

My buddy Fred made the vent line for the left tank. Now it's time for the right tank so this was my first experience with bending, cutting and flaring aluminum tube.

The vent line is 1/4inch and is still relatively easy to manipulate and bend.

First step, unroll the vent line and try to make it as straight as possible. The tube comes coiled up so you need to unroll gently.



Then you cut it to length. Cutting aluminum tube must be done with a tube cutter tool. A hack saw is too aggressive for this work. The cut needs to be really smooth to make sure that the aluminum does not create cracks when performing the flaring operation.

Position the tube cutter on the aluminum tube to cut. The wide support in the bottom of the tool goes on the part of the tube you want to keep.

To cut a tube, put first light pressure of the circular cutter wheel to the tube (light pressure) and rotate the tool gently. When you return to the original position, the cutter should be back in the same location where it started (low quality cutters may have difficulty doing that when the wheel is able to swivel a bit).

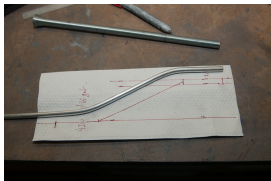
Once rotated, give the black knob a half turn and rotate the tools again once or twice around the tube. You will feel the pressure get less. As it floats freely, give it another half turn. Repeat this until the cut part falls off.

In preparation of flaring, use sandpaper on a block to sand perpendicular on the tube. Also deburr the edge in circular turns (no scratching along the length of the tube but circular around the edge). This will allow clearance for the sleeve later on.

Don't forget to deburr the interior of the tube. You will be surprised about the difference in radius in the tube before and after. (putting pressure while cutting can make the radius smaller by burr building).

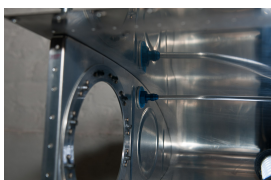
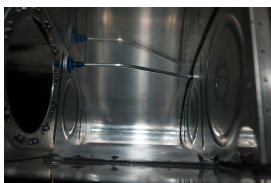


Then you need to bend the vent line for the offset from the predrilled hole and the position where you put your vent line elbow in the outerrib. I made a drawing on paper how I wanted it and then bent the tube using fingers and bend-sleeve.



Then installed the line in the tank and clecoed the inner rib in. Surprisingly, this did not need a lot of tuning.

You can easily adjust the bending while the tube is in the tank. Important here is that there is a close match between the nipple of the AN833-4D elbow and the tube. There should be no tension at all or otherwise said, you should not have to pull the tube to get the tube on the nipple. Tension may lead to stress and cracks. Maybe not as critical with this vent line but life-critical when working on the fuel lines. So you better get it straight from the first time. You see what I mean in the next two pictures.



Next picture gives a better idea about the offset of the vent line. Also look at the inner diameter of the tube. This one is nicely deburred. If your's is smaller, you forgot to deburr.

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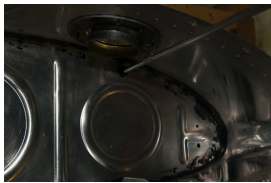
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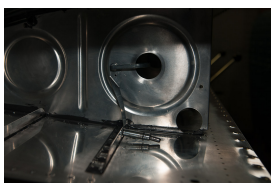
Then moved on to create a new vent clip. This little piece of aluminum has to be constructed from .025 scrap aluminum. Make a nice bend in it. Nothing is critical here. Just make sure the tube sits tight in the clip and that the clip is aligned with the line of the vent tube.



Next step, drilling the reinforcement plates that go in the nose of the outer ribs on the rib. I installed the rib, held the plate on the inside and marked with a line the position of the reinforcement plate. Then remove the rib and repositioned the plate along that line. Then clamped and drilled #30.



Made the anti hang up guide for the inner rib. I actually made an inverted copy before from the one in the left tank. So this was easy. Drilled #30 and installed them using a LP4-3 pop rivet.



