Testing Rivet Shear Strength

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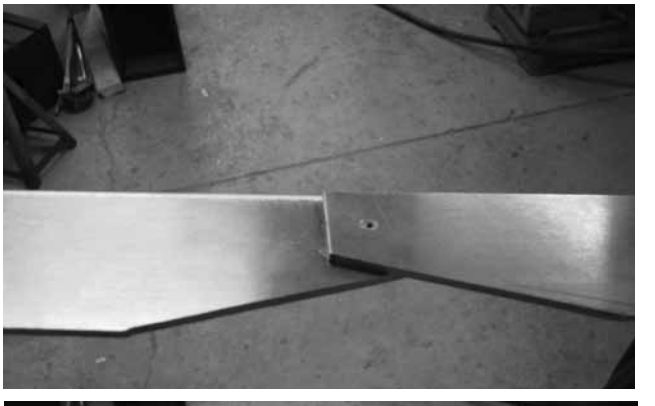
The Sonex uses pulled 1/8" stainless steel rivets throughout the aircraft, other than in the main spars. The pulled rivets can be involved in joining parts that experience some significant loads, and one area is in the vicinity of the main spar tunnel where it joins the cabin side walls. This is where the main spar bolts are located that join the wings to the fuselage.

Gussets which are penetrated by the main spar bolts have to be flush riveted to the side wall assembly and spar tunnel with the rivet heads inside the tunnel where space is very restricted. CCC44 rivets have to be used so you can insert them when loaded in the rivet puller. However, the material thickness being riveted is at the maximum 1/4" recommended for this size of rivet. Sonex therefore indicate the gusset on the formed side of the rivet should also be countersunk to ensure proper rivet retention.

My thoughts were just how strong is this arrangement, considering the sensitivity of the areas being riveted? I therefore set up a simple test in which I joined two 1/8" plates with one CCC44 rivet with countersinks in both plates as per Sonex instructions, and did some shear testing to see just what this arrangement could handle.

One side of the assembly was secured to a table with screws and the other end had a large hole which supported a loop of heavy rope into which I could step and apply a significant shear force. I stood with my other foot on bathroom scales so I could see how much force I was applying by observing how much the indicated weight dropped. I went up to applying my full weight of 200lbs with no apparent deformation of the rivet or material, which surprised me considerably for such a small retaining device.

I had increased the gusset size to include all 24



Top Down: The test piece; the countersunk factory head of rivet; and the shop head pulled into countersunk hole.

rivets in this area. Simple logic would say this plate could take at least a 4800lbs of shear load from the main spar bolt, though this would not be the case as loads would be supported by other components. The area of each gusset would actually see about ¼ of the load from everything associated with the fuselage. Under 6g maximum, this would be about 1500lbs. Clearly there is significant margin even under these extreme worst case conditions where the gusset took the entire load, which it should not.

All the fuselage load into the main wing spars is taken by one 3/8″ x 4 -15/16′ bolt at each side of the cabin. It sure looks minimal. Perhaps I worry too much? Maybe I should just keep building as per the plans developed by folk who know a lot more than I do.