Skybolt™
Aerospace Fasteners
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Vans RV Cowling Installation Featuring Skybolt's Newest VLoc™ Cowling Fastening System

Rev 8 August 15, 2011 US Patent Pending

History – In 1990, Skybolt installed one of the first ever Camloc® cowlings on our RV4. This RV4 became our test bed for another Skybolt original, the adjusting fastener receptacle that would allow one stud length to cover a wide range of panel thicknesses. Without this concept, we could have never sold the concept into this market. Although the Skybolt CLoc® system was more expensive than the hinge design, to date, we have never heard or read about any builder regretting the effort or expense. From Oshkosh to Sun'n Fun, Skybolt took our innovation to market beginning in 1993 and continuing through 2006 when we shifted our customer interactions to a forum venue. This customer interaction has helped us to better understand our own product as perceived by the builder. This has led us to what we believe is our best ever innovation to serve the emerging kit plane market. Skybolt may be a prominent name in fasteners for the Airbus A380 or the Army's latest and greatest MRAP or JLTV that protect our troops, but our roots remain where it all started, the Vans RV marketplace. We walk the Vans flight line twice a year to see how our product grows in acceptance; just like we watch NASCAR depend on Skybolt for the absolute lightest and best quality fasteners for all their cars; or how the NHRA depends on Skybolt products to protect drivers in 300 mph "track diversions". We learn. We innovate. And for 2011, we are unveiling new designs that make cowling installation and functionality better than ever. So much better, we feel that the hinge option may be something of the past. One has to wonder why Cessna, Beech, Boeing, or Airbus do not use hinge for their cowlings. Surely they would want the "clean" look or the cost savings. Only they know the end cost and it basically ends up spending a quarter to save a nickel. All said, we respect that the beauty of the builder market is choice. Vans designed this magnificent aircraft to fly for less than $20,000. Back in the 1980s, there may have been a Vans aircraft that flew for less than $50,000. Today, the popularity of the aircraft lends itself to much higher investment dollars. But what a tremendous bang for the buck in every new RV6, 7, 8, 9, 10 and beyond!

We are so convinced that this design will change the way a cowling is constructed, we applied for a US Patent to protect our devotion to our product and in the end, our customer. One thing is for sure, you can depend on Skybolt to be the *Rolex* of panel fasteners.

There are several builder choices for installing the cowling. These instructions assume a complete cowling installation using the Skybolt VLoc™ fastening system. Although some experienced builders may have developed an approach or process somewhat different than Skybolt, we acknowledge that there are several ways to achieve a common goal. The first and foremost objective is to define the objective.

1) Obviously, we would like to complete the cowling installation phase with perfection; something to be proud of.

2) Maximize utility. By selecting the Skybolt VLoc™ option, it is also obvious that utility, the efficiency of installing and removing the engine cowling is accomplished.

3) Insure that the fastening system is everything it is supposed to be.

Let us first address an issue that is unique to a fastener versus hinge: The chance of the cowling skin bulging in flight. The hinge is a continuous fastener; the VLoc™ fastener is a concentrated fastener in that the loads are isolated to the area of the fastener itself. All aircraft manufacturers have to deal with this. Look inside any production cowling, aluminum or composite, and you will either note a doublers spanning the cowling axis either at the fastener line or adjacent to the fastener line. The later allows for a much improved cowling trim with the airframe and accomplishes the same load carrying ability. Some older production composite or fiberglass cowlings simply used bulk as a substitute for doublers. The latest and greatest Vans cowlings or Sam James cowlings use much lighter materials bonded into the cowling skin that create good load carrying properties. Sam James uses a special capillary material that greatly increases structure without adding unnecessary weight. The evolution of the Vans cowlings plus the standard of 3-1/2 inch fastener spacing should eliminate any skin bulges in flight. If, for any reason a bulge was detected in flight, Skybolt can supply strips of the capillary material we call “Skybeam”. It can be added to the cowling at any time.

Before you begin –

1) If you are building a Vans aircraft, review the Vans installation instructions and drawings to note many references and similarities of mounting a VLoc™ cowling versus a hinge cowling.

2) We assume the engine is mounted. Otherwise it would be a bad gamble to assume the center of nose in respect to the engine and spinner.

The other important factor is to determine exactly how close the cowling nose is positioned to the immediate aft surface of the spinner bulkhead. This is for engine cooling issues. Too close and the spinner contacts and rubs the cowling; too far and it may lead to engine cooling issues. There are some excellent topics in this regard

available at www.vansairforce.com. By the time you have reached the "Finishing Kit" stage for the RV series, you are most likely familiar with the informative website. If you are building anything besides and RV, again, this site is jammed with excellent information. Skybolt suggests posts by

Rudi Greyling, www.RudiGreyling.com,

Dan Horton, regular guru on Vans Air Force

Darwin Barrie, www.jdair.com

Ivan Kristensen, http://ivankristensen.phanfare.com/2292606_4268126#imageID=690905 , to mention a few.

We will assume that you have determined the exact trailing edge of the spinner so that the cowling mounting process can begin.

Step 1 - Construct a mockup wooden flywheel/ring gear extension that will locate the most forward edge of the cowling and serve as support for the upper and lower cowling.

1) Level the wings.
2) Place the Upper Cowl into position and obtain a level reference between the two inlets.

Figure 1

3) Make a reference mark on the rear surface of the Upper Cowling extended aft of the firewall onto the fuselage skin.
4) Cleko the Upper Cowling, behind the firewall trim line, to a few locations where the fuselage skin and the firewall attach (3/32" rivet holes).

5) Position the lower cowling (trimming may be required for the landing gear) using a strap or an appropriate stand in order to center the air cooler scoop (not all aircraft), then drill and Cleko the rear of the Lower Cowl. Drill a hole in the face of the

Lower Cowling (to later fill) and anchor it with a long sheet metal screw.

