Model (s) affected: RV-3

PURPOSE: To specify airframe alterations required on VAN'S AIRCRAFT RV-3 airplanes for re-designation to model RV-3A for the purpose of exempting them from the limitations dictated by FAA GENOT RWA 1/40 SVC B, dated Mar. 24, 1981. Said GENOT requires that airworthiness certificates of all RV-3 aircraft be suspended until new ones are issued which prohibit aerobatics. Said aerobatic prohibition is permanent, and will be applicable to all aircraft designated VAN'S AIRCRAFT RV-3.

BACKGROUND: Said GENOT was issued as a result of three, possibly four, fatal accidents involving wing failures on RV-3s . Preliminary investigations had revealed that aerobatic flying, particularly sharp pull-ups at high speeds, was the probable cause of some of the accidents.

Prior to releasing of the RV-3 plans, Van's Aircraft performed stress analysis calculations for the major wing components. These were calculated to withstand loads of 9 G's before failure. Flight testing of the prototype RV-3 was performed which stressed the wing to 6½ G's in straight forward, accelerated pull-ups. After a number of plans built RV-3s were flwon, several builders reported experiencing over 6 G's in flight testing or aerobatic flight, without sustaining any airframe failure.

Between July 1978 and March 1981, three or four (depending on variations in observer reports) RV-3s experienced wing failure in flight. Two were observed doing abrupt maneuvers at high speeds at the time of failure, and the other two were engaged in forms of aerobatic flight but lacked close observer testimony regarding the degree of aerobatic involvement at the time of failure. Official accident investigations and (in one case) investigation by Van's Aircraft personel, have shown that in all instances, some construction deficiencies occured in all failed RV-3s . In two cases, the deficiencies were determined to be primary contributing factors in the failure, suggesting that these airframes could have failed below the design stress limits. The other two were less well defined, making it difficult to conclude whether or not failure occured at or below design limits.

As a result of the accidents, two complete and one partial stress analysis were performed by govenment and private engineers. All concluded that the RV-3 wing structure, as designed, was adequate to withstand a 9 G ultimate load, with the possible exception of the root main wing rib. This finding was admitted by the analysist to be conservative because it neglected strengths provided by adjacent structural members.

A static load test was performed by Van's Aircraft on an RV-3 structure built according to plans and loaded (stressed in accordance with professionally derived criteria. Failure of the main wing spar occured at a 9 G load as per calculations. No failure of the root rib or rear spar attach was evidenced.

Official investigations and observations by Van's Aircraft personnel and associates have found that builders are prone to error in the construction of certain components, particularly the rear spar attach. It was also found that these errors often evade observation by the builder and FAA inspectors. All RV-3 wing failure accidents have involved pilots other than the builders, two were non-owners, and none occured during formal flight testing. This suggests the possibility that these RV-3s may not have been adequately flight tested, and that the pilots may not have been aware of this. It has also been found that some RV-3s have been granted aerobatic authorization without having been adequately flight tested or even having demonstrated aerobatics to the FAA.

In consideration of all of the forgoing information, the following conditions must be complied with before any VAN'S AIRCRAFT RV-3 can be re-designated an RV-3A and issed new operating limitations not subject to GENOT TWA 1/40 SVC B.

STRUCTURAL CHANGES:

Drawings CN-1-1, CN-1-2, CN-1-3, and CN-1-4 detail airframe changes which must be performed on a VAN'S AIRCRAFT RV-3 before it can be re-designated an RV-3A, and authorization for aerobatic flight can be granted by the FAA. The required changes involve reinforcing of the rear spar toot end and the rear spar center section, and refinforcing of the root main ribs. Options are provided for making these modifications because of differing structural components specified on early or late RV-3 plans and/or kits, and because of differing states of construction at which the builder must make the modifications.

CN-1-1 details rear spar and center section modifications for RV-3s built from plans and kits supplied before Sept. 1980. These are distinguished by rear spar center sections of 1 x 1 x 1/8" 6061-T6 angle.

CN-1-2 details wing root rib modifications which can be performed on all RV-3s regardless of root rib thickness or degree of completion, including finished airplanes. Root ribs of pre-Sept. 1980 plans and kits were .020" thick, whereas later ones were .032" thick.

