LONG-EZ - INTERNAL RUDDER BELHORN

(Intended for use with the larger high performance rudders only)

NEW CONSTRUCTION

In order to use the internal rudder belhorns, you will need to install the rudder cable conduits in the top of each wing in a slightly different position than what is called out in section I of the Long-EZ plans. If you have not laid up the top skins of your wings, you can install the rudder cable conduits into the foam cores of each wing per the layout on page A-2. Note that the inboard end of the rudder cable conduit is essentially in the same position as called out in section I for the original rudders. It must pass as close as possible to the outboard tip of the ailerons, then go close to and somewhat parallel to the trailing edge to give the correct "pull off" angle to the rudder cables as they pull the internal belhorns to deploy the rudders. This is very important and, if you do not route the cables and their conduits correctly, you will not be able to deploy the rudders to their full travel.

The method of installing the conduit is exactly as called out in section I, using a Dremel to route a 1/4" trough in the top of the foam cores. Only the new layout, or position, of this trough is different.

RETRO-FITTING TO AN EXISTING LONG-EZ - FIRST, THE BELHORNS

Make two (2) FB-2 belhorns from 1/8" thick, 2024-T3 aluminum and treat them with Alodine. We have found that if we glass bead blast aluminum parts then clean them in Alumiprep and then treat them with Alodine, we get best results. Make four (4) FB-1 steel, parts from .032 4130N sheet. We simply cleaned these steel pieces with metal prep and painted them with spray can zinc chromate.

Clamp the FB-1 steel pieces in position on the FB-2 belhorns and drill #30 holes in five (5) places per page A-1. All parts are drawn full scale on page A-1. We used solid AD rivets to secure FB-1's to FB-2. Have the clevis pins and cotter pins on hand to install the rudder cables. Note: when you have swaged the 18-1-C sleeves and AN100-3 thimbles onto the 1/16" diameter rudder cables, you must carefully place the thimbles in a smooth jawed vice and gently squeeze the AN100-3 thimbles to flatten them so the thimbles will slip easily between the two FB-1 steel pieces on the end of the FB-2 belhorns. See page A-1.

Remove the rudders and install the new belhorns, one into each rudder per the series of photos and per the drawing on page A-5. The belhorns are potted into the rudders with flox and two plys of BID are laid up over the belhorns and up the inside of each skin of the rudders.

The existing depression in your rudders may work fine, otherwise you will have to modify this depression, or hole, in the forward web of the rudder so that your belhorns will lie in exactly the proper position. When the rudder is fully deployed, that is to say between 5" and 5-1/2", measured at the lower trailing edge of each rudder, the new belhorn must exactly line up with the center of the wing trailing edge at the inboard face of each winglet and the rudder cable conduit should point at the clevis pin in the forward end of the new belhorn. We temporarily "glued" the belhorns into position in each rudder with a few spots of Hot Stuff, instant glue, then mounted the rudders and checked the position of each belhorn. It took several iterations to get them exactly correct, and then we permanently floxed and glassed them into each rudder.

When this has cured, install the rudders and check for correct alignment and position of each belhorn.

Now, turn to page A-3 and, with a length of 1/4" OD x .035 wall 4130 steel tubing which you have previously sharpened per the sketch, use this tubing as a drill, carefully "sight" from the inboard corner of each aileron to the rudder pulley mounted on the firewall. We found it helpful to make an aiming mark on the root of the wing with a Magic Marker.

Using a dowel, we opened a hole in the aileron cut-out, web first. Then we drilled through the foam and wing root rib with the sharpened tube-drill. We hit both wings first time and we then installed Nylaflow tubing through this hole, lightly sanding the plastic conduit and coating it with micro to glue it into the foam core. We Hot Stuff-ed the Nylaflow ends to the inboard rib and the airleron web to hold it in position and then potted the ends in micro and laid up one ply of BID over the Nylaflow to permanently lock it in place.

We Dremel-ed out the web at the outboard aileron corner, made a Magic Marker mark on the top skin over the Dremel-ed hole. We also Dremel-ed a 2"x2" hole in the outboard face of the winglet (see photo #11). Then we cut through the inboard skin of each winglet so we could see into the end of the wing at the trailing edge. This was opened up with a Dremel on the under side of the wing trailing edge skin (see photo #12) so that we could positively see where the rudder cable conduit had to be positioned. We then used the 1/4" diameter steel tube drill to drill through the foam core from the outboard face of each winglet to the outboard corner of each aileron cut-out. Using our mark on the top skin of

the wing, we were able to hit it perfectly on one wing (we had to try twice on the other wing!). Again, a length of Nylaflow conduit was micro-ed into this hole, leaving the outboard one inch or so loose so it could flex forward and aft as required to align the rudder cable with the clevis pin in the end of each belhorn.

Six pieces of Nylaflow, each 2" long were then Hot Stuff-ed to the "shelf" forward of each aileron. (See lower page A-4, section A-A). These short pieces of conduit were potted in micro and glassed over with one ply of BID.