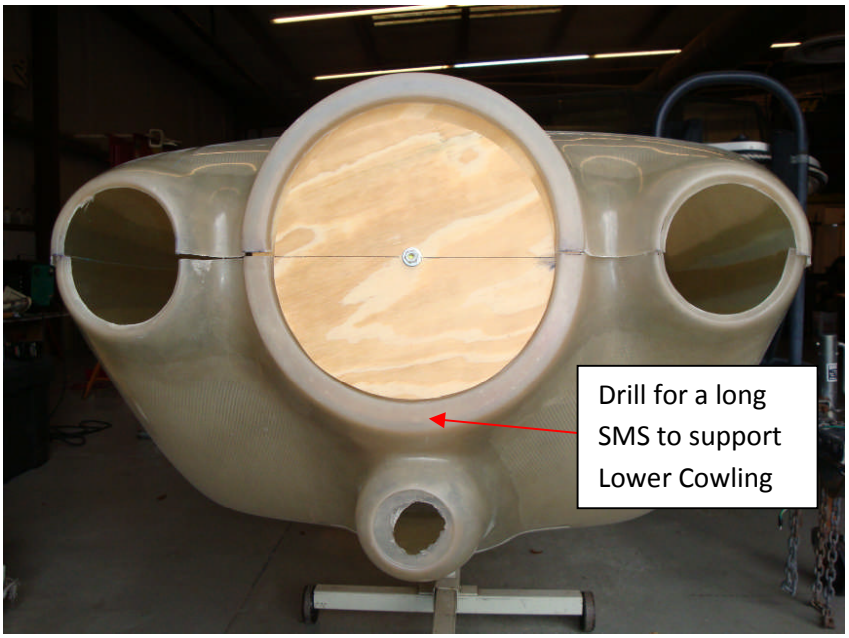


Figure 2 represents what you will be looking at. Use a die grinder to carefully remove material to achieve the desired fit.

Figure 3

Figure 4

Figure 5 represents initial trimming to establish the forward location of the side trim line. (Note: This RV8 mockup places the intake holes and spinner split on center. The hole split can be located off center as shown in Figure 6 versus centered in Figure 7

Figure 6

Figure 7

Step 2 - Scribe Firewall Trim Lines

Now that the forward split trim line has been established, we can move to the rear and trace the firewall trim line.

Figure 8

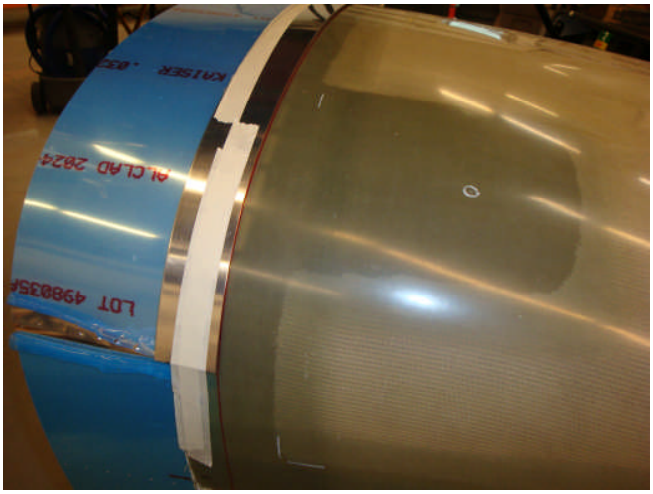


Figure 9

Looking at the cowling skins in Figure 8, it is obvious that a cowling split line has some leeway starting at the front working toward the rear. The firewall trim line, however is well defined. In Figure 9, I found that a strip of aluminum (sheared perfectly straight) is the best possible way of scribing a perfect line around the firewall. Note that the firewall has an 8 degree break adjacent to the fuselage skin break. Therefore the trim line changes angles at this point. For obvious reasons, I was very conservative on locating these lines. My plan is to make the first cut, then check all the lines again followed by smaller cuts until the trim line appears to be a perfect fit.

Step 3 – Determine the Cowling Split Line

The forward most split location is now defined. To determine to rear split line, a couple of thoughts come into play:

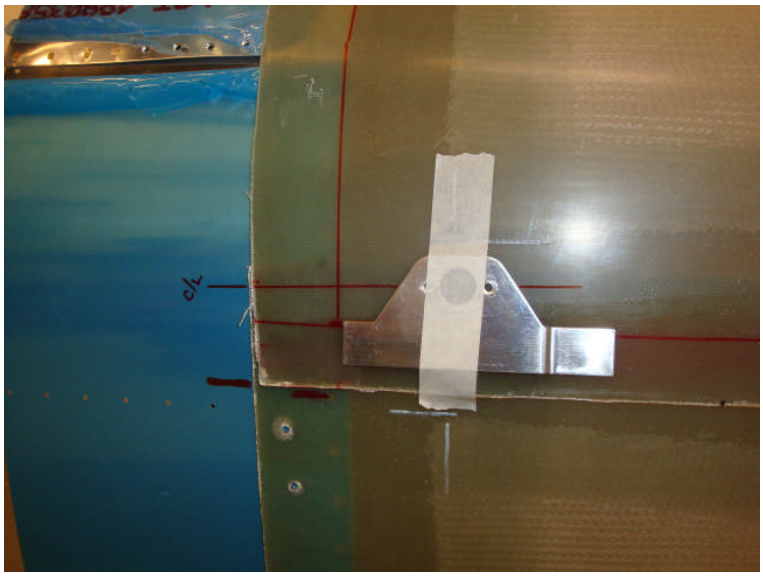
1) Note the inner doubler material clearance relative to the perceived location of the split line flanges (the flanges along the sides).
2) The rear most fastener flange is really a firewall flange if we plan it correctly. This should give the most cowling support where it is needed. Looking ahead, Figure 10 illustrates what we want to achieve:

   Ideally, this flange (labeled FSF-L (Firewall/Side Flange-Left) ends up perfectly in line with the side mounted flanges.

Figure 10

So for planning, we need to determine an approximate rear split line. With wings level, mark both the right and left sides as shown in Figure 11. Scribe a line forward to the nose.