CN-1-3 details rear spar and center section modifications for RV-3s built from plans and kits supplied after Sept. 1980. These are distinguished by rear spar center sections of 1½ x 1½ x 3/16" 6061-T6 aluminum angle.

CN-1-4 details wing root rib modifications which can be performed on RV-3s of varying vintages. Option #1 applies to all vintages or degrees of completion. Option #2 and #3 apply to new RV-3 construction projects and to all inprogress RV-3 wings which have not yet had the final (top) skins riveted on.

MODIFICATION PROCEDURE-ROOT RIB

The torsional strength of the wing is increased by adding angles or bars to the upper portions of the root rib as shown on CN-1-2 and CN-1-4, or by adding additional ribs near the root as shown on CN-1-4. Both methods of root rib reinforcement are applicable to completed wing pannels because all required work can be performed without removing any wing skin. Use of the bars is probably the easier method because their installation does not require the removal of any skin rivets and because they are to be riveted to the exposed side of the rib. Use of the angles is more involved but does offer a neater, more structurally efficient modification. Whichever method is selected, one very important point is that the angles or bars be securely riveted to the main and rear spars. This is done through the root rib attach angle on the main spar, and a similar angle to be added to the rear spar during this modification. When using angle reinforcements, refer to Section A-A' drawings for positioning. Wing walk stiffeners dictate that the angle on the upper portion of the left root rib be attached to the inboard side of the rib web. In some instances where the reinforcement angles and spar angles do not provide lap joints, gusset plates as shown in Section C-C' must be used. When bar reinforcements are used on the side of the rib web with raised web stiffener rings, the bar is to be riveted to the web at all contact points; the high points of the stiffener rings.

Options #2 and #3 are suggested for modifications being done on wings in early stages of construction, or at least those being done before the final (top) wing skins is riveted on. Of these, Option #3 is probably the best because it more effectively stiffens the skin of the inboard wing, and also permits the builder to simplify wing walk construction.

MODIFICATION PROCEDURE-REAR SPAR AND CENTER SECTION:

This modification is detailed on drawings CN-1-1 and CN-1-3, and its primary purpose is to increase the bearing area of the rear spar bolt attach, and to place this bolt in double shear rather than single shear as per the original RV-3 plans. It is also intended to emphasize the importance of, and help assure that proper bolt edge distance is maintained. The plans specify a minimum edge distance of 7/16". When the spar doubler plate is installed, the original hole edge distance can be as little as 3/8 inch, providing that the doubler has the specified edge distance of ½ inch. Any member in which the hole edge distance is less than 3/8 inch must be replaced before proceding with the modification.

RV-3 plans and kits supplied before Sept. 1981 have a rear spar center section made of 1 x 1 x 1/8 6061-T6 aluminum angle. This modification, per CN-1-1, requires that a doubler plate be added to the outboard ends of the center section. For completed airplanes, accomplishing this will require that part of the seat skin be drilled free and bent up for access, and that a larger hole be cut in the fuselage skin for this member. The three outboard most rivets on each side are to be drilled out and replaced by AN3 bolts. The reason for this is that they are both easier to replace and stronger than the original rivets. Along with this, the rear spar root plate must have a doubler plate riveted to it.

For RV-3 plans and kits supplied after Sept. 1980, a heavier center section spar was provided. (1¼ x 1¼ x 3/16 6061-T6 angle) This member needs no reinforcement, but the rear spar root plate must be modified per CN-1-3 to place the bolt in double shear. Modification of the rear spar root should be done in conjuction with the root rib modifications detailed on CN-1-2 and CN-1-4.

Two points of importance in this modification are the bolt hole edge distance mentioned above, and that the hole be such that it provide a snug fit for the bolt. Final drilling of the hole with a "D" drill will provide the desired fit.

OTHER REQUIREMENTS:

In addition to meeting the structural requirements of this change notice, the following items must be complied with before aerobatics will be authorized for an RV-3A

1. A recording accelerometer must be installed as permanent instrumentation.

2. An entry must be made in the aricraft log by either the aircraft's manufacturer (builder), owner, or FAA Inspector, attesting to the maximum in-flight G-load the aircraft has been subjected to in testing. The G-load value is to be measured by a recording accelerometer, and can be witnessed after the flight by the person making the endorsement.

