REPLACING THE AFT RUDDER CABLES

***Note*: You must have the assistance of a qualified Aircraft Mechanic to perform this procedure. A logbook entry with the mechanics signature is required. Please read these instructions all the way to the end *before* beginning.**

Description:

If you have ever changed a cable in the Seabee you know it can be a very challenging experience. The rudder cables are no exception and the aft cables are especially difficult, as it is a two-piece system. AC 43.13 says that any time a cable is frayed at a pulley or a fare lead they must be changed. That's what happened to me. This is a BIG job, as you have to remove the rudder and vertical fin so, if you are nervous now, stop. Read no further.

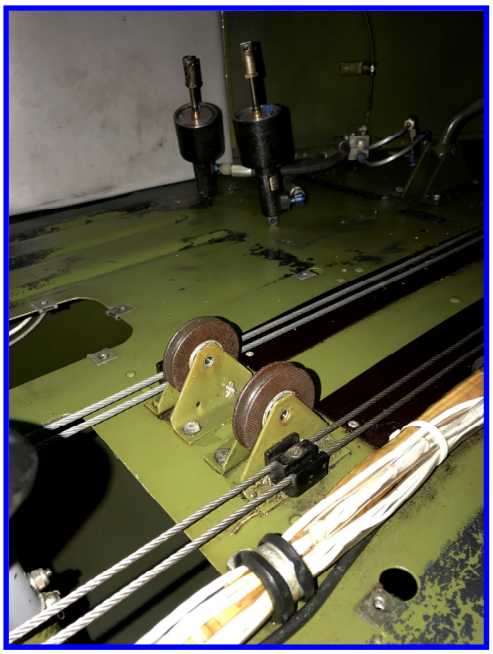
The Forward Rudder Cables run from the control arms under the center cover by the Hydraulic Pump Handle and run aft, around a set of pulleys under the front center covers to the Rudder Junction just forward of the tail wheel inside the fuselage. This "Junction" provides cable termination for the Air Rudder, Water Rudder and Tail Wheel Steering (if you have that). The cables then run back to their respective control system. There are fare leads in four places: above the tail wheel and above the Water Rudder that will need to be removed. The "Junction" must be removed with the aft Air Rudder cable and Water Rudder cable and replaced onto the new cable before the end cable balls are swaged in place. You must find a cable company that is willing to do this and not lose the junction. Beachhurst Industries in Virginia is such a place and the contact information is on the Seabee Club website under "Recommended Services".

Procedure:

Do yourself a favor as you go and take photos of all the parts you remove BEFORE you remove them. These photos will be indispensable later on when you reinstall everything.

Remove the front seats and remove the center cable covers then disconnect the rudder cables from the control arms. These are attached with clevis bolts, castle nuts and cotter pins. Remove the forward rudder cable pulleys (2") and set them aside. This will allow enough slack that the rudder cables can be pulled aft and allow access to the rudder cable "Junction" in the rear. While the forward rudder cables are exposed, check for fraying that will, most likely, occur right under the forward pulleys. You have to bend them to see if they are frayed! If so, replace them now. It will be easier. The procedure is on the Seabee Club website here: **http://republicseabee.com/Files/Check%20Your%20Rudder%20Cables.pdf**.
The locking Tail Wheel Seabees don't seem to have the fraying issue as much as the Steerable Tail Wheel versions but check them anyway.

Republic used 2" pulleys for the forward rudder cables which are really too small. AC43.13 says minimum pulley diameter for these 5/32" cables is 3-3/4". Who knew? This could cause the fraying you may see. There is a cure (not a fix) for this in an up-coming article.



Forward Rudder Pulleys aft of Rudder Pedals
(Rudder Pedals Removed for painting)

Remove the triangular side panels just forward of the Air Rudder and disconnect any wiring going to the Air Rudder. You should have one wire connection for the white taillight and there may be others. Remove the Air Rudder by removing the hinge bolts; one on top, one in the middle and two at the lower rudder control horn. This will allow the Air Rudder to be removed by pulling it straight aft. Use care in pulling the taillight wire (and others) through the tail bulkhead. Set the Air Rudder aside.