After the Nylaflow conduit is cured in place, a 1/16" diameter rudder cable can be threaded in from the outboard end toward the wing root.The Nicropress sleeve and thimble should already be installed on the ends of each cable. Connect the belhorn to the cable end with the clevis pin and try deploying the rudders by pulling on the cable at the wing root. Be sure that there is no hang-up and that the belhorn strikes the corner of the wing trailing edge at the inboard skin of each winglet at full rudder travel. Measure at the rudder trailing edge for 5 to 5-1/2 inches of rudder deflection.

When the rudders are closed or faired, the FB-1 steel pieces should be flush with the winglet outboard skin. When you are satisfied with your installation at the rudder/winglet, repair the hole in the outboard winglet skin, also, the hole in the wing trailing edge. Be certain no epoxy or micro gets into the cable or conduit and that there are no interferences with the rudder/belhorn travel through its total travel.

If you have brake master cylinders mounted on the firewall, per the plans, you will have to connect the rudder cables to the CS-15 belcrank which is mounted on the firewall (see plans section I, chapter 16-5) with one very important difference, you must install a compression spring which you will set up like a Cessna tailwheel spring (see page A-5) between the CS-15 belcrank and the rudder cable. (We obtained our springs, part #1887, from Century Spring Corp., 222 E. 16th, Los Angeles, CA 90015.) The reason for this is that your rudders now have a positive stop. (They did not have any stop before, when built per plans.) This means that without the spring in the cable, you could reach the rudder stop and not be able to reach the brake! The spring is there to assure that you can always apply pressure to the brake master cylinder.

You should set it up so that on the ground, the rudders go to full deflection (hit the stops in the wing trailing edges) before you start to get any braking. Now the spring should stretch, allowing you to apply the brakes.

With the rudders set up this way, you are assured of being able to use maximum rudder for steering on the ground before you have to use brakes. This will make taxiing easier and

will give you more life out of your brake pads. Once you are airborne, 5 to 5-1/2 inches of rudder travel is more than you need, especially at high speed. This is where the spring is calibrated to stretch allowing you to deploy only about 3 to 3-1/2 inches at higher speeds which is just right. Our flight testing has involved several different springs to get this just right.

If your brake master cylinders are mounted up front, as many builders have done to afford better access to the magnetos and to achieve a more favorable CG condition, you will have to run the rudder cables inboard around the AN210-2A pulleys mounted in the CS-72 pulley brackets then down to the CS-15 belcrank. From the belcrank, the cable (it only needs to be 1/16" diameter since this cable no longer applies the brakes) should run forward to the rudder pedals. We removed the CS-15 belcranks and substituted pulleys in between the CS-71 brackets. Our rudder cables go around this new pulley and through the firewall (through a Nylaflow conduit floxed into the firewall to the rudder pedals. This eliminates the need for a vertical slot in the firewall for the rudder cable to travel up and down due to the action of the CS-15 belcrank.

The new "tailwheel" type compression spring (see page A-5) must be installed between each rudder cable and each rudder pedal to allow you to apply the brakes after the rudders have reached their mechanical hardstops in the wings.

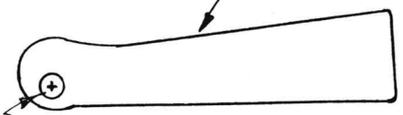
We have over two years of experience on the "hidden" rudder belhorn with compression springs in the cables system and we are very pleased with the results. It is possible to taxi using only rudder to steer. Having more rudder deflection, the rudders are more effective at taxi speeds. Even when brake is required for steering, having the rudder deployed out to its stop assures that it is providing the maximum turning force before using the brakes which cuts down on brake wear.

In the air, the springs allow just the right amount of rudder deflection (more at slow pattern speeds, less at cruise) which is exactly what you want. We believe this installation is an improvement over the original plans (large rudders) from a practical, operational sense as well as simply making the airplane look better.

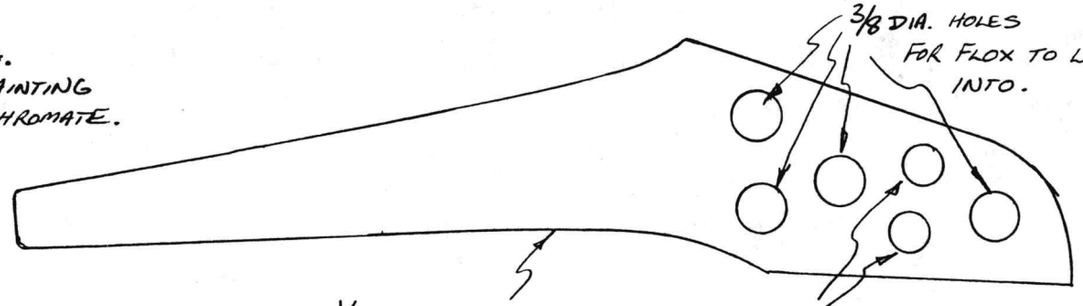
Have fun!