Figure 11



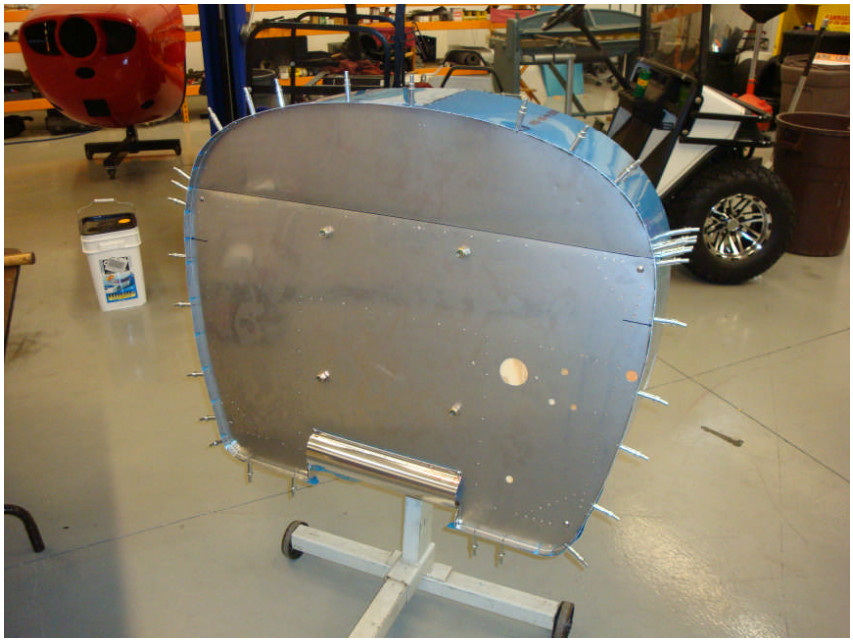
Position a flange so that the top of the tabs are about .230 to .250 above the scribed split line. Then scribe a line rearward to indicate a centerline of the fasteners along the side. (C/L)

Figure 12

Remove the cowling skins in order to install firewall flanges.

Step 4 – Firewall Flange Installation

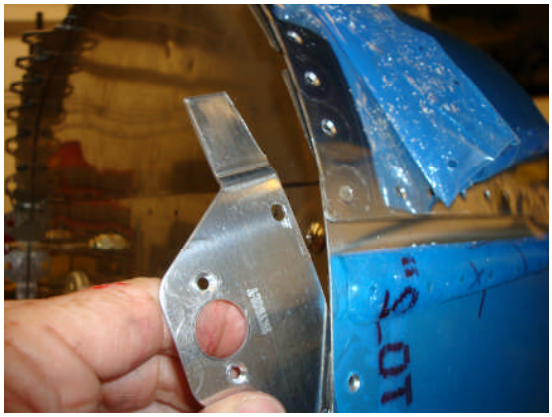
First, countersink all flange rivet holes.



In this photograph, there are 4 small screws located where the engine mount bolts to the firewall. As the mounts are installed prior to installing the cowling, I will simulate the engine mounts and plan my flanges accordingly.

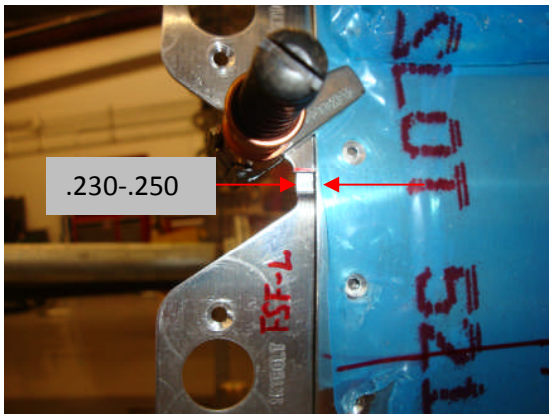
In the previous step, we determined where FSF-L and –R will be located. Then, beginning with the Upper Engine Mount, we can determine the next obstacle.

Figure 13



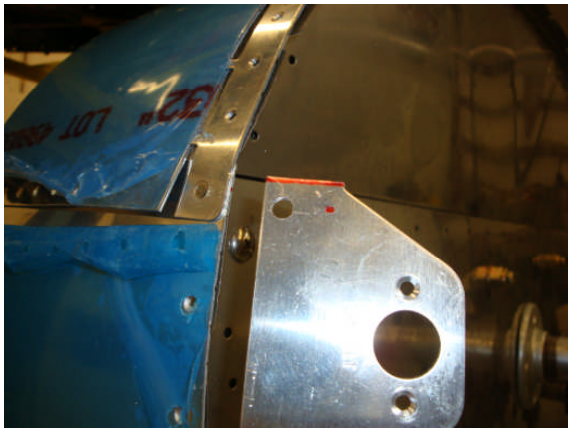
It is very easy to experiment with various flange spacing in order to achieve a target of 3-1/2 inch spacing as we work our way upwards from FSF-L and R. Some adjustment for engine mount clearance is easily accounted for.

Figure 14



Plan to leave some adjustment to FSF-L and R as noted. There is a good chance that the C/L mark may change ever so slightly once the actual split line is cut and the skins come together. With some allowance for up or down adjustment, we can keep the flanges in alignment. Also note approximately .230-.250 tab spacing from the firewall skin. You will find that good eyes can set this throughout the cowling very efficiently. Measuring never hurts if in doubt.

Figure 15



If you riveted the skin as shown prior to installing the engine mount, simply cut a relief hole in the flange at this location.