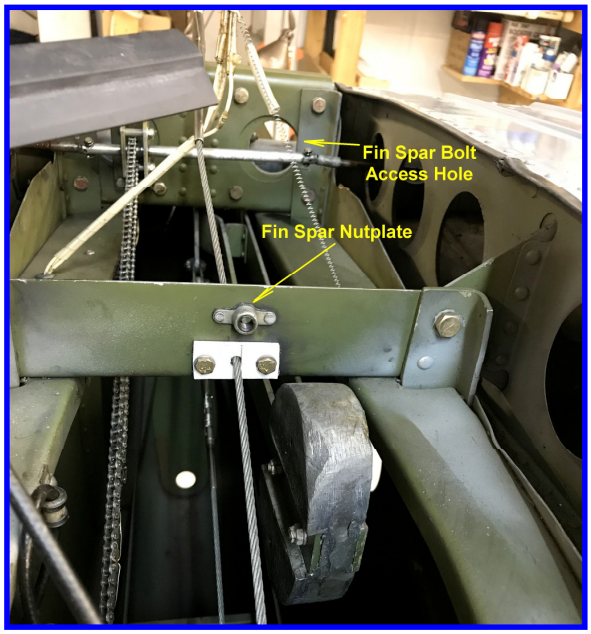
The vertical fin must be removed to gain access to the aft rudder pulleys (2”) under it. There are five bolts holding the vertical fin in place; four on the aft vertical fin bulkhead and one way inside the vertical fin at the forward vertical fin spar. These are all 5/16” bolts so one socket will remove them all. The four bolts on the bulkhead are simple to remove but the one bolt inside the fin is a little tricky.

You can remove this bolt in one of two ways:

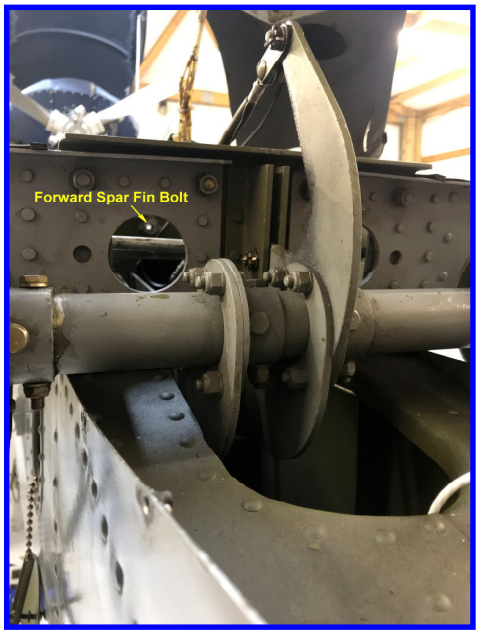
Method 1 – Lift the elevators up to lower the elevator counter weight. A 14” piece of PVC pipe holding the control wheel back in the cockpit works great. Then remove the left-hand hand hole just below the left horizontal stabilizer. Reach up and forward into the hand hole and locate the spar bolt. It’s just above the upper elevator cable. Remove it. Don’t drop it. Okay, get a magnet and pick it up.

Method 2 – Get a flashlight and locate the forward bolt at the vertical fin forward spar. You can shine the flashlight through the left triangular access panel that covers the fin and fuselage. With a long (24”) socket extension and a 1/2" socket, go in from the left triangular access panel and over the elevator trim sprocket to remove the bolt. The bolt goes into an anchor nut so you don’t have to worry about losing the nut. This anchor nut is riveted to the fin retaining spar that is attached to the airframe.

NOTE: After removing the vertical fin, if the spar bolt can be turned by hand into the nutplate, the nutplate must be replaced (P/N AN366F-524A).



