AN3 bolt into that hole, and drill the remaining holes out to 3/16".

Drill out all of the specified rivets (DWG. CN-2-2) in the lower spar flange bars. (Notice on DWG. CN-2-2 some rivet positions in the line are shown with little circles. This denotes that the original 1/8" rivet should be left in because it is located too close to the web of the rib to permit drilling and replacing.) Drill and enlarge in the same manner as used for the upper spar flange bars. Replace with AN470AD6 (3/16" dia.) rivets. When riveting, use a heavy bucking bar weighing about 4 lbs. It will be necessary to use a heavy duty rivet gun of 4X or 5X rating to drive these rivets. It will also be necessary to use extreme care when using a heavy duty rivet gun in restricted quarters. Make every effort to hold the gun straight and steady to prevent damaging the rivet or spar.

TYPE I SPAR WITH A REMOVABLE WING TANK:

- a. With open access from the front side of the spar, drill out the appropriate rivets with a #30 drill. Position the stiffener angle in place using 1/2" thick spacer blocks to maintain distance from the upper skin. Hold the stiffener angle in place and drill through the open rivet holes, using them as drill guides. Separately, drill (enlarge) the center hole to 3/16" in both the stiffener angle and the spar. Temporarily bolt the angle in place and drill the remaining holes out to 3/16"; through both the spar and the stiffener angle in the same pass.
- b. Re-fit the angle to the spar and insert bolts through all three holes. If a hole in the stiffener angle is found to be slightly misaligned, it can be enlarged slightly to fit the bolt. Precise fit of the bolts in the angle is not critical. Quality of the holes through the spar flanges is.
- c. Drill out all specified rivets in the lower spar flange bars. Drill and enlarge in the same manner as above. Replace with AN470AD6 rivets as specified on DWG. CN-2-2. When riveting, use a heavy bucking bar with a weight of about 4 lbs. Also, it will be necessary to use a heavy duty rivet gun, a 4X or 5X variety.

PROCEDURE FOR ROOT END OF SPAR; INBOARD OF STA. 22.25:

Installation of the spar stiffener angle inboard of STA. 22.25 is accomplished in approximately the same manner as described above. The difference being that the stiffener angle is wider (1.25 x 1.25 x 1/8") and extends inboard of the root rib through a hole cut in that rib. (see Photos 15-18) The additional width of the stiffener angle is needed because the attaching bolts are on two different center lines. Also, note that this stiffener angle is to be spaced only 3/16" down from the spar upper flange, also needed to accommodate the center line of the most inboard bolts.

With the introduction of the TYPE II Spar in 1984, the wing walk was re-designed and two additional ribs were added between the root rib and the rib at Sta. 22.25. It is possible that some TYPE I wings were altered during construction to incorporate this "added ribs" feature. If so, the following procedure explains the stiffener angle installation.

Because of the close rib spacing near the root of the wing, it will be necessary to alter the three inner most ribs so that the spar stiffener angle can be installed. The procedure for doing this is depicted and described in Photos 15-23. Drilling and grinding the notches in the ribs is tedious and demanding work. Take your time and get it right. Once the ribs are notched and the angle slipped into position and clamped, drilling of the stiffener angle for attachment to the spar is the same as for the more outboard stiffener angle segments.

This section of stiffener angle spans a change in spar thickness where the 1/8" thick root plate ends. Use 1/8" plus 0.025" spacers on the outboard side of this transition, and 0.025" spacers inboard.

The above procedure applies to root and #2 ribs which have a 3/4 x 3/4 x 0.063 angle end flange as specified in the plans. Cutting the slot in the ribs requires cutting a slot in the rib end angle as well.

The photos (#15-23) depict an optional procedure which requires that the angles which form the front flanges of the first two ribs be removed (drilled off) before the notch is drilled and filed into the rib web. With this procedure it is easier to cut the notch, but more difficult to later replace the end angles. Angles used for replacement must have a joggled end to fit over the 1/8" thick leg of the spar stiffener angle. For those who elect this method, or who find that they (for some reason) must remove the angles, Van's Aircraft can supply replacement angles with a 1/8 joggled ends.

The preferred procedure is the former, that of leaving the rib end flange angles riveted on and drill/notching through both the rib web and the adjacent leg of the angle. Drawing CN-2-11 depicts both methods.

Type I SPAR WITHOUT WING FUEL TANKS, and WITH ADDED WING WALK RIBS:

The stiffener angle can be attached to the forward side of the spar inboard of Sta. 22.25. Locating the angle on the forward side of the spar will eliminate the need to notch out three ribs to accommodate the stiffener angle. However, the root nose rib must still be notched. Refer to DWG. CN-2-12.

