

Replacing worn out MS hinges

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For the hinging of ailerons, flaps, inboard gear doors and the elevators of the small tail, Lancair utilized MS20001 hinge material. Unfortunately if used as supplied in these applications, MS hinges will wear quickly. The diametrical tolerance on MS hinges and pins is too loose for applications with high dynamic loads. Fortunately there is solution. Replacing the MS hinge with larger diameter wire has been shown to extend the life of the hinge material indefinitely. The process of reaming and replacing the hinge wire is best done on new unused hinge stock before any wear takes place. Once put in service with the smaller MS hinge pins, the ID will quickly grow out of round to the point where the hinge can no longer be saved.

Most Lancair airframes were originally built using MS hinge pin material. Now many have badly worn hinges and hinge replacement is in order. Figure 1 shows a used section of hinge up against a new piece. Wear was so bad it can be seen. A total of about .030" movement was measured against the hinge pin.



Figure 1, Worn vs. New Hinge Material

Replacing MS hinges where mounting screws are countersunk can pose some difficulty. Countersunk screws cannot tolerate any positional shift and still seat well. In most cases, the wing skin or horizontal stabilizer skin was match drilled when the hinge was first made. Every little positional imperfection is translated to the mating composite skin. Replacing the hinge ideally requires an identical copy. This can be done by making a drill jig from the original hinge. The jig aligns new and old hinges at the hinge pin while holes are matched drilled in the new hinge material. The result is an exact copy of the original. The jig can be saved in case another copy is needed. With regular maintenance this will likely be the only copy ever needed. The cloned hinges on N91CZ have been in service for more than 1000 hours with no sign of wear.

Fabricating Hinge Clones

The following section walks through the steps required to fabricate the jig and then clone the hinge. Figure 2 shows a hinge section as removed from the aircraft. Hinges can be assembled in one of two senses. One will lie flat when opened up, the other has one section inverted such that the hinge has a stagger. The Aileron hinge has one side inverted and, as such, does not lie flat. The jig must accommodate the stagger such that both hinge sections are parallel. Two strips of 1/8" aluminum are used as base material for the jig. (Figure 3) The cross pieces can also be made from 1/8" stock and riveted together as needed. In this case, a piece of 1/4" material was machined down to accommodate the stagger.

The old hinge is riveted to the jig using some of the existing rivet holes exposed after the nut plates were removed (Figure 6). The mounting holes must be carefully drilled through the jig. This must be done on a drill press to maintain perpendicularity of the holes.

New hinge material is then cut to the same length as the original hinge and fitted to the underside of the jig. After the first hole in each hinge half is drilled, a temporary screw and nut should be used to clamp the hinge firmly in place. This will prevent slipping while drilling the remaining holes. Once finished, the hinge can be removed from the jig and nut plates can be added where needed. Small safety wire holes can be added to the ends if needed. Now the hinge can be reamed to either .0955 to accept 3/32" hinge pin or to .098 to accept the larger .096 hinge pin. The 3/32 hinge pin is easier to obtain from any local welding supply. Hinge material that falls into the upper range of the allowable hole diameter, may benefit from the larger wire.

The reamers are very short and thus need an extension for most hinges. Stainless steel surgical tubing can be used to make reamer extensions (2mm OD, 1.5 mm ID). The end of the reamer is ground down and inserted in the tubing. The tubing is then crimped onto the reamer. A cordless electric drill on low speed (~100 rpm) works well to feed the reamer through the hinge.