Front View - Fin Removed

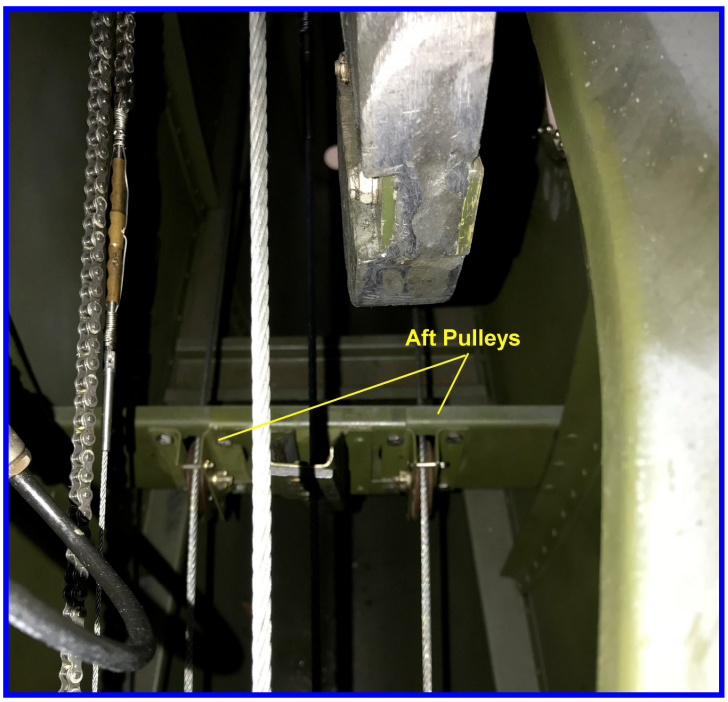


Rear View - Forward Bolt Access

Place some soft padding (moving blanket) on the left or right elevator to prevent scratching the paint. With the help of another person, lift the vertical fin straight up and over onto the padding. Take care to not strain the wires (antenna, lighting, etc.) that may be running up the vertical fin. You should be able to disconnect the wires going up the vertical fin if you want to move the fin elsewhere.

Remove the rudder control horn pivot bolt (at the lower end of the tail spar) and pull the rudder control horn aft. The cables can then be removed from the control horn and fed forward through the tail bulkhead (This will give enough slack to the cables so the “Junction” can be pulled through the side hand holes).

Just under the forward vertical fin attach point are two 2” pulleys. These must be removed to allow the cables to be pulled forward. The easy way to get the cables through this point is to remove the pulleys. There should be a cotter pin or retaining pin going through the pulley bracket that prevents the cable from slipping off the pulley. It is a pain to remove the pins so take the pulleys off. Check the pulleys for wear and replace if necessary. Check the pulley clevis bolts, as above, for wear and replace if necessary.



Aft Rudder Pulleys below Vertical Fin

Check the rudder control horn bushings for wear and replace if necessary. These are common oilite bushings and are available at most aviation supply stores. Also, check the hinge bolts for wear. If you can run your fingernail down the grip of the clevis bolt and you don't feel any grooves or resistance, then you can reuse them. If you feel any imperfections in the bolt grip they must be replaced. See photo below.

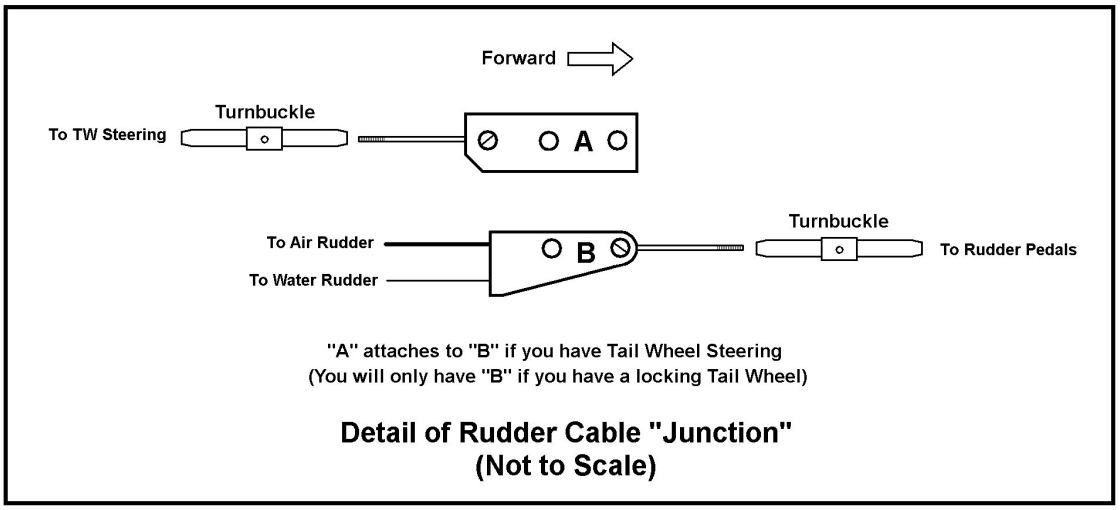
Lower Rudder Control Horn Pivot (Note Oilite bushings)