PART # FB-1

4130N STEEL .032 THICK
MAKE FOUR (4) PIECES
PER THIS FULL SCALE DWG.
TREAT BY PAINTING
WITH ZINC CHROMATE.



#12 DIA. DRILL THRU. NOTE: THIS HOLE IS DELIBERATELY OFF SET CLOSE TO THE EDGE.

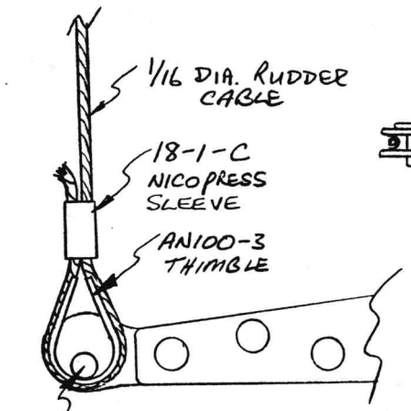


3/8 DIA. HOLES
FOR FLOX TO LOCK
INTO.

5/16 DIA. HOLES

PART # FB-2

1/8 THICK, 2024-T3 ALUM
BELHORN. MAKE TWO (2)
PARTS PER THIS FULL SCALE
DRAWING. — TREAT WITH ALODINE.



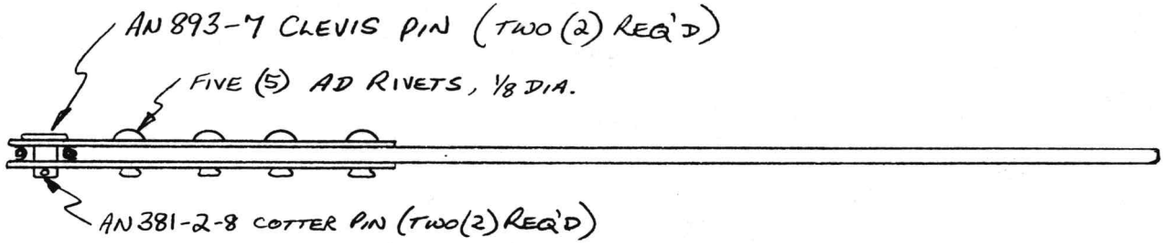
1/16 DIA. RUDDER CABLE

18-1-C NICOPRESS SLEEVE

AN100-3 THIMBLE

AN393-7 CLEVIS PIN

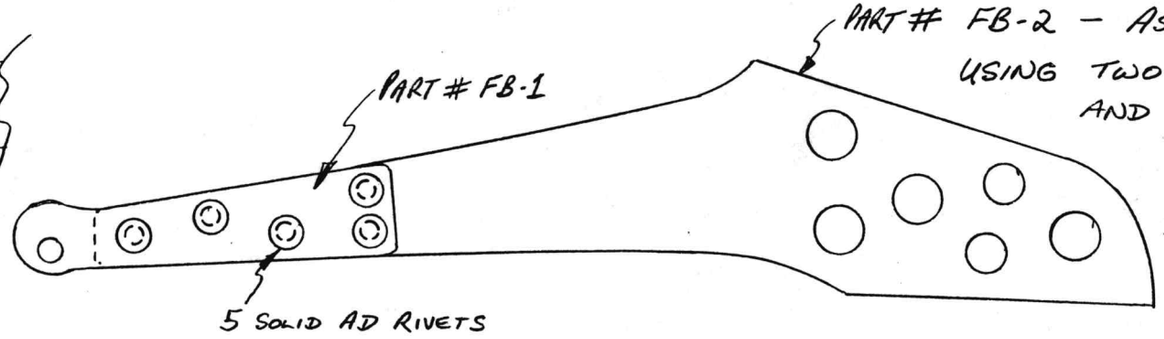
ABOVE DETAIL SHOWS
1/16 DIA. RUDDER CABLE
IS FLUSH WITH EDGE
OF PART # FB-1's



AN 893-7 CLEVIS PIN (TWO (2) REQ'D)

FIVE (5) AD RIVETS, 1/8 DIA.