- a. Notch the leading edge root rib in the same way as shown and described in Photo #15, 16, & 17.
- b. Drill out two rivets at sta. 20.375 and 21.625 as shown on DWG. CN-2-2. Enlarge to 3/16".
- c. Position the stiffener angle and mark through evacuated bolt holes. Drill 3/16 holes to correspond with existing bolt holes in the spar.

STEP 8. SPAR WEB MODIFICATION-COVERING LIGHTENING/ACCESS HOLES IN WEB.

General: In addition to stiffening of the upper spar bars and substituting larger rivets in the lower spar bars, CN-2-I requires that the lightening/access holes in the spar web be structurally covered. This is accomplished by riveting a 0.063" thick cover plate over the hole at Sta. 29.25, and 0.040" thick cover plates over each of the remaining access holes outboard through STA. 58.

Procedure:

- a. Cut pieces of 0.063" and 0.040" 2024-T3 aluminum into strips 3 13/16" wide and 5.25" long, for use as covers over the lightening holes.
- b. Position each plate on front side of spar web and drill holes per DWG. CN-2-9. To assist in handling of the hole cover plates (in the restricted access space), drill a 1/8" hole in the center of the plate into which a cleco can be inserted to function as a temporary handle. There are places where the doubler plate overlaps rivets in a web stiffener angle. These rivets must be drilled out and then these holes drilled through the doubler plate also.
- c. Repeat the item "B" for all holes in spar web out to and including Sta. 58. A single cover plate of 9 5/8" length can be used to cover two holes where they occur within the same inter-rib section. The blind rivets used to attach the hole covers to the spar web are MSP-42 monel Pop rivets. Do not substitute any generic aluminum Pop rivet as they will not provide adequate strength.

General: The angle extrusion and sheet (hole covers) provided have been anodized for corrosion resistance, and need no further priming or painting. Exposed ends of the angle (from sawing) need not be primed.

Caution: Any spray painting, even with spray cans, should be done in well ventilated area and only when using respirators. All spray paint containers contain warnings which should be taken seriously.

WINGS WITHOUT FUEL TANKS.

Stiffener angles must be installed before hole covers are riveted on. Position angle segments, shims, and bolts in place. Install washers and nuts and tighten. To position hole cover plates, pass them into the wing through the leading edge root rib and then outward by reaching in through the spar web holes. When Pop riveting the hole covers on, start with the most outboard end and work towards the root. This will permit reaching through remaining holes to handle and position each successive cover plate.

Wings With Fuel Tanks. Working from the open front side of the spar, fitting, drilling, and riveting the hole cover plates can be done easily at any time during the alteration project.

STEP 9. RE-RIVET SKIN:

Start by riveting the skin to the ribs, working from back to front. Rivet as much as possible while reaching in under the front edge of the skin. Then cleco the remainder of the skin and reach in from the ends, through the root rib and through the bellcrank opening, to rivet the remainder. It may be necessary to relocate the pitot line or wiring in order to get the bucking bar in to set some of the rivets.

(If any rivet holes had been damaged or enlarged in the process of drilling out old rivets, the new rivet may be sub-standard. If uncertain of rivet quality, it is acceptable to drill additional rivet holes spaced between original rivets. Though the skin is only 0.025" thick, it may be machine countersunk for these extra "last minute" rivets.)

STEP 10. To complete the spar stiffening alteration, it is also necessary to add a stiffener angle to the spar root within the fuselage. Drawing CN-2-2 shows this angle segment located just inside the fuselage skin extending inward adjacent to the steel splice plate. This angle can be easily marked by clamping it to the back of the spar root stub while the wing is removed from the fuselage. The holes are drilled and the fit of stiffener angle-to-spar bolt holes is then checked. This done, it can then be installed as the wing is being bolted to the fuselage during re-assembly.

CONCLUSION: RV-3 wing spars modified to conform to CN-2-I, and which have been built to aircraft standards of aircraft quality materials, will permit aerobatic flight at or below flying weights of 1050 lb. gross (1050 lbs. plus wing fuel.) We cannot emphasize enough the importance of the operational weight of the airplane as it relates to the stress on the wing spars. The stress on the spars increases in almost direct proportion to the weight of the airplane. While performing aerobatic maneuvers when loaded above the specified aerobatic gross weight doesn't mean certain structural failure, it does mean a reduction in the design safety margin to below that specified by the FAA. The safety margin is designed in for good reason: don't violate it. Don't perform aerobatics at gross weights in excess of 1050 pounds. (or, 1050 lbs plus wing fuel weight)

Some RV-3s have been over-built and over-equipped to the extent that their empty weight plus pilot and minimum fuel exceeds their 1050 lb. aerobatic gross weight. As such, these aircraft should not be classified as aerobatic, nor should any aerobatic maneuvers be performed in them.