3. A placard must be placed on the aircraft's instrument pannel stating the maximum tested G-load. The Placard should read: "Aircraft N________has been flight tested to an acceleration load of ________G's. Do not exceed"

4. The maximum acceleration load that an RV-3A, at a max. aerobatic gross weitht of 1050 lbs., should be intentionally subjected to is 6 G's either positive or negative. Even if a greater load is unintentionally experienced during testing, 6 G's is the highest level which is to be recorded in the aircraft log and on the placard.

INSPECTION POINTS:

Following is a list of possible errors in the construction of an RV-3 wing which can have an appreciable effect on its strength. Presence of any one or more of these errors will result in a reduction in strength and the RV-3 will not meet 6-G limit load aerobatic requirements at a gross weight of 1050 lbs. Therefore, it should not be re-designated an RV-3A. By definition, an RV-3A is one built in strict compliance with VAN'S AIRCRAFT RV-3 plans and has been modified in accordance with VAN'S AIRCRAFT CN-1. Thus, any RV-3 with a known structural deviation, whether included in the following list or not, should not be re-designated an RV-3A.

1. The rear spar attach to the fuselage. Either the spar root or the fuselage center section bolt edge distance should be a minimum 7/16 inch.

2. All bolts specified for the main spar center section (within the fuselage) must be in place or the wing spar strength will not be at design level.

3. All rivets attaching the spar flange strips to the spar web must be in place as specified in a staggered pattern. Aligning any of the rivets in the two rows in a vetical line will reduce the spar strength by as much as 10%.

4. Substitution of larger than 1/8" rivets in the spar flange strip attachment will result in reduced strength. If a 3/16" bolt or rivet is substituted, a strength loss of up to 6% will result.

5. Construction of the spar with the outer dimension of the flange strips less than 6 3/8" will result in a loss of strength of 2% for every 1/16 inch of reduced spar depth.

6. The bottom center skin of the fuselage must be attached to the wing bottom skin by machine screws and plate-nuts as specified on the plans.

7. The Seat Step plates of .040 aluminum must be installed on the forward portion of the seat which attaches to the upper flange of bulkhead #3. This is necessary to add support to the spar center section.

FLIGHT LIMIT LOADS AND SPEEDS

Because each RV-3 is individually manufactured, limit G-loads and limit speeds must be established for it individually through flight testing. Any variation in structural or aerodynamic qualities of an RV-3 could cause its limit to be lower than the suggested limits which were determined for the prototype RV-3. Thus, the following are suggested limits, and should not be arbitrarily applied to any RV-3 without first determining through careful flight testing that it can safely withstand them. Undetected structural errors could cause any specific RV-3 to be unsafe if operated at these limits.

Never Exceed Speed: 210 mph Statute. This speed is to be determined through flutter testing up to a speed 20 mph above this, or 230 mph. Flutter testing is accomplished by exciting the controls (sharply slapping the control stick) at various speed incriments up to this level. The controls should immediately return, hands off, to neutral after such an excitation. If they do not, and show any indication of oscilating or fluttering, testing at higher speeds should not be attempted until a cause and cure has been found. Control flutter, when encountered, can be almost instantaneously destructive, so all flutter testing should be done at a safe altitude (5,000 ft. or above), wearing a parachute, and with pre-planed egress procedures. A recommended procedure is to excite the controls while the airplane is decellerating in a climb. Thus, a speed slightly in excess or the desired test speed should be attained in level flight or a dive, the nose pulled up smoothly, and the controls excited as the aircraft decelerates through the desired speed. Should any flutter tendency occur, there is a possibility that it will dampen itself because the speed is decreasing to a previously tested "safe" level.

Once tested in this manner, it should be reasonably (but not 100%) free of the possibility of flutter if the airplane is never flown in excess of 20 mph below man flutter test speed. Painting of the control surfaces can affect their flutter tendencies, so testing should either be conducted after painting, or should be re-tested after painting. Other flutter contributing factors are excessive paint or surface filler on the control surfaces which affects balance, irregularities in the shape and mounting of the control surfaces, free play or "slop" in the control linkages (including the trim linkage), and incorrectly bent trailing edges of the control surfaces.