Secured the nut on the AN833-6D elbow for the fuel line on the pickup tube according to vans service bulletin. Things were a bit different as with the left one. The nut holes for the safety wire here ended up on the other side then with the left one. Therefor, I had to 'go around' with the wire to be able to get the locking function on. Make sure you check twice on the direction here. You want the safety wire to lock the nut when you loosen it, not when you thighten it.

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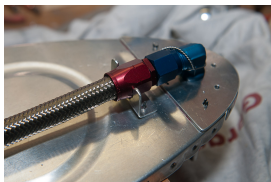
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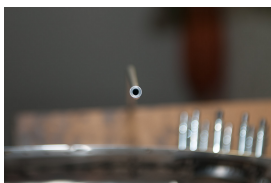


Installed the anti rotation bracket for the flop tube and drilled it's holes #40 and dimpled the two holes in the rib. Countersunk the holes on the bracket.



After a lot of reading, research and discussions, I finally got to the point of making a flare myself.

The picture below shows a nearly perfect flare. I had to restart it 3 times before I finally got it in my fingers. There was also a bit of dirt on the rollo flare tool head so I had some markings on the inner aluminum extrusion. Again probably not critical for the vent line but I wanted things to be perfect so restarted until it was good. If you are wrong, cut it off after the flare and restart. Just make sure you have enough length left for the length that has to go in the rollo tool.



The question is, 'how much is enough, and how much is too small'.

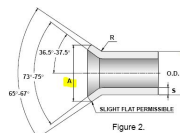
I discussed this with various people and finally came up with the following theory.

The width of the flare had to match the width of the widest point of the sleeve that goes over it. I tested this and then found the table below online. When I measured it, I found indeed the same numbers. You'll get the catch in the pictures below.

In the table, you see the width in mm of the diameter for the outer borders of the flare.

There are different numbers for the fuel line 3/8 then for the vent line 1/4. I marked the numbers in the table below for the vent line.

## Assembly Instructions



Perform flaring according to SAE J533. See Fig. 2.  
See Table 1 below for dimensions.

Table 1: Flaring

| Nominal<br>Tube<br>O.D. | A<br>Single Flare Diameter |      |       |       |       |      | R     |      | S   |     | Deburring prior to<br>flaring                                                                                                                                                                                                                                              |
|-------------------------|----------------------------|------|-------|-------|-------|------|-------|------|-----|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                         | Inch                       |      | mm    |       | mm    |      | Inch  |      | mm  |     |                                                                                                                                                                                                                                                                            |
|                         | Max                        | Min  | Max   | Min   | ±0.02 | ±0.5 | Max   | Min  | Max | Min |                                                                                                                                                                                                                                                                            |
| 1/8                     | 0.20                       | 0.18 | 5.08  | 4.58  | 0.03  | 0.8  | 0.035 | 0.88 |     |     | To assure producing satisfactory<br>flares, it may be necessary to<br>perform deburring operations on<br>the tube end prior to flaring.<br>Smoothly breaking the inside<br>corner before single flaring<br>ferrous, and some non-ferrous<br>tubing is normally required to |
| 3/16                    | 0.28                       | 0.25 | 7.11  | 6.81  | 0.03  | 0.8  | 0.035 | 0.88 |     |     |                                                                                                                                                                                                                                                                            |
| 1/4                     | 0.36                       | 0.34 | 9.14  | 8.64  | 0.03  | 0.8  | 0.065 | 1.65 |     |     |                                                                                                                                                                                                                                                                            |
| 5/16                    | 0.43                       | 0.40 | 10.92 | 10.16 | 0.03  | 0.8  | 0.065 | 1.65 |     |     |                                                                                                                                                                                                                                                                            |
| 3/8                     | 0.49                       | 0.45 | 12.44 | 11.59 | 0.04  | 1.0  | 0.065 | 1.65 |     |     |                                                                                                                                                                                                                                                                            |

Now how to you use the rollo tool to make a flare ?