Also, it is important to remember the difference between Design Strength and Ultimate Strength. Design strength is the loading which the airframe will support indefinitely without permanent deformation. Ultimate strength is that point at which the structure will break. The FAA specifies that ultimate strength be 50% higher than the Design strength, to allow for the effects of airframe age, unintentional overloads, gust loads, etc. The 50% is an emergency margin, not a gift or grant to be used at will. A wise pilot will not intentionally fly into that safety margin. Stated another way, above 6 G loads, all bets are off.

NEGATIVE LOAD LIMIT:

The Design limit negative load for RV-3s modified in accord with CN-2-I is 3 Gs. The original RV-3 spar was of symmetrical section, and as such, had essentially equal positive and negative G strength. Altering an RV-3 spar in accordance with CN-2-I alters the symmetry of the spar, rendering its inverted strength less than its positive strength. The new -3 G limit is the minimum acceptable limit which the FAA requires for aerobatic category aircraft. While conservative for the altered RV-3 spar, a negative 3 Gs is more than adequate for the sport aerobatic maneuvers for which the RV-3 is intended.

OPERATING WITHIN LIMITS:

This discussion and these instructions are designed to help the RV-3 builder alter his RV-3 wing structure so that it meets aerobatic requirements. It is by no means a guaranty of indestructibility. Flight operating limits remain very real and the final measure of safety rest directly on the pilot. The pilot must make himself aware of these limits and prepare himself to operate his RV-3 within the established aerobatic limits, the primary tenants of which are:

- 6 Gs maximum positive load at a maximum aerobatic gross weight of 1050 lbs. (1050 lbs. plus wing fuel weight).
- -3 Gs maximum negative load at the above weight limit.
- 210 mph (statute) Never Exceed Speed.
- 132 mph (statute) Maneuvering Speed. (Maximum speed at which full control can be applied. Full elevator application at this speed will produce a 6 G load. Full elevator application at any speed above this will produce loads in excess of design limits. Full aileron and rudder application are not to be applied at speeds in excess of 132 mph, though the loads applied cannot easily be measured in Gs)
- No aerobatic maneuvers should be attempted in any RV-3 unless it is equipped with a recording accelerometer.

CONDITION INSPECTION:

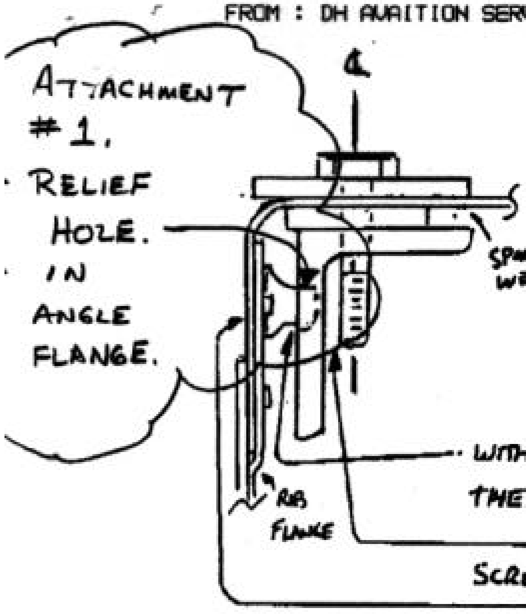
In the process of removing the wings from the fuselage and opening the skin on the inboard 1/2 of your RV-3 wings, you have the opportunity to conduct a very thorough condition inspection. The object of this inspection should be defects caused by time/usage and construction errors/quality control. In many instances, the airplane was built by someone other than yourself. As an Amateur Built Experimental aircraft, the builder was an amateur with undocumented qualifications. Because of this and because of the unknown depth of the original airworthiness inspection by the FAA, you should not assume that your RV-3 structure meets airworthiness standards comparable to a standard category production airplane.

The strength benefits to be expected from complying with CN-2-I assume that the RV-3 wing, particularly the wing spars, were constructed in accordance with the construction plans and manual, and that aircraft quality workmanship standards were adhered to. If not, the intended 'strength benefits of the CN-2-I Spar Alteration may not be realized. "If there is some unknown weak link in the chain, strengthening the other links will not make the total chain any stronger".

Below are some, but not necessarily all, items to look for while the wings are off your RV-3, and opened, offering an unusual opportunity for inspection. If you find any obvious problem, it should be corrected in conjunction with the execution of CN-2-I. If you find a conditions which is suspect but not certain, contact Van's Aircraft Inc. for further evaluation and possible correction.