AN 381-2-8 COTTER PIN (TWO (2) REQ'D)



PART # FB-2 — ASSEMBLE TWO (2)
USING TWO # FB-1 STEEL PIECES
AND ONE # FB-2 ALUM PIECE
PER COMPLETED BELHORN

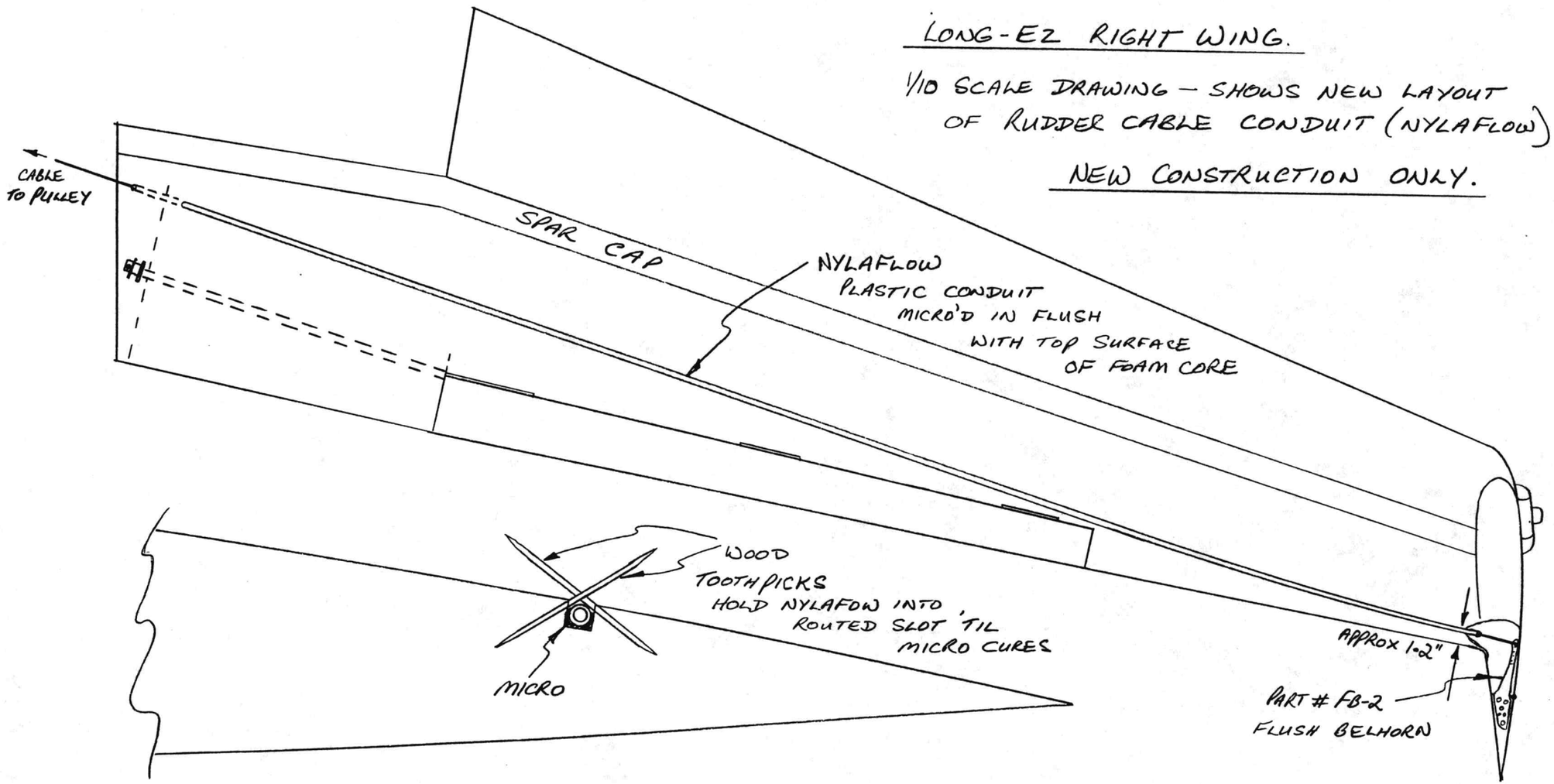