Figure 16

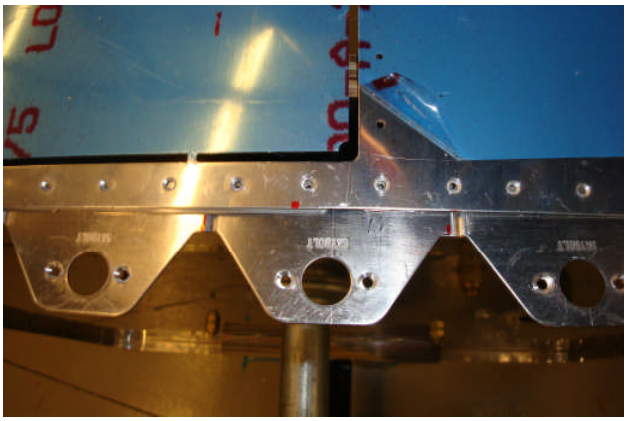
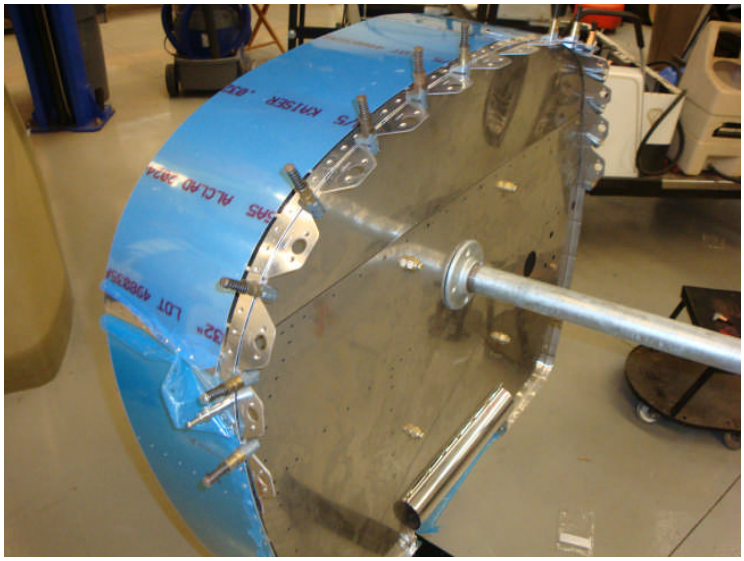


Figure 17

Figure 17 shows the top center flanges. For spacing, note that the end tabs have been cut, thus the spacing at the top center was reduced to 3.0 inches.



The top flanges are ready for riveting (except for FSF-L and R).

On to the lower portion and bottom, use the same logic as the top. The lower engine mount defines the starting spot. I chose to work from the bottom flanges and work my way back towards the top.

Figure 18

Figure 19

The firewall flanges have been positioned and riveted. **Figure 20**

Step 5 – Trimming the Cowling

I used a die grinder with great success. I also had the luxury of a fork lift to elevate the cowling for a comfortable handle on trimming a straight line.

I began with the Lower Cowling Firewall first. It took 3 or 4 trips back to the grinder before I was happy with the trim and the firewall skins mated quite nicely.

Now that the firewall trim line has been cut, the next challenge is how to support the cowling to check fit.

Figure 21

Skybolt has included Cleko adapters for this purpose, **SK-RVCI**. The idea is to only drill a 1/8 inch hole in a couple of places to secure the skins so that accurate hole location can be established. To secure the Lower Cowling, it is easy. For the Upper Cowling, tape the adapters in alternate holes, drill the tape and install the cowling and Cleko.

Figure 22

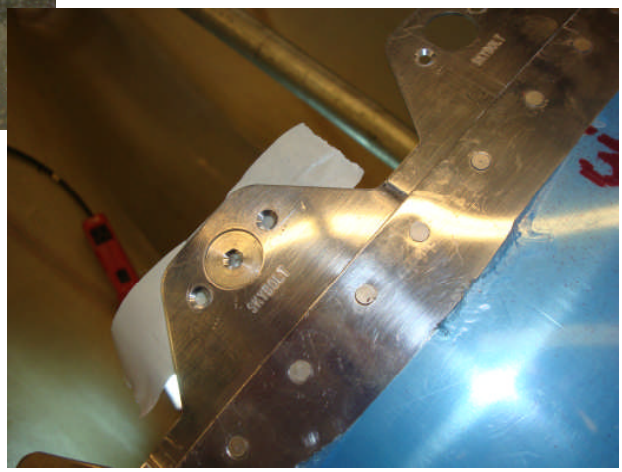
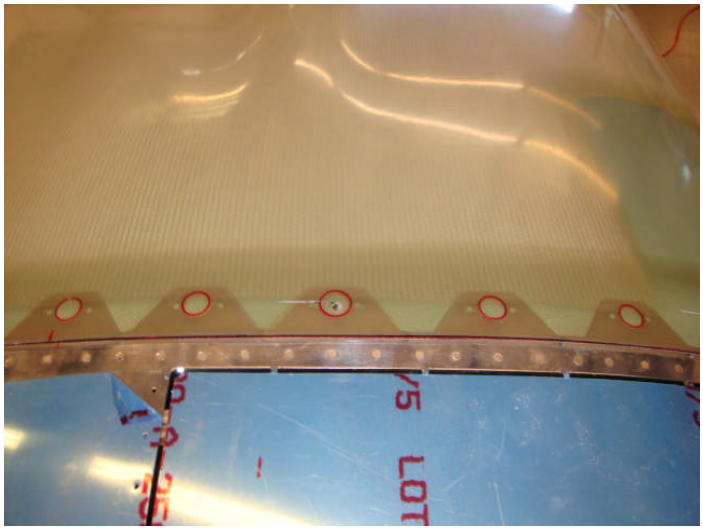


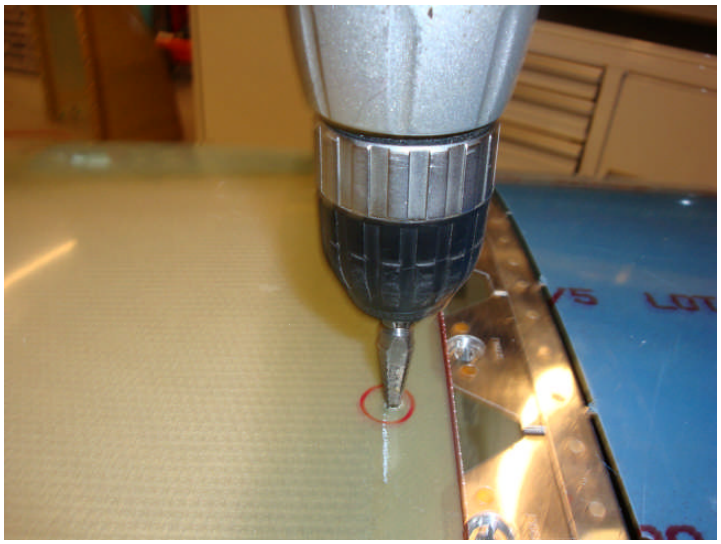
Figure 23



You may find that a light inside either helps or hurts in sighting the center holes. Either way, carefully trace each center hole. Cleko alternate holes to insure that the skin is drawn down onto the flanges.