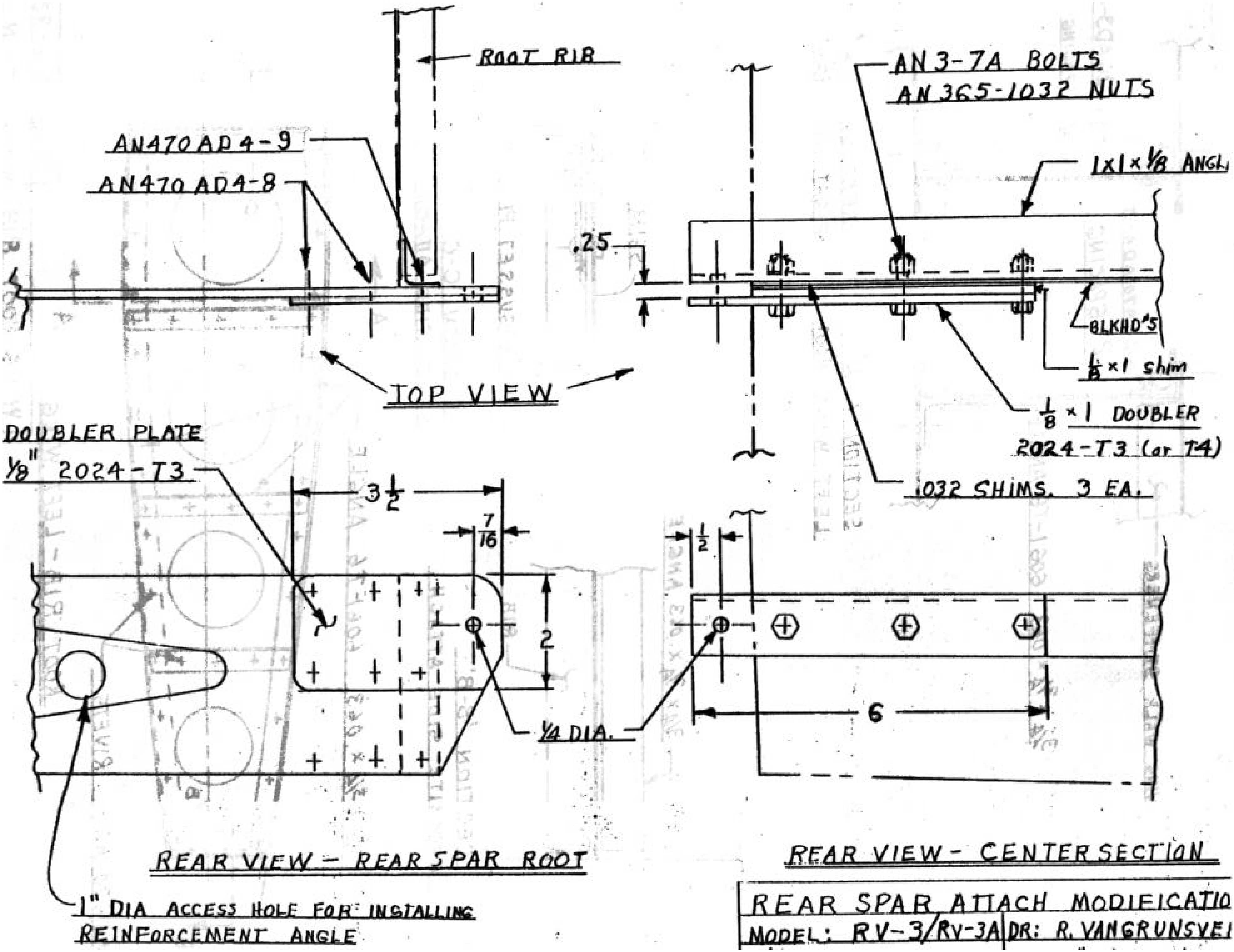
MANEUVERING SPEED: 127 mph statute. By definition, maneuvering speed is the maximum speed at which full and abrupt controls can be applied. It is also the minimum speed at which limit G-load can be produced. Thus, at any speed in excess of this, full control application could result in G-loads in excess of design limits. The maneuvering speed is function of clean stall speed. For aerobatic category aircraft, it is $\sqrt{6}$ x stall. Because the RV-3 has a low stall speed, its maneuvering speed of 127 mph is low, particularly in relation to its top level flight speed, and Never Exceed Speed. Based on the same formula used to determine maneuvering speed, full control application at 210 mph would produce a G-load of 16. From this it should be very obvious that at any speed above maneuvering speed, the pilot becomes the limiting factor: he can impose destructive loads on the structure through excessive control application. Because of it's high ratio of top speed to stall speed, the RV-3 is more susceptible to pilot-induced overstress than are most other contemporary aerobatic airplanes.

