Riveting the FBV Seismometer Booms

Though they are less familiar as fasteners, Aluminum rivets were chosen to assemble the booms for several reasons:

1. They are non-magnetic
2. They are light weight.
3. They are very cheap, about 1.5 cents each.
4. When set, they expand to tightly fill the hole, resulting in a joint which is very solid and not likely to generate mechanical noise (pops).

We chose to use AN470A universal-head rivets, which are made of the softer low-alloy aluminum, and which require less force to install.

http://www.eaavideo.org/video.aspx?v=21190816001
http://www.aircraftspruce.com/catalog/hapages/solidalumrivets.php

These are quite adequate for our use as they are not being used to hold together an airplane structure, which would usually require the use of stronger AN470AD rivets.

In preparing to install the rivets, it is important to consider the technique for drilling the holes. The exact location of the rivets is not terribly important, but it is necessary that the holes in the three layers of metal be exactly centered on each other. If they aren't, when the rivets are installed they will generate large sideways forces on the material as they expand, tending to buckle the thinner material and introducing stresses which might later show up as a noisy assembly.

First, the locations of the holes should be marked on the topmost aluminum piece. Then all three layers should be carefully aligned and squared and then clamped together. Undersized pilot holes (3/32" or #40) are then drilled through all three layers centered on the marks. After drilling, each hole install a Cleco sheet holder to temporarily keep the holes aligned and clamped.

http://www.aircraftspruce.com/catalog/topages/clecosheetholder.php
http://www.eaavideo.org/video.aspx?v=1454906775

After drilling all the holes, remove one Cleco and drill the rivet hole to its final size of 0.1285" #30 (#27 for 6-32 clearance holes), thereby guaranteeing the desired hole alignment. Deburr the hole and install a rivet. In this way you can insure that the rivets do not generate side stresses. Then continue by removing the next rivet Cleco, drill its hole to size and install the rivet. When all rivets are in place the #27 holes for the 6-32 screws may be drilled. This is the way that airplanes are assembled, often drilling with only a hand-held drill.

For the FBV designs, requiring only a few, soft rivets a manual rivet-squeezer is the appropriate tool. One having a 1-1/2" reach and 1-1/2" gap will be needed.

http://www.aircraftspruce.com/catalog/topages/integralSqueezer.php

[Note: This squeezer actually has a gap only slightly over 1-1/4" and must be modified.] Two dies are needed, an AT108[A]S-1/8 Cupped Rivet Set which is recessed to engage the rounded 'factory head' of the rivet and an AT109AP Flush Rivet Set which forms the 'shop head' on the rivet.

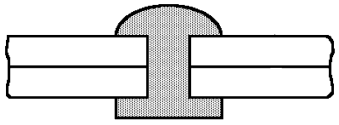
http://www.aircraftspruce.com/catalog/topages/dimplsets.php

For practice and to adjust the squeezer it will be necessary to make up a test piece from scraps of the boom material built up to match the boom thickness. A half dozen 1/8" or #30 holes may drilled through the stack for installing test rivets.

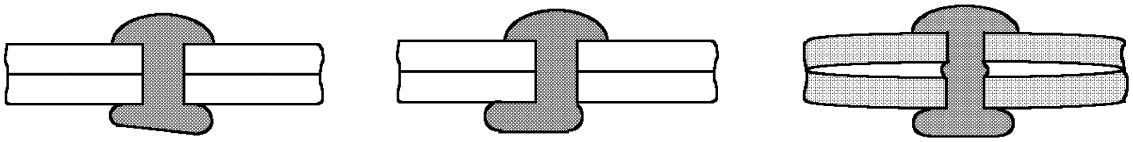
The layers should be well clamped together and a little pressure should be maintained on the factory-head of the rivet so that it remains firmly in contact with the top sheet while it is being squeezed.

To get a good result, the squeezer should be centered on the rivet and held perpendicular to the sheet while the rivet is squeezed. Then the shop-head should be inspected to assure that it was properly formed.

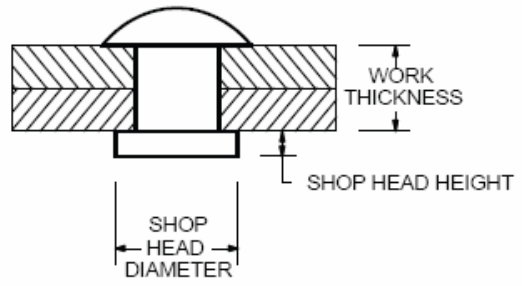
A properly installed rivet:



Bad rivets:



For these 1/8" diameter rivets the ram of the squeezer should be adjusted until a shop-head diameter of about 0.2" is obtained, 3/16" at a minimum. At the same time, the height of the shop-head should not be squeezed thinner than 1/16". Once the squeezer is adjusted you can start installing rivets in the boom.



Modifying (only) the 12-01465 rivet squeezer for use with the Inyo:

As received, the jaw gap of this squeezer measures only slightly over 1-1/4", not the advertised 1-1/2". When used with the necessary dies, the ram of the rivet squeezer can not be adjusted sufficiently wide to allow you to install 3/8" rivets in the Inyo's 0.205" stack of aluminum. To allow it to work, the squeezer ram may be shortened by 0.225" by machining material from both of its ends.

To modify the ram:

1) Remove the black plastic cap from the fixed squeezer handle. The end of a spring will be visible, retained by a 1/8" anchor pin.

2) Hook the spring end-loop and pull it out sufficiently to allow it to be retained with a small nail bridging the open end of the handle. This removes spring tension from the anchor pin.

3) Drive the anchor pin substantially to one side, using a 1/8" pin punch or equivalent so that the spring, adjustment screw and ram may later be removed. Again hook the spring loop and pull on it to allow the nail to be removed and the spring to be un-tensioned.

4) Remove the retaining 'C' clip from the handle pivot pin.

5) Remove the pivot pin to free the handle, and remove it.

6) Pull the spring, adjustment screw and ram past the end of the anchor pin and out of the handle.

7) Unscrew and remove the ram.

8) From the end of the ram having the adjustment holes machine off 0.125".

9) From the end of the ram having the screw threads machine off 0.100".

10) Screw the ram back onto the adjustment screw and tighten it finger tight.

11) Hook the spring end back into the flat side of the adjustment screw.

12) Insert the ram, adjustment screw and spring back into the fixed handle.

13) Push them in until the notch in the base of the screw is visible in the opening in the handle.

14) Use a small screwdriver to push on the spring wire to rotate it to the rear, away from the opening. The spring attachment hole in the adjustment screw should now be centered in the opening.

15) Insert the handle with its cam resting in the adjustment screw notch and insert the pivot pin.

16) Replace the retaining 'C' clip on the pivot pin.

17) Gently push on and try to rotate the ram to be sure the handle cam is properly seating in the adjustment screw notch.

18) Hook the loop in the end of the spring and pull it out so that the nail can be re-installed to hold it.

19) Drive the anchor pin back into place, through the spring loop.

20) Pull on the spring loop to lift it off the nail, remove the nail and allow the spring to rest again on the anchor pin.

21) Replace the plastic cap on the fixed handle.