Work from the top toward the sides.

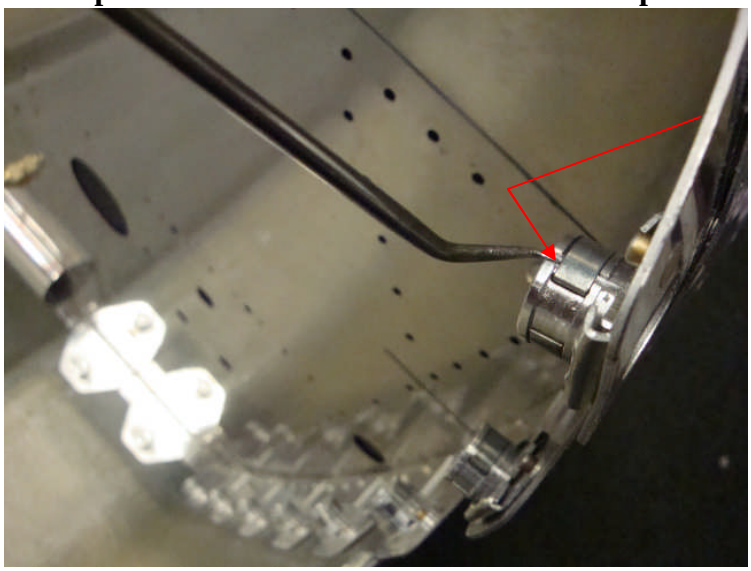
Figure 24



Using the Unibit-1, drill the marked holes to ½ inch. Stop every 2-3 steps to determine center. You can "walk" this drill to find center prior to the last step

Figure 25

Step 6 – Install SK215-4 and SK245-4 Receptacles



Be certain to orient the antilock pins toward the outside (forward around the firewall; up along the sides) for access to the locking clip. Once the pins are removed, a curved pick tool is inserted in the same groove as the pin to raise the locking clip allowing adjustment of the insert.

Figure 26

Note: This kit includes 6 each SK245-4 floating receptacles. I used them in the Upper Cowling, three each in the lower rear corners. This will allow some adjustment of the rear cowling skin so that a good trim line is maintained. Some slight movement of the cowling is allowed to find this fit prior to locating the side mount fasteners. Once they are located, the cowling becomes rigid.

Rivet all firewall receptacles with MS20426AD4-4 rivets.

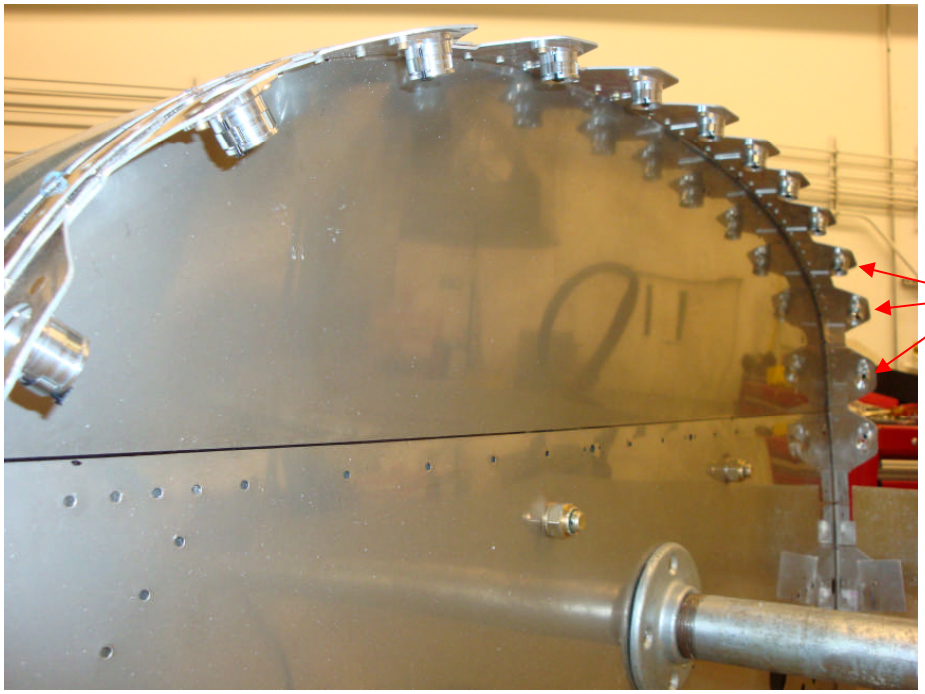


Figure 27

SK245-4 Floating Receptacles

Install SK-OS Grommets.

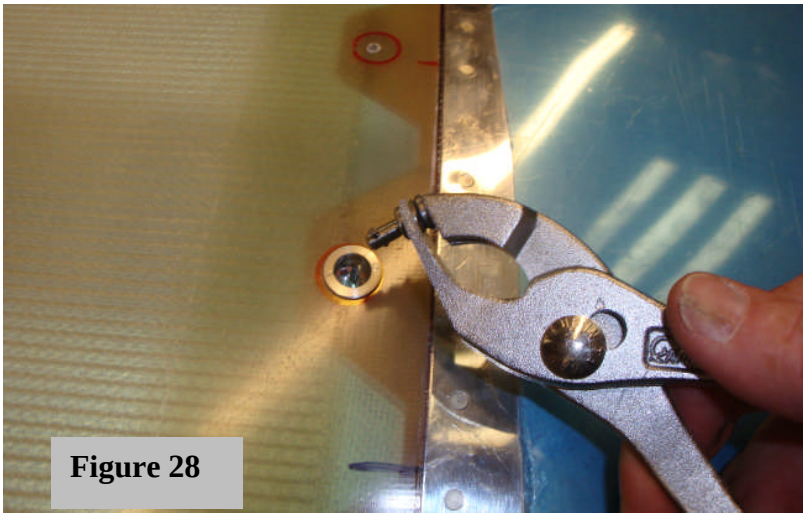


Figure 28

Note: Normally, we install the grommets then retainers, then the studs as shown. The R4G retainers install very easily with the Skybolt SK-T26 tool. But for painting, to remove the grommets, it can be cumbersome to remove the retainers. As the grommets fit relatively snug in these skins, you might consider not installing the retainers until after painting.