PART # FB-1

5 SOLID AD RIVETS

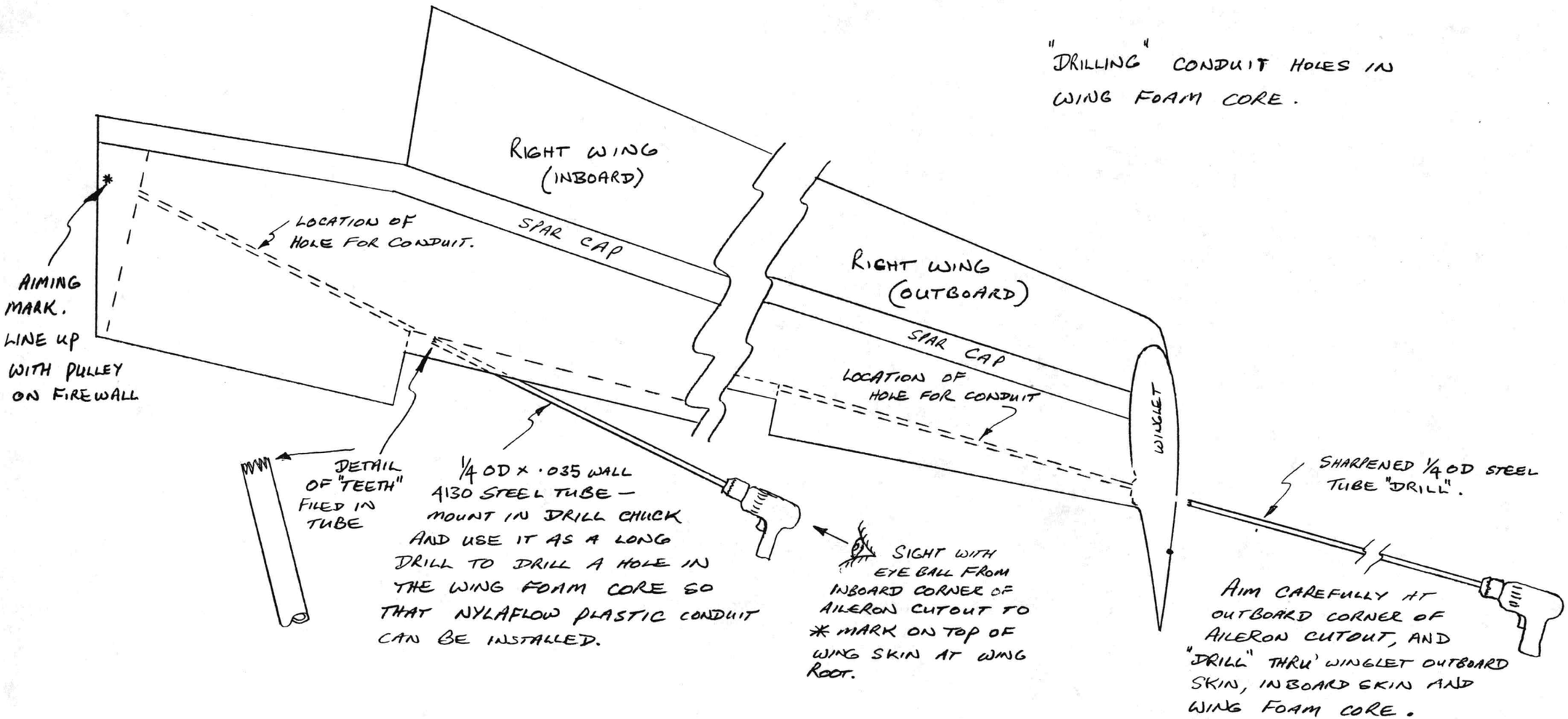
LONG-EZ RIGHT WING.

1/10 SCALE DRAWING – SHOWS NEW LAYOUT OF RUDDER CABLE CONDUIT (NYLAFLOW)

NEW CONSTRUCTION ONLY.