I could describe it here in detail but there is a very good video shown at EAA video's at <http://www.eaavideo.org/video.aspx?v=3727487ut001>

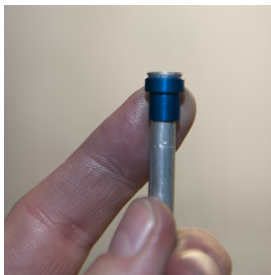
I got the right diameter with about 8 half turns of the arm of the flare tool.

I eye-balled it when making the flare and then tested with the width of the sleeve. When I measured it later on I found that I had indeed the minimum required diameter.

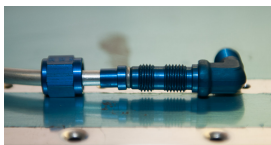
I got the right diameter with about 8 half turns of the arm of the flare tool.



The picture below shows the same flare with the sleeve on. That's how it should look. Notice the outer edge of the flare is nearly equal with the outer edge of the blue sleeve. If I would go little wider, I would be equal to the sleeve and possibly be very close to .350 which is the ideal width.



Below you see how it looks like when you hold this sleeve on the nipple of the AN833-4D elbow.



Then attached all back on the tank and re-matched the fit. Perfect !



On sunday, I got back to rivetting on the fuel tank. I had two more ribs to do on the outside.

I took some more pictures for the beginners with sealant. This is more or less how it looks like when your rib is inserted and put in place with cleco's.

On the outside ribs, the sealant should ooze out of the flange. You can nicely see it here in the picture. This is about the perfect quantity.



I used the squeezer to set all those rivets. Then Peggy helped me with shooting the 1/8 rivets in for the reinforcement pieces in the end of the nose. The ones on the fuel cap side are really a pain as you can

hardly see, light and buck in there at the same time. I ended up using the next next length rivets for the outboard side plate. Probable used a little too much sealant in between so the heads were a little short at first. The remaining 5 were at longer lengths and more then sufficient.

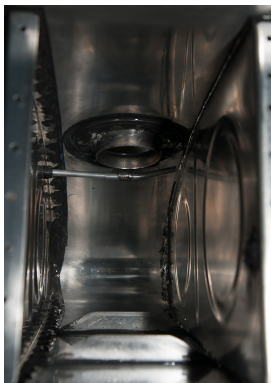
Same on the inboard side. Here we had to install the reinforcement angle that holds the front of the wing to the fuselage and which is also the place where the fuel comes out through the AN833-6D elbow as shown in the picture below. Applied lots of sealant as these are the places where most people encounter leaks when testing.



All installed on the inner rib



Fuel cap installed and fuel vent line bend up. The rivetting of the fuel vent clip went much easier on the right rib.



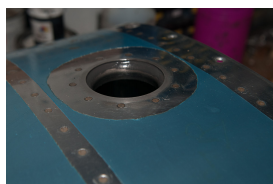
Fuel cap cleaned top side.

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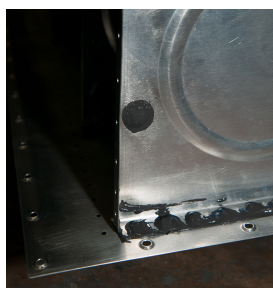
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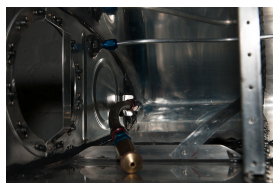


Covered up generously all rivet heads with sealant. In the picture you also see the blob over the AD6 rivet that covers up the tool hole in the middle of the rib.

Use electric tape when rivetting, this will produce the nice line as you see in the picture. It is virtually impossible to do this without taping and you will have hours of cleaning work after.



Inside view in the first bay after installation



close up on the flop tube front of the inboard rib. (fuel pickup-

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Installed the drain valve inboard. This time also used small strips of electric tape to ensure openings between the blobs on the rivet heads so water can float to the lowest point.



Again the vent line in the fuel cap.



Next mission is closing the tanks. But now I'm off to Chicago again for two weeks. Work will continue after that.