Tip – To install studs with 4P3 Pliers, turn the stud 90 degrees as shown in Figure 28. Also align the pin with the insert slot as viewed through the grommet center hole. This makes initial stud engagement so much easier.


Figure 29

Engage the studs into the receptacle noting that the stud is locked but loose. Continue turning as if the stud is a machine screw. The antilock pin will allow the insert to turn thus drawing the stud down to the proper flush-locked position. To gain access to the pin, you must unlock the studs and remove the cowling. To unlock, use a sharp push-turn motion that should unlock the stud with little disturbance of the insert. With the cowling removed, pull all antilock pins.

Using a flat blade screwdriver (See Figure 30), turn each insert to the 1:00/7:00 position and you will see/hear the locking clip lock the insert.

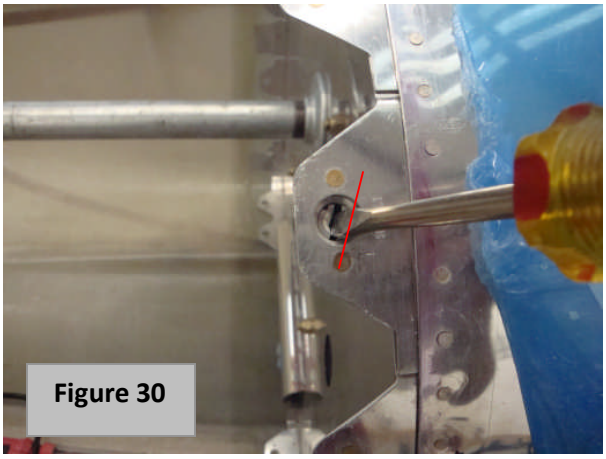


Figure 30

Install both cowlings and lock all firewall fasteners. Recheck both side split lines.

1) Cut the Upper Cowling Split Line
2) Reinstall Upper Cowling and lock all fasteners.
3) Scribe the Lower Cowling split line.
4) Remove both Upper and Lower Cowling and cut the Lower Cowling split line.

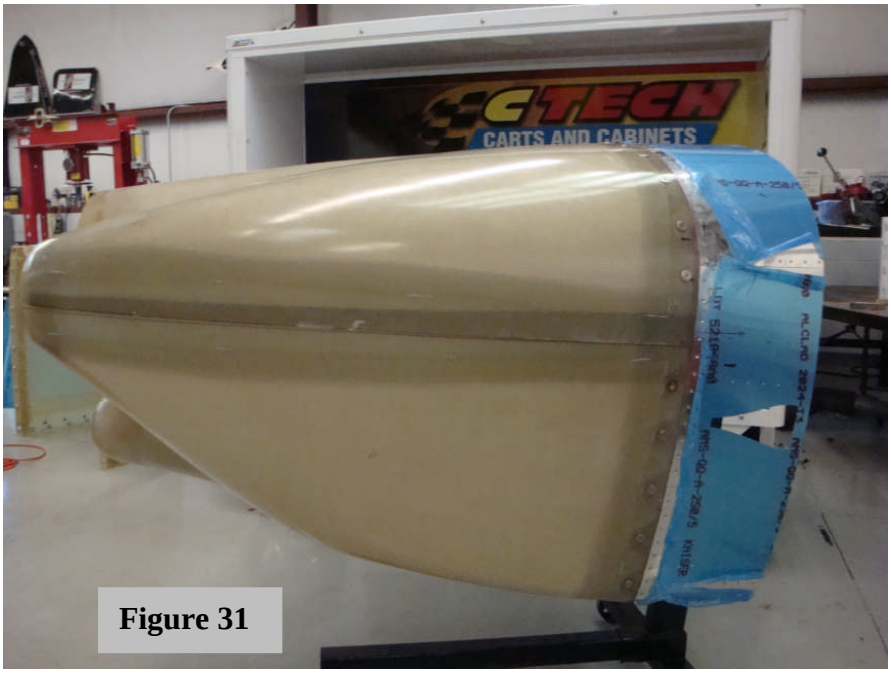


Figure 31

Install both Upper and Lower Cowlings noting that all trim lines are to your satisfaction. Chances are only you and the Grand Champion Judge will ever know a minor error.

If any portion of the firewall trim line has more than about .040 gap, try shifting the cowling to eliminate this gap. The floating receptacles will allow this.