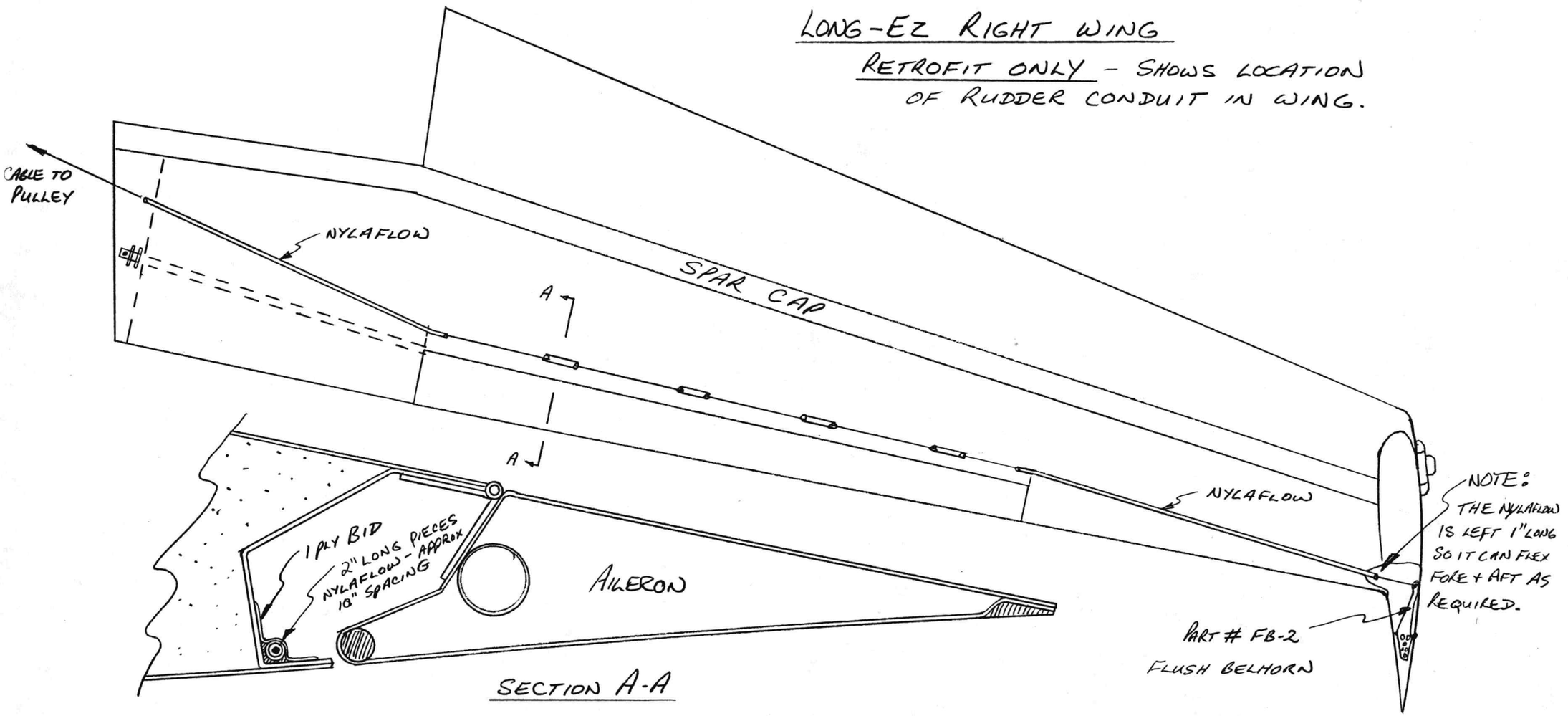


"DRILLING" CONDUIT HOLES IN WING FOAM CORE.



LONG-EZ RIGHT WING

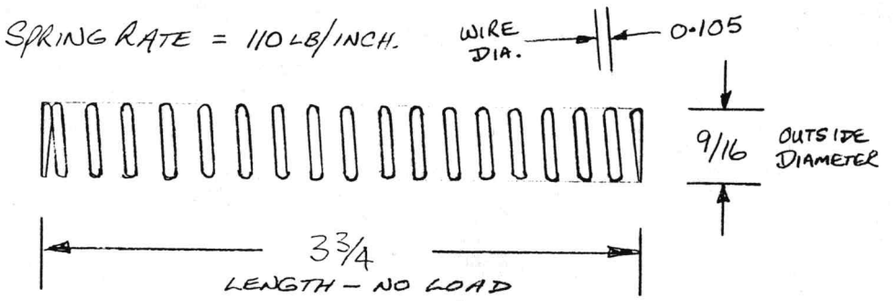
RETROFIT ONLY - SHOWS LOCATION OF RUDDER CONDUIT IN WING.

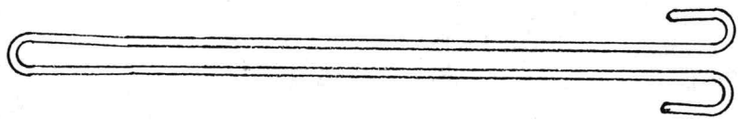


SECTION A-A

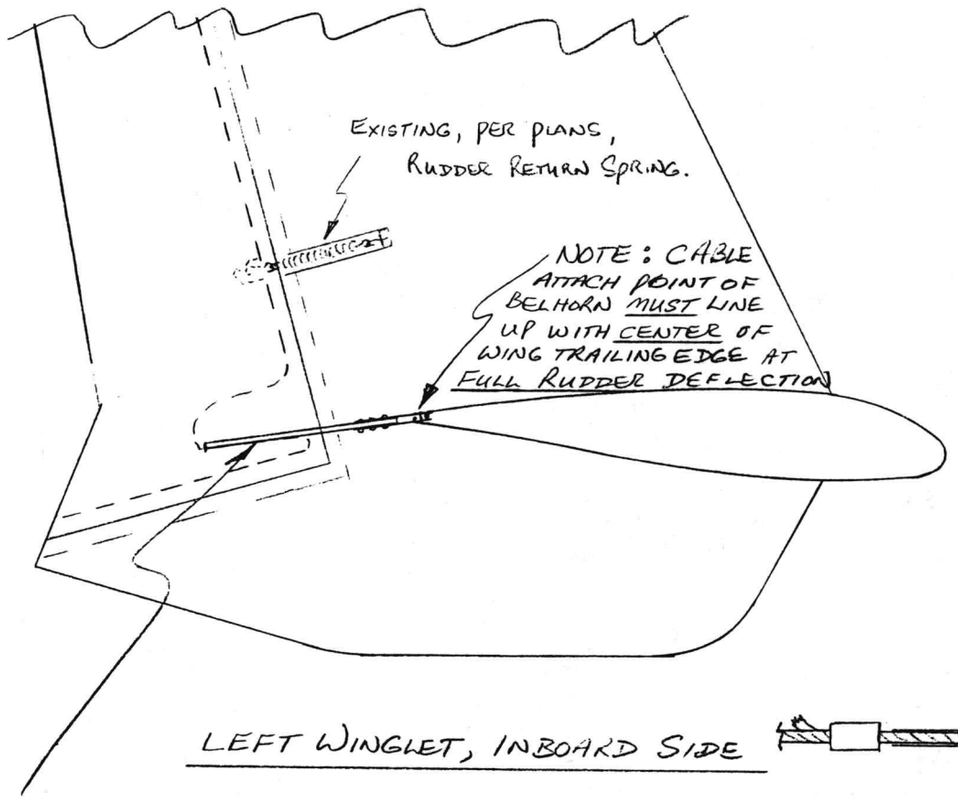
TWO (2) STEEL COMPRESSION SPRINGS REQUIRED
CENTURY SPRING CORP. PART # - 1887

SPRING RATE = 110 LB/INCH.