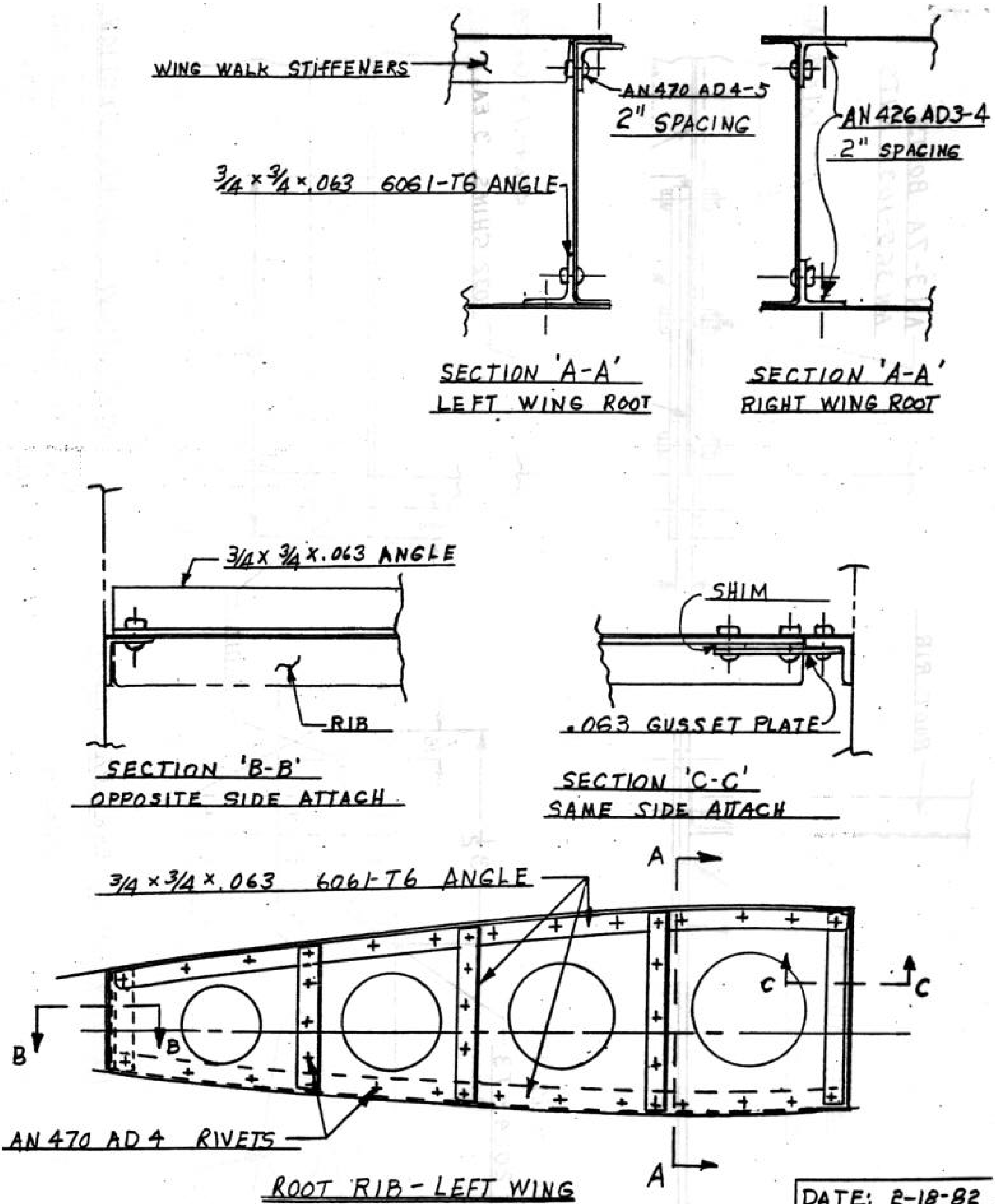
MAXIMUM G-LOAD: plus or minus 6 G's. This is the suggested never exceed G-load for an RV-3 flown at an aerobatic gross wt. of 1050 lbs. For operational gross weights above this, aerobatic maneuvers should not be performed. This also assumes that the RV-3 was built in strict conformity with the plans. Any variation in materials used, dimensions of primary structural parts, or workmanship standards, can cause a loss of strength and cause the limit load to be less than 6 G's. Examples of such factors are covered under INSPECTION POINTS.

