

# Bashing The Hanger 9 Cessna 182 ARF

## Part 4

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Pongo Air

This is the final installment of a four-part article covering a variety of modifications incorporated into a Hanger 9 Cessna 182 ARF. Upgrades to the elevator pushrod assembly, incorporation of a pull-pull rudder system, and the addition of a moving pilot's head will be described.

### Elevator pushrod upgrade

Earlier on in the series, I noted that I was less than satisfied with the control surface rigging which was supplied with the kit. Main complaint with the supplied pushrod and clevis rod rigging is how flexible the assembly is. The pushrod was light balsa and the threaded clevis rod was very soft and easily bent. As an experiment, I installed the supplied pushrod for the elevator. The result of the experiment was that the elevator could be flexed up to  $\frac{1}{2}$  inch, which was unacceptable for safe control of the airplane.

The simplest method of upgrading the push rods is to purchase a fiberglass or carbon fiber pushrod kit. An alternate would be to obtain a 3-foot section of  $\frac{1}{4}$  or  $\frac{5}{16}$  in hardwood dowel. Dave Brown and Aerospace Composites offer the fiberglass/composite kits. Hardwood dowels may be purchased at the hobby shop or local hardware store. One will still need to obtain three, 12 inch long steel threaded clevis rods, to replace the soft metal ones supplied with the kit.

The Cessna 182 is a split elevator design, which requires a "Y" type pushrod installation. Use the supplied pushrod as a template and build the replacement push rod to the same length; the finished product will be an exact match.

The replacement pushrod may be installed per the directions. I recommend incorporating a set of cross braces  $\frac{1}{2}$  way down the inside of the fuselage to support the control rod. These were constructed from four wood stir sticks and glued in place. Reference figure 1.

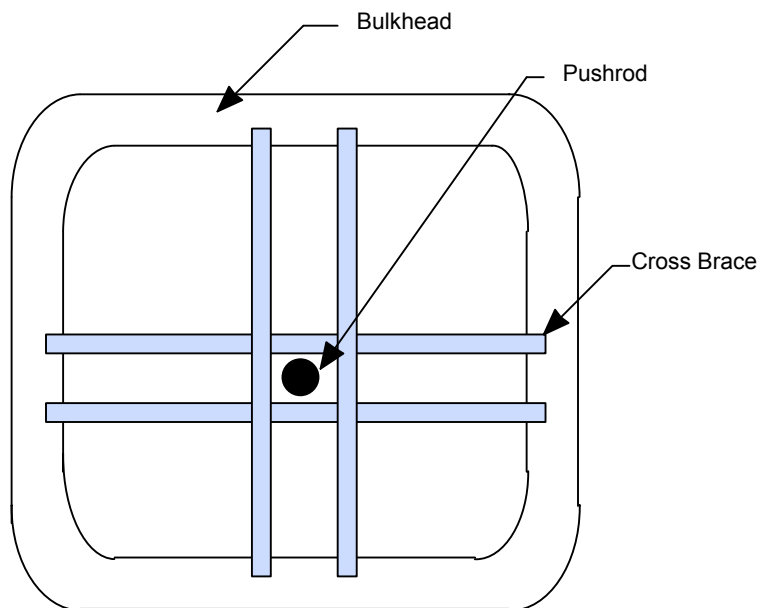


Figure 1 Cross section view of pushrod bracing

## Pull – Pull Rudder System

Required materials:

Qty	Description
1 pr	Control horns
2	2-56 x 1 inch machine screws
2	2-56 flat washers
2	2-56 lock washers
2	2-56 nuts
1 pr	Cable/pushrod guides
1	DuBro 2-56 Pull-Pull rudder kit

The DuBro 2-56 pull-pull rudder kit consists of a spool of jacketed cable, cable crimps, clevis hardware and rudder control horn. The servo used for this installation should be a ball bearing type servo or the servo will fail prematurely.

### Fuselage preparation

Lay the fuselage on its side. Secure the rudder in place so it is aligned to the vertical stabilizer. Using a piece of string as a guide, position one end of the string even with the top of the rudder servo arm on the outside of the fuselage. Route the string towards the tail section of the fuselage, taping the string on the rudder, one inch from the rudder bottom. This will be the angle and routing of the pull-pull cables on the inside of the fuselage.

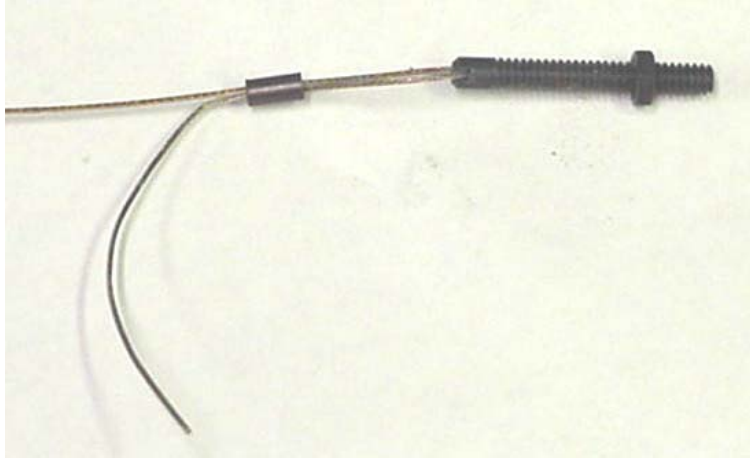
Mark the area where the pull-pull cables would penetrate the top of the fuselage. Drill a pair of 1/8-inch holes at this location for the cables to penetrate the fuselage. Later on these holes will be enlarged to incorporate a pair cable/pushrod guides. Mount the control horns on the both sides of the rudder using 2-56 hardware. The string and tape may now be removed from the fuselage.