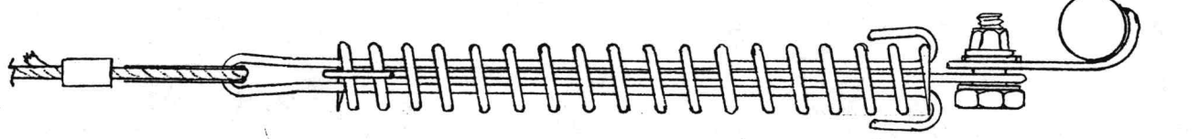


BEND UP FOUR (4) PIECES OF .050 MUSIC WIRE PER ABOVE SKETCH

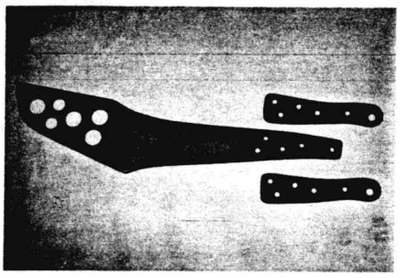


LEFT WINGLET, INBOARD SIDE

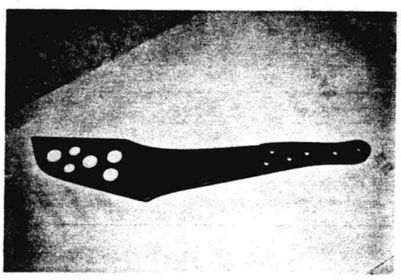
NEW, INTERNAL RUDDER BELHORN IS FITTED INTO RUDDER IN A BED OF FLOX, THEN TWO (2) PLIES OF BID @ 45° ARE LAYED UP OVER THE BELHORN, LAPPING ONE (1) INCH UP THE INSIDE OF THE RUDDER SKINS ON EACH SIDE.



INSERT ONE .050 MUSIC WIRE PART INTO EACH END OF EACH SPRING. ATTACH ONE END TO THE RUDDER PEDAL BRACKET WITH AN AN-3 BOLT. CONNECT THE RUDDER CABLE TO THE OTHER END WITH AN 18-1-C NICOPRESS SLEEVE AND AN100-3 THIMBLE

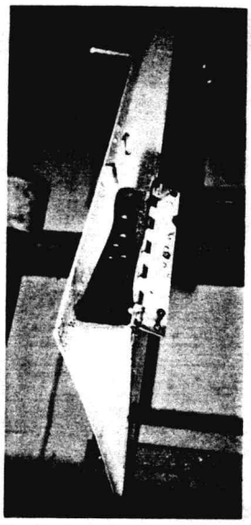


(1) 1/8" thick aluminum rudder belhorn, treated with Alodine. 1/32" thick 4130 steel parts are painted with green zinc chromate.

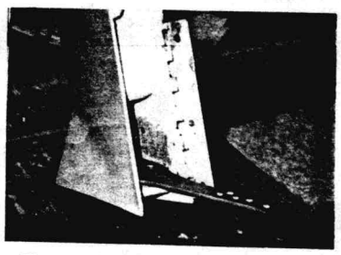


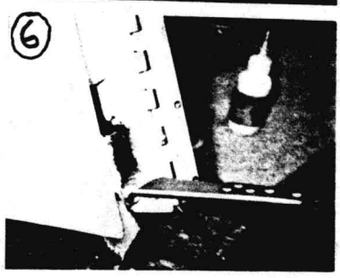
(2) The 1/32" steel parts are shown rivited to the 1/8" aluminum belhorn. Solid AD rivets are used.

(3) The completed rudder belhorn is fitted into the rudder. Sand all painted surfaces and grind away the glass as required to correctly position the belhorns.

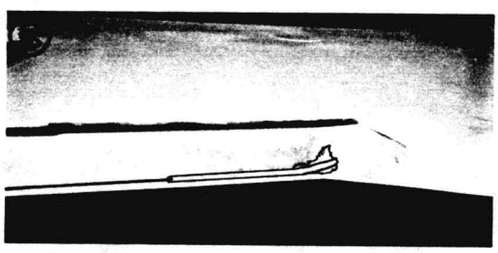


(4) & (5) Two more views showing the position of the new rudder belhorn in the rudder just prior to installing it permanently.