Step 7 – Install Side Flanges

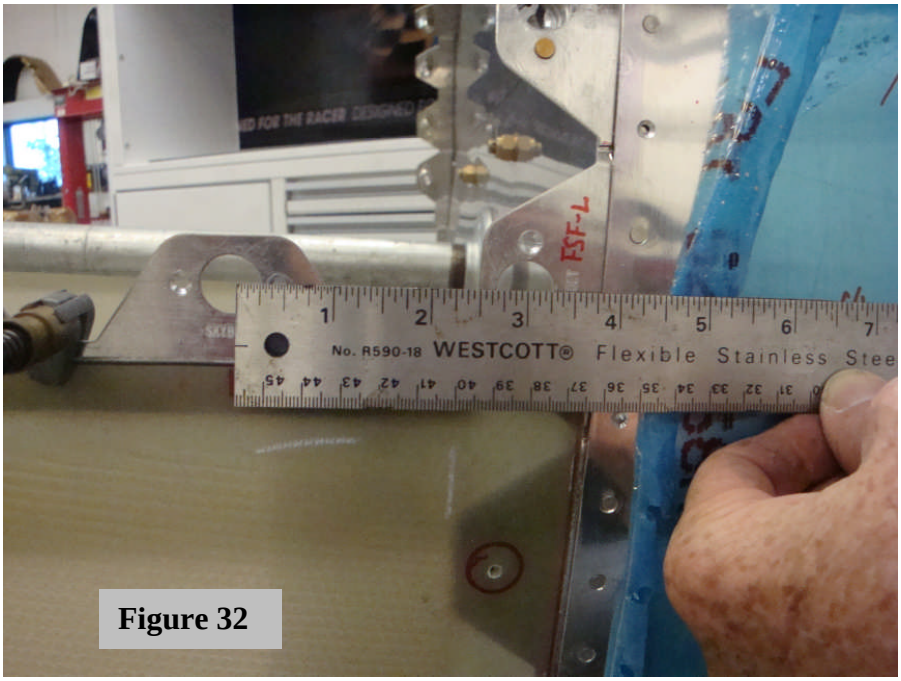


Figure 32

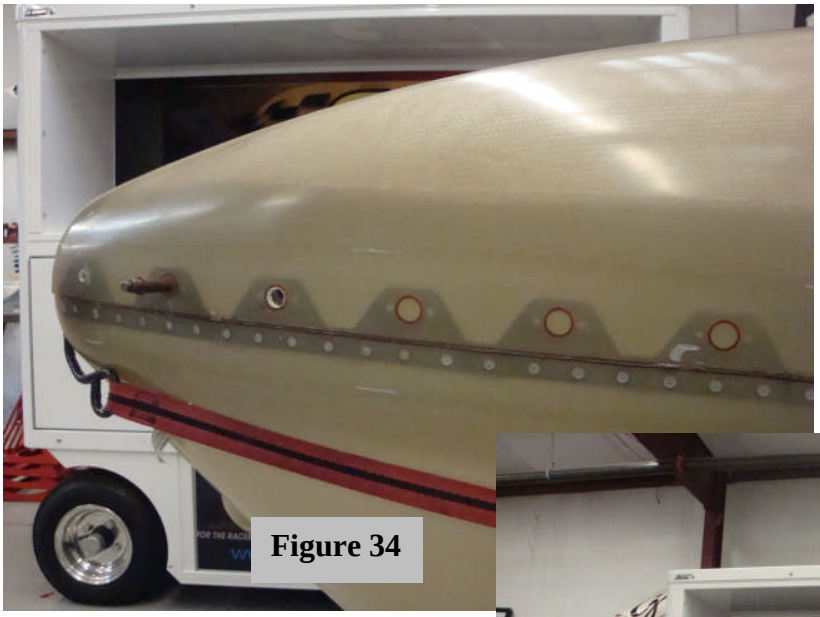
Begin with the rear flange. Position the rear side flange 3.0 inches from the center of FSF-L(R). Adjust FSF-L(R) to align and rivet it to the firewall.

Move forward with each flange; as far forward as practical. In the case of the RV 8, 3-1/2 inches worked out perfectly.

Another consideration unique to the RV8 is the IO390 Angle Valve Engine. The rocker box covers come very close to the cowling sides. Adjust receptacle spacing to not interfere with the covers. If a receptacle is close to any rocker cover, place a sized neoprene type hose over the receptacle to provide a buffer.

This drill jig is the absolute best for locating and drilling side flange holes. Once drilled, I made a deep countersink so that the rivet heads can be filled with paste; sanded; and painted.

Figure 33



I ended up with a slight gap at the lower left rear. By shifting the cowling, I closed the gap nicely.

Mark and drill all side holes to ½" as before.

Remove Upper Cowling and install SK215-4 receptacles.

Figure 34

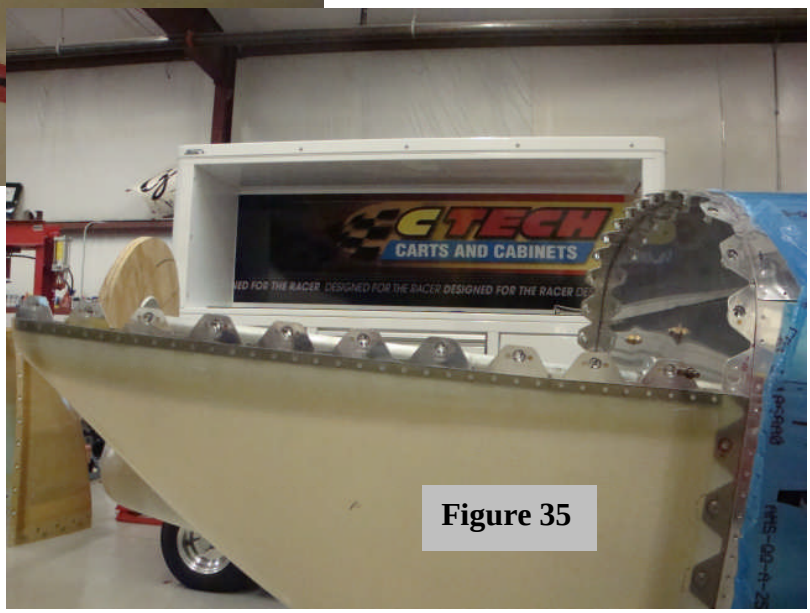


Figure 35

Install Upper Cowling. Install grommets and studs as done previously. Adjust as noted in previous steps. Remove antilock pins; set inserts; install cowling for the last time (not really); and MARVEL!