- 1. Under/Over driven rivets. Refer to section 3 of the construction manual for rivet head standards. Also, handbooks such as the STANDARD AIRCRAFT HANDBOOK include aircraft riveting standards.
- 2. Corrosion. Inadequate initial corrosion protection (primer paint) and/or excessive exposure to moisture or other corrosive elements could have damaged your RV-3 wing structure. Superficial surface corrosion can probably be removed and the surface re-coated with primer. Deep corrosion could result in the need for major rebuilding or rejection of the structure.
- 3. Insufficient edge distance for center section bolts. If during construction, any of the 20 bolts which join the left and right wing panels together with the steel center section splice plates were mis-located too near the edge of the splice plates, loss of strength could occur. Refer any findings of irregularities to Van's Aircraft Engineering Department for review.

- 4. Oversize and/or elongated holes for center section bolts. Poorly drilled holes for the center section bolts will reduce the spar strength. Often this error is in the form of elongated holes cause by the drill bit wandering off centerline during the final holes sizing process. Also, it is possible that bolts larger than specified have been used. Some builders have been known to drill out defective holes to larger diameters in an attempt to correct a bad hole. Larger bolts are in themselves stronger, but the larger holes weaken the spar and splice plates. Some builders overlook this engineering consideration based on the simple expedient that "bigger is better".
- 5. Extra holes drilled in spar flange strips. Any holes drilled in the spars, particularly the spar flange bars, could reduce their strength. For the same reason as in Item #4, oversize rivets and/or bolts in the spar could actually weaken it.
- 6. Damaged or defective control push rods. Push rod linkages should be checked to assure that the end fittings and bearings have been constructed per plans and that they are not dented, worn, or corroded.
- 7. Cracks around aileron bellcrank mount. The brackets which attach the aileron bellcrank to the wing rib are subject to spanwise loads which tend to flex the rib. This can cause cracking of the rib web.

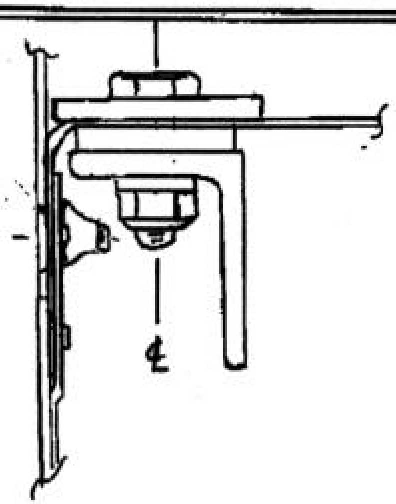


HELP!

SPAR MOD – CN-2-3 RV-3

THE PROBLEM !

WITH ANGLE HARD UP AGAINST A/NUT FOR TANK :- THEIR IS NOT ENOUGH ROOM TO FIT NUTS AND SCREWS FOR TANK.



THE FIX ?

DEAR DICK

WHEN FITTING SPAR MOD CN-2-3 TO MY RV-3 I FOUND I HAVE THIS PROBLEM. IF I TURN THE ANGLE THE FIX WORKS. (ST 22 AND 07B ONLY). DO YOU THINK THAT IT WILL STILL WORK (STRENGTH.. ECT) IF I USE THIS FIX? THE TWO ANGLES 1B OF ST 22 WILL HAVE TO BE MADE TO WORK (SOME HOW!). WHAT ELSE CAN I DO IF YOU DONT THINK I SHOULD? (NEW WING?)

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Date: March 6, 2001

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Dave;

Sorry it's taken me so long to get back to you.

The 1/8 x 1 x 1 ¼ angles act as stiffeners to the spar bars. These angles help to strengthen the structure by helping it resist buckling due to compression loads primarily in the upper spar cap bars. Generally, the greatest amount of compression would be in the outermost part of the spar bar. That is why the flange of this additional angle was situated as close to the outer part of the bars as it was. According to my figures, there should have been enough room for the platenuts provided the wing was built according to our specifications. With that, we offer another possible solution.

In an effort to keep the horizontal flange of the angle as close to where it was located during our static tests (as shown on the CN-2-3 drawings), drill a relief hole (see attachment 1) at the points of interference with the platenuts. This relief hole in the 1/8 x 1 x 1 ¼ angle should be no deeper nor larger in diameter than necessary. This will allow the angle to be moved closed to the spar flange so that a nut may be installed.

The design you suggested would also stiffen the spar. However, since we have not tested the spar in this configuration we cannot tell you how effective this would be. If you don't like our suggestion, yours will probably work, just how well we cannot say.

Let me know if you have any other questions.

Sincerely;
Phillip Rivall