Figure 2 Pull-Pull kit

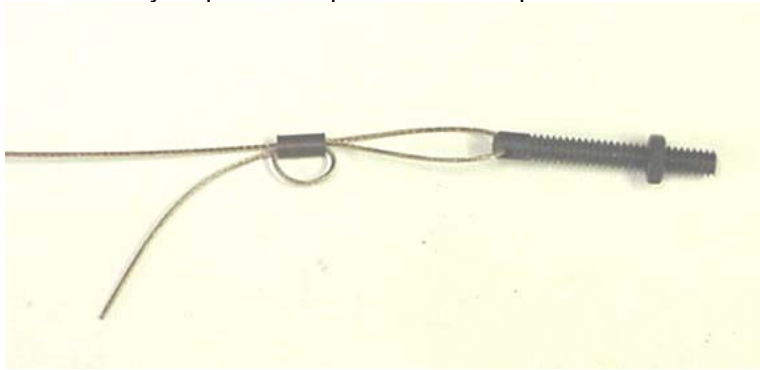
### Cable construction

Build two cable assemblies as follows. Cut a single 3-foot length of cable from the cable spool. Slide a single cable crimp onto the end of the cable, thread the cable through the clevis rod and back through the cable crimp as shown in figure 3. Do not crimp the cable crimp



**Figure 3 Cable crimp installation**

Thread the cable through the cable crimp a second time as shown in figure 4. This is a safety loop. Position the cable crimp approximately  $\frac{1}{2}$  inch from the threaded clevis rod. Remove the excess cable out of the safety loop and crimp the cable crimp.



**Figure 4 Cable crimp installation**

Install 2-56 nuts on each of threaded clevis rods, positioning the nut approximately mid-span on the rod. Install the clevis on each clevis rod. Position the rudder servo cross arm so it is perpendicular to the fuselage. Install the clevis and cable assembly on the servo cross arm. Don't forget to add a small piece of fuel line tubing to prevent the clevis from springing open in flight. Reference figure 5.



**Figure 5 Pull-pull cables installed on servo cross-arm**

A time saving trick to routing the cables (or push rods) through the fuselage is to tie a small nut onto the end of a string to act as a weight. Stand the fuselage on its nose and feed the string and nut through the holes drilled in the tail section. Connect the pull-pull cable to the string with tape and slowly pull the string and cable assembly back through the hole in the tail section.

Route the cable assemblies through the tail section of the fuselage one at a time. Ensure that the cables are not entangled on the elevator pushrod or become crossed overtop of each other. Slide the cable guides overtop top of each cable so they may be glued in place later on.

Using the same procedure that was used to build the servo arm ends of the cable, install the cable crimp, clevis rod and clevis on the end the cable. **Do not crimp the cable crimp.** Install the clevis and cable assembly on the rudder control horns, reference figure 6. Verify the servo control arm and rudder are centered in mid position. Remove the slack in each pull-pull cable and then crimp the cable crimp. Install the cable guides.

Final adjustment- Radio system on, rudder trim tab centered, adjust the pull-pull cable lengths so the rudder is centered. The cables should have minimal tension. If they sound like a ukulele, they are too tight. Ensure the 2-56 nuts are snug against the clevis.



**Figure 6 Pull-pull cables installed on servo rudder**

### **Moving Pilot**

This addition will take less than 20 minutes to incorporate. It involves creating a mount for the pilot's head and then attaching the mount to the rudder servo.

Required materials:

<b>Qty</b>	<b>Description</b>
1	Pilot head
1	Wood dowel ¼ inch diameter.
1	Wood stir stick
2	2-56 x 1 inch machine screws
6	2-56 nuts
4	2-56 flat washers
AR	White Glue



**Figure 7 The Pilot**

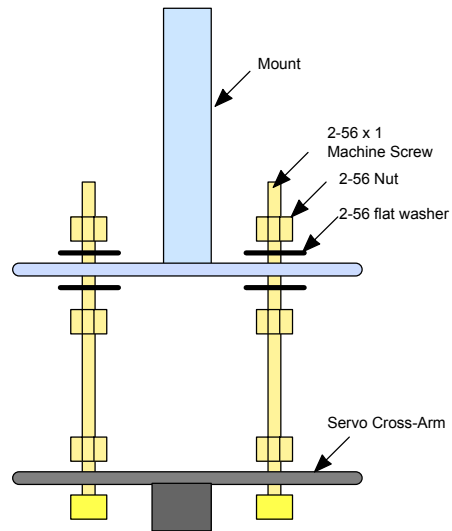
Construct the wood mount from the stir stick and a length of wood dowel. Cut the stir stick down to the same length as the servo cross-arm. Length of the dowel is dependant on where desires the pilots head to appear in the windows.



**Figure 8 Mount**

Using a spare servo cross-arm as a template, center the servo cross-arm over the base of the mount. Mark the base with the two inner most holes of the servo cross-arm. Using a 1/16 inch drill bit, drill a pair of mounting holes in the base.

Install a pair of 2-56 x 1 inch machine screws into the underside of the rudder servo cross-arm. Secure the machine screws in place using a pair on 2-56 nuts. Install the servo arm onto the rudder servo and connect the rudder pull-pull cables to the servo arm. Add a single nut to each of the machine screws, locating the nut approximately 1/2 inch above the servo arm. One the nuts have been positioned, add a single flat washer to the hardware stack. Install the head mount onto the machine screws, followed by a second flat washer and nut. Hand tighten the hardware stack. Reference figure 9.



**Figure 9 Hardware stack-up**

Install the pilot's head onto the wood dowel. A small drop of white glue will secure the pilot's head to the dowel.



**Figure 10 Pilot's head installed on mount**

Final check. Before flying the plane, make sure the pilot is secure and all of the controls move freely though full range of motion.