Figure 36

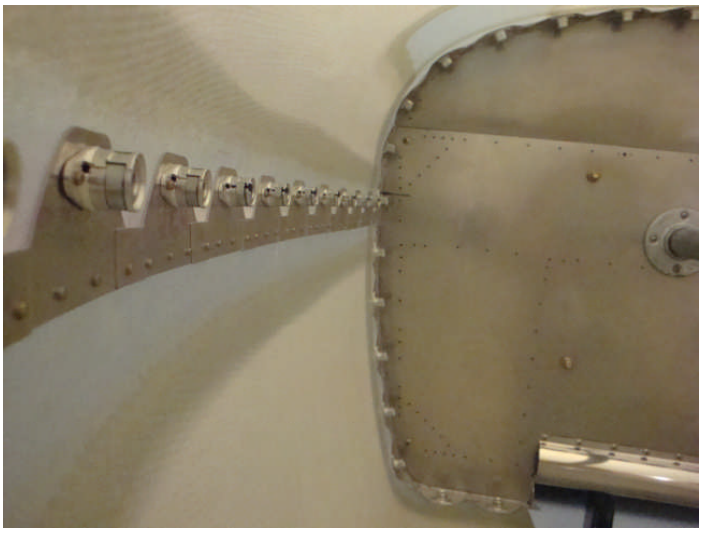


Figure 37

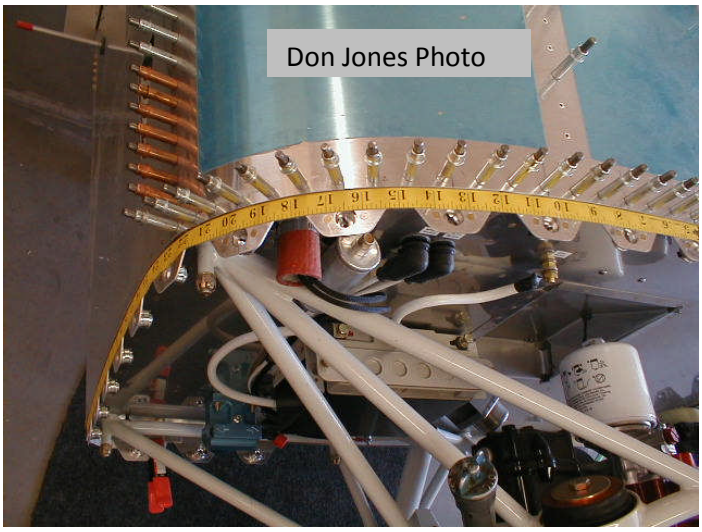
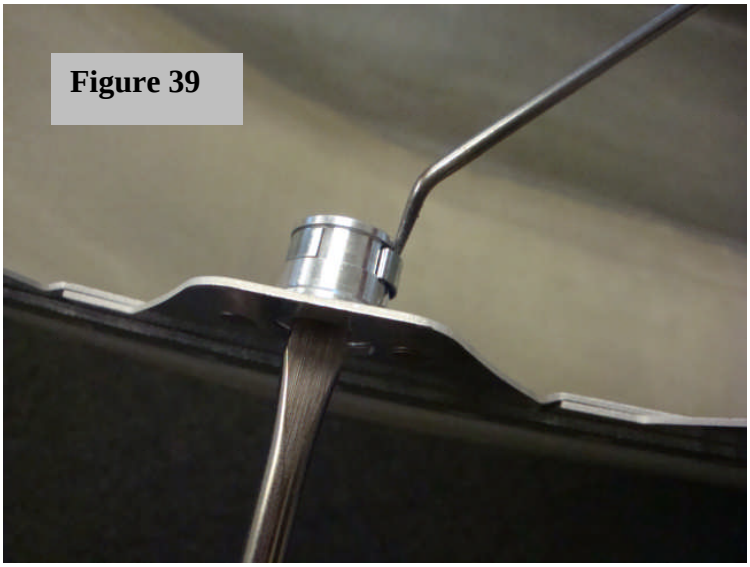


Figure 38

Step 8 – Re-Adjusting the VLoc™ Adjustable Receptacle (after initial adjustment and pin removal)



The easiest method of re-adjustment is with a curved pick tool (part of any pick tool set). It allows access in tight spaces and is much easier to use than a straight pick tool.

Locate the locking clip tab (the reason we orientated the receptacle in Step 6, Figure 26). Insert the pick and lift the tab, unlocking the insert, adjust with flat blade screwdriver. One half turn adjusts the fastener .015; one full turn adjusts the fastener .030; the equivalent of a stud dash number.

Comment: Critiquing the final installation, having checked the cowling skin thickness prior to installing the flanges; and noting the Vans instructions referencing an optional .020 shim between the flange (hinge) and the firewall lip; because the skin thickness varies from .005 to .030, it is almost easier to think about placing a .032 shim beneath all the flange mounting surfaces. Then, shim the top surface of the flange where it mates with the cowling skin by a flange by flange basis. One easy way of shimming the flange to skin surface is with aluminum HVAC tape available at any ACE/Home Depot/Lowes store. This will provide that final touch of perfection. For the RV8, there is no need for a shim between the mounting surface of the flange and the firewall because of the baggage door strip (F-821B). This increases the allowance for all tolerance variations for the cowling skin; for the thinnest variation, it is easy to add shim material to the flange surface.

For the cowling nose, the VLoc™ fastener will work if not retained (you remove them to prevent hang up when attempting to install cowling). Because of the high load area, many production aircraft use Platenuts and machine screws for maximum clamp force. Vans instructions briefly describe this installation.

For the Oil Door, we suggest doing a search on Oil Doors on www.vansairforce.net. There are many suggestions on how to install the Oil Door including various “Kits”.

Skybolt wishes to thank all Vans builders for their support, input, and suggestions.

Vans RV4 Supplement

The RV4 has a “Cheek Cowl” that presents challenges for the hinge fastening system, but lends itself ideally for the Skybolt VLoc fastening system. Although the traditional side hinge used an extended pin to lock into the cheek cowling, aerodynamic stress loads at the cowling split and at the sharp angle between the firewall and the cheek cowl are testimony that an improved fastening design is appropriate. The RV4J-C1P-C and RV3J-C1S-C kit includes 8 fastener sets to properly fasten the cheek cowl.

As there are options as to how to mount the SK245-4 Receptacles, note that the Levold photograph removed the fiberglass end piece and installed a fabricated flange (prior to the SK-RVFS1 flange design).