As with flutter testing, G-load testing should be conducted systematically, progressing gradually to higher and higher levels. 6 G's is the highest level recommended in testing. This is the max load which the structure is designed to be able to withstand indefinately. While the actural calculated breaking strength is 9 G's, the structure is designed to withstand this load for only

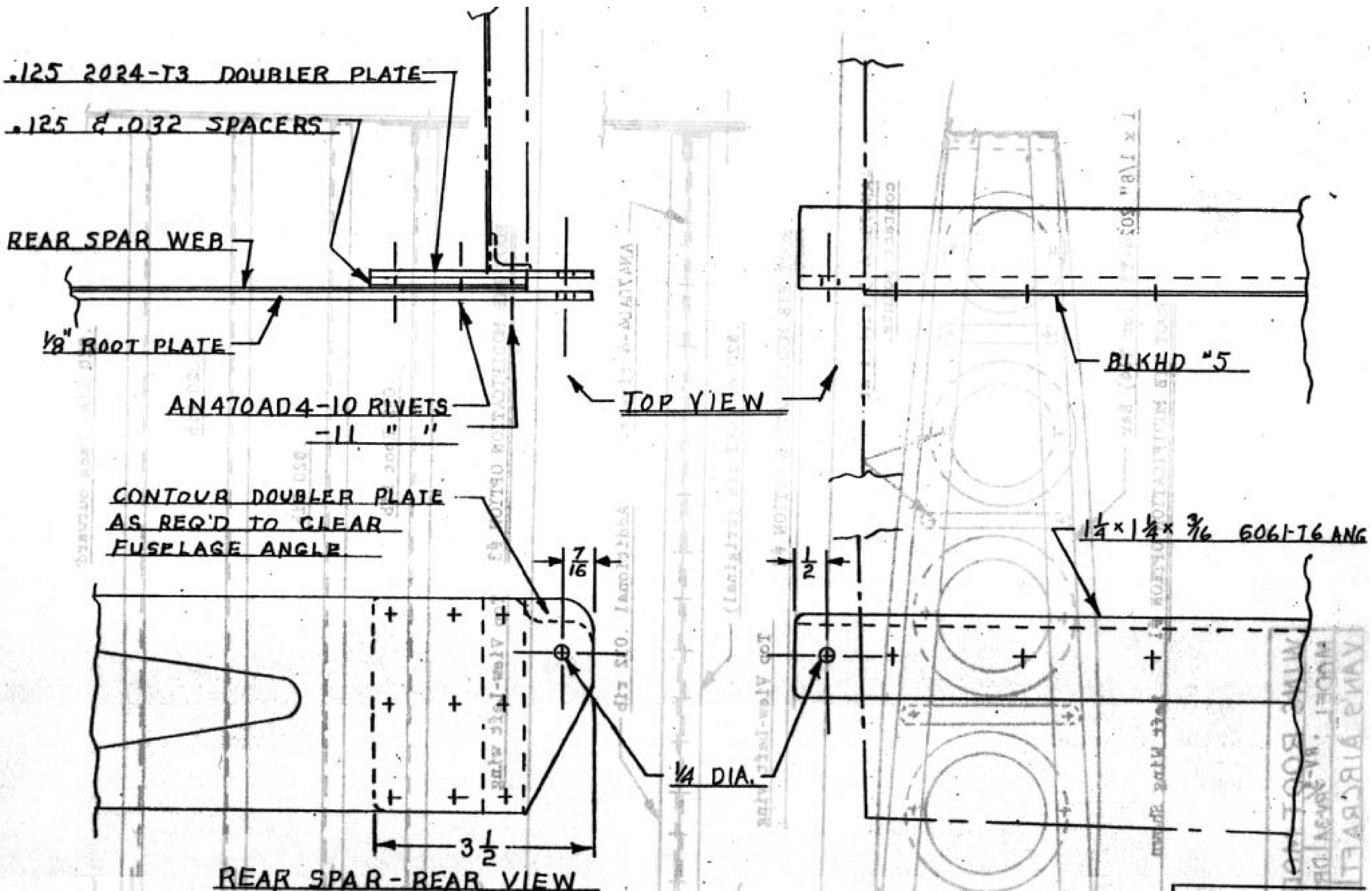
3 seconds. Approaching this load level could permanently weaken the structure even though failure does not occur. The margin between 6 and 9 G's is reserved to compensate for the effects of airframe detioration through aging, fatigue, material flaws, or construction errors. G-loads of over 6 should never intentionally be applied to an RV-3 structure.