Figure 2, Used and worn MS hinge as removed from the aircraft

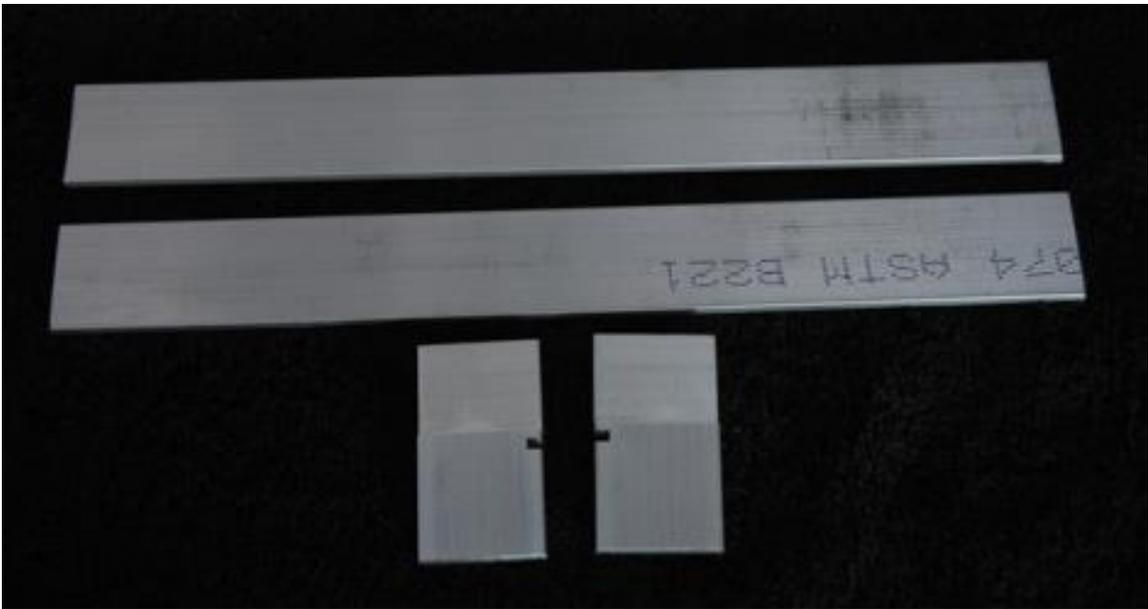


Figure 3, 1/8" bars and cross pieces before assembly. Note slots for hinge pin alignment



Figure 4, Riveted hinge Jig

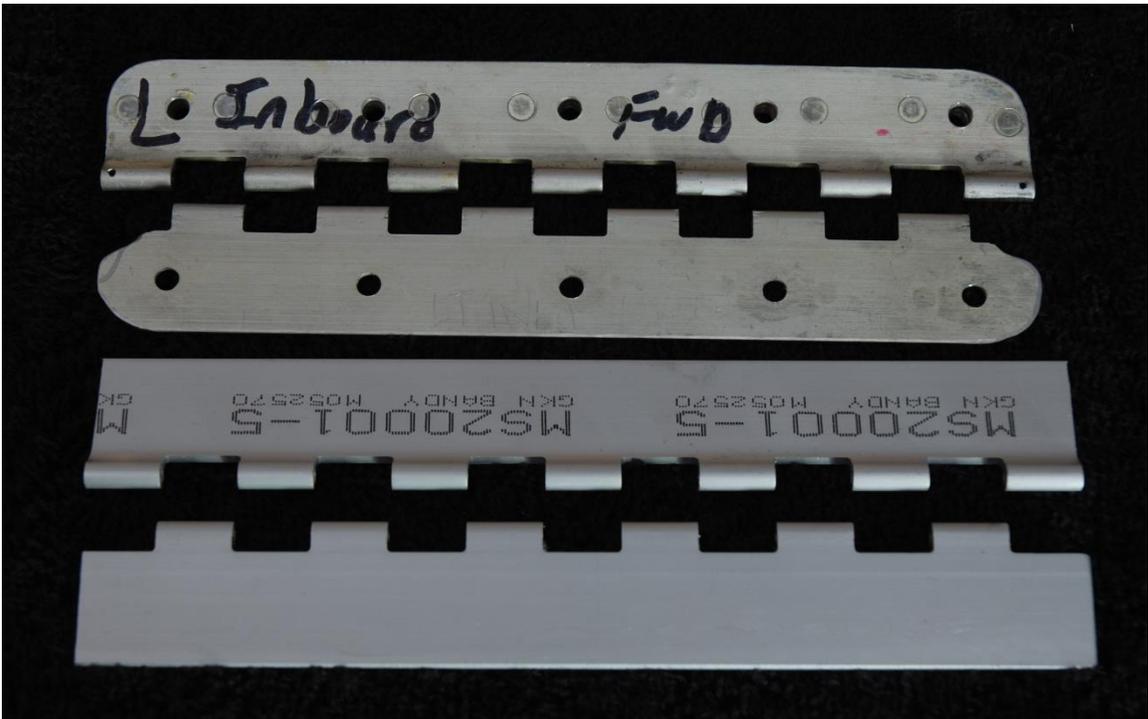


Figure 5, New hinge cut to match length



Fig 6, Old hinge riveted to jig



Figure 7, Completed hinge jig



Figure 8, New hinge material fit to underside of jig



Figure 9, Cloned hinge complete



Figure 10, Reamers for making close tolerance MS hinges