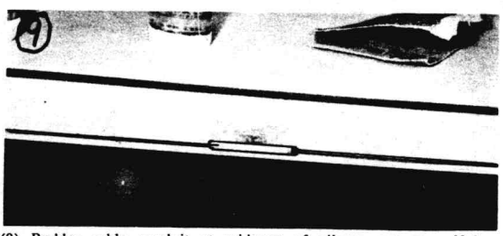




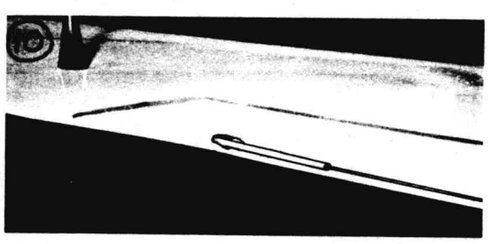
(6) & (7) The new belhorn is bedded in wet flox and two plies of BID are laid up over the belhorn and up the inside three sides of the rudder. This permanently attaches the new belhorn to the rudder.



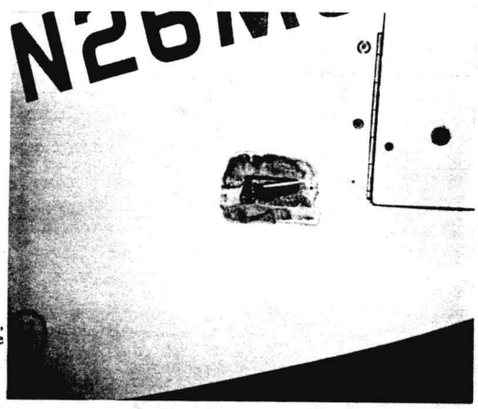
(8) Rudder cable conduit at the root end of the aileron cut-out, prior to filling with micro and laying up one ply of BID over the nylon conduit to lock it in place. (Sand conduit lightly).



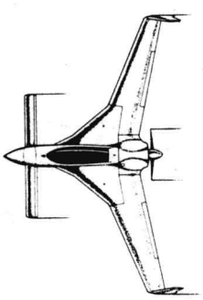
(9) Rudder cable conduit at midspan of aileron cut-out. Nylon conduit held in place by a few drops of Hot Stuff, instant modeling glue. One ply of BID will be laid up over the conduit, locally, to permanently lock it in place.

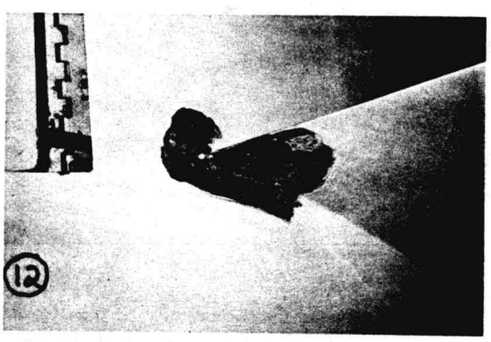


(10) Rudder cable conduit at the outboard end of the aileron cut-out, prior to micro and one ply of BID.

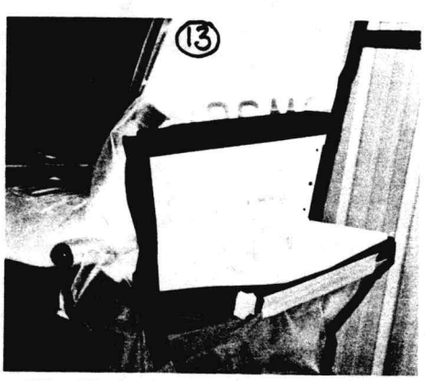


(11) Rudder is temporarily mounted in place and rudder cable end is visible through this access hole in the outboard face of the winglet. Carefully check that rudder travel is sufficient and that there are no hang-ups before covering this access hole with two (2) plies of BID.

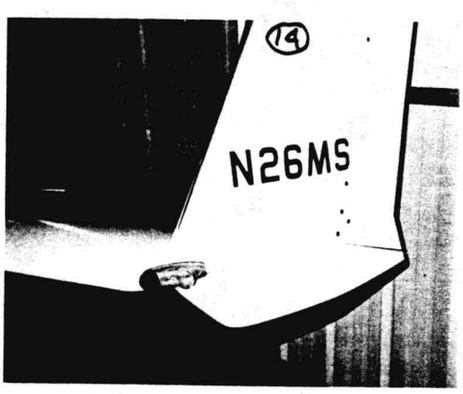




(12) Inboard face of the winglet, and under the trailing edge of the wing, are sanded and an access hole is cut to ensure that the cable and belhorn operate freely and that travel is correct with no snags.



(13) Winglet is masked, the access hole is glassed and filled and contoured and filled and sanded smooth, prior to painting.



(14) & (15) After final paint - now doesn't that look better? Clean, simple, low drag, hidden rudder belhorns - read to fly.