Operation of a high speed homebuilt airplane, particularly in aerobatic flight, involves a certain element of risk. Proper testing will reduce the on-going risk to a minimal level. While such testing itself involves some risk, it can also be minimized through use of safety equipment and procedures.


ROOT RIB
AN470 AD4-9
AN470 AD4-8
TOP VIEW
.25
AN3-7A BOLTS
AN365-1032 NUTS
1x1x1/8 ANGL
BLKHD'S
1/8 x1 shim
1/8 x 1 DOUBLER
2024-T3 (or T4)
.032 SHIMS, 3 EA.
DOUBLER PLATE
1/8" 2024-T3
3 1/2
7/16
2
1/4 DIA.
1/2
6
REAR VIEW - REAR SPAR ROOT
REAR VIEW - CENTER SECTION
1" DIA ACCESS HOLE FOR INSTALLING
REINFORCEMENT ANGLE
REAR SPAR ATTACH MODIFICATIO
MODEL: RV-3/RV-3A
DR: R. VANGRUNSVEI



	DATE: 2-18-82
WING ROOT RIB MODIFICATION	
MODEL: RV-3/RV-3A	DR: R. VANGRUNSVEN
VANS AIRCRAFT	DWG: CN-1-2

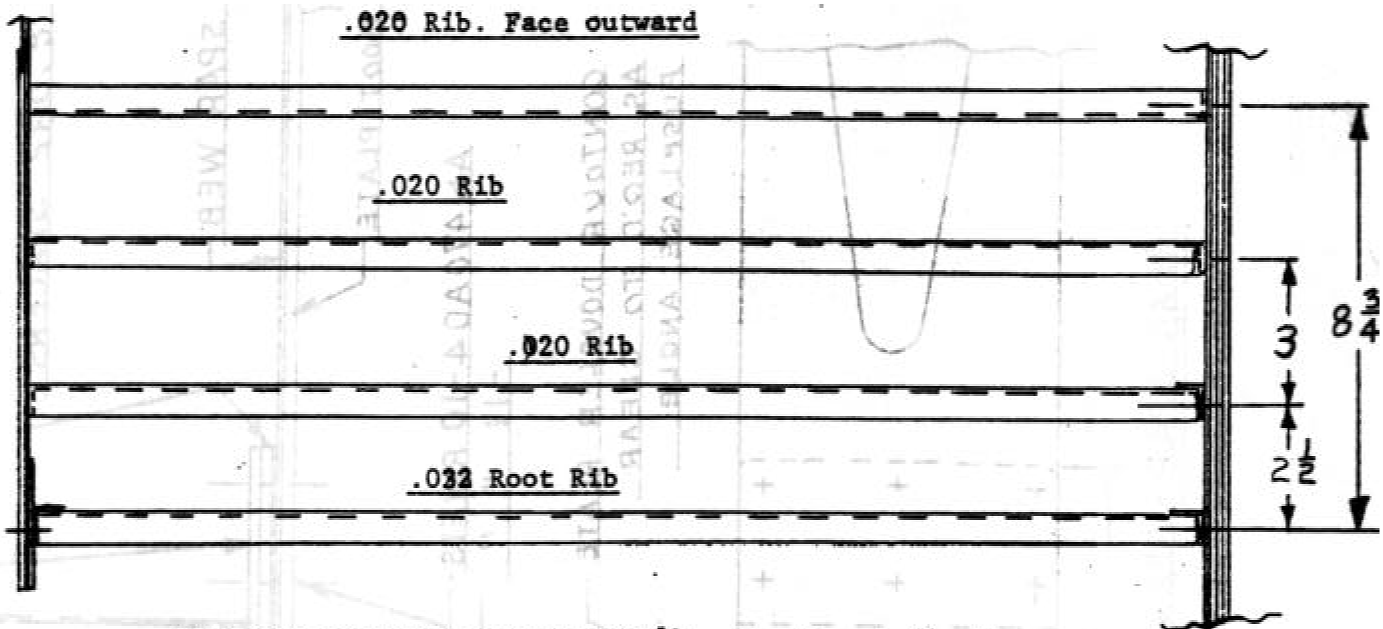


DATE: 2-18-82

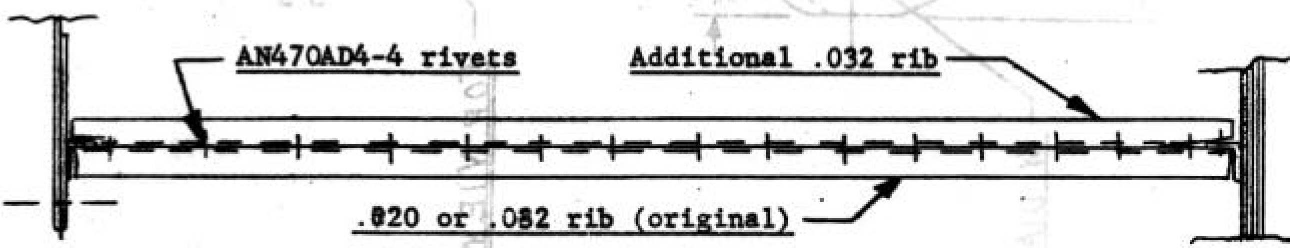
REAR SPAR ATTACH MOD.

MODEL: RV-3/RV-3A DR: R. VANGRUNSVE

VAN'S AIRCRAFT DWG # CN-1-3

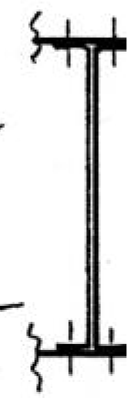


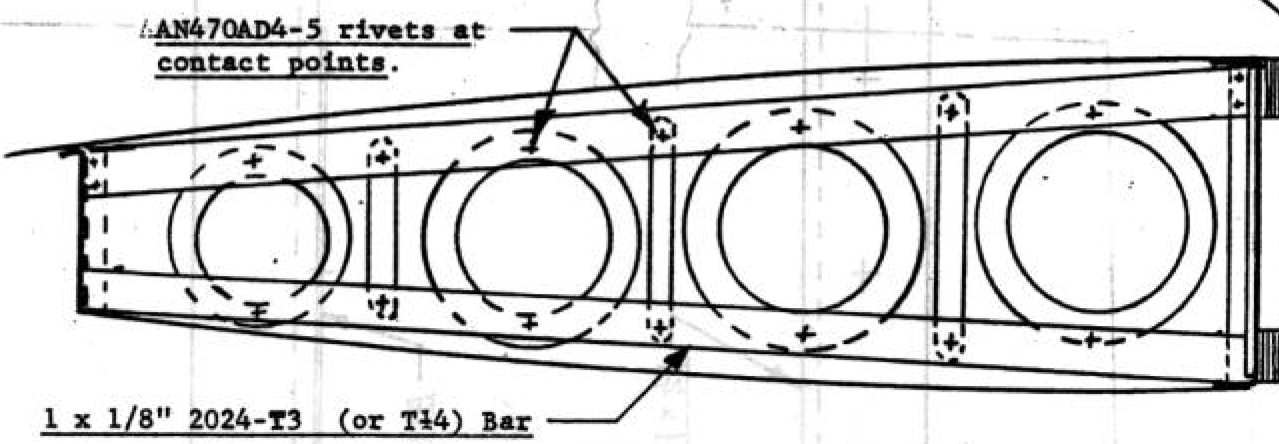
ROOT RIB MODIFICATION OPTION #3 Top View-Left wing



Top View-Left wing

ROOT RIB MODIFICATION OPTION #2





ROOT RIB MODIFICATION OPTION #1 Left Wing Shown

WING ROOT MODIFICATION	
MODEL : RV-3/RV-3A	DR: R.VANGRUNS
VAN'S AIRCRAFT	DWG: CN-1-4