Open the four side hand holes just forward and above the tail wheel. There are four fare leads that need to be removed in order to remove all the cables. There are two fare leads just above the Water Rudder that are part of the Water Rudder support bracket and two on the tail wheel bulkhead. The fare leads are a two-piece arrangement so once you have the bolts removed the fare leads slip apart for cable removal.

Aft fare leads above tail wheel

Aft fare leads above water rudder

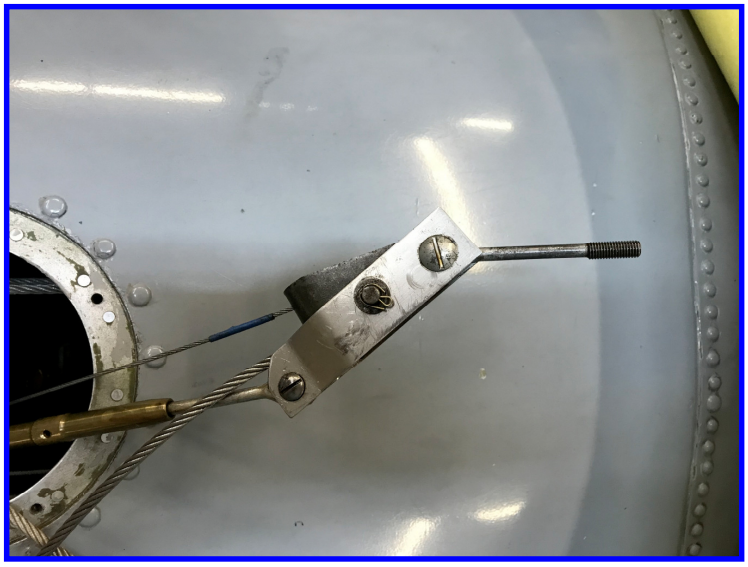
You should have enough slack in the cables now to disconnect the Water Rudder cables at the springs located at the top of the Water Rudderpost. Remove the turnbuckles and keep the turnbuckles on the springs for now. Remove the safety wire from the tail wheel steering cables and remove the turnbuckles. Remove the turnbuckles on the forward end of the junction leading to the forward rudder cable. You can then pull the cable “Junctions” out through the top access, if you have it, or the side hand holes.



Sketch of the “Junction”.

"B" must be sent to the cable shop with the Air Rudder and Water Rudder cables connected to it.

If you don't have tail wheel steering, you can now remove the aft Air Rudder/Water Rudder cables out through the side hand holes. If you have tail wheel steering, you must remove the tail wheel cable fitting that is sandwiched over the "Junction" (Part "A" above). Not that it matters that much but I labeled the junctions left and right for later installation.



"Rudder Cable Junction. Small cable is Water Rudder.
Turnbuckle is Tail Wheel Steering. Large Cable is aft Air Rudder.
Stud to the right goes forward to the Rudder Pedals.
(Top handhole shown. Side handhole will work too)

With all of the "obstacles" removed you can now take the aft Air Rudder/Water Rudder cables out and you should have the aft Air Rudder cable, Water Rudder cable and "Junction" as a unit. As I mentioned, the cable assembly must be sent to the cable shop as a unit as the "Junction" must be installed on the cable before the cable end balls are swaged in place. I would prefer to be at the shop when they do it but this is not practical in most cases. If your Water Rudder cables are in good shape they should not have to be replaced when the aft Air Rudder cables are swaged in place.

> **Note:** It was recommended by Beachhurst Industries, the expert cable guy, that you use galvanized steel cables instead of stainless steel. The galvanized process allows for lubrication between the cable strands where the stainless steel does not. He says, "When you see the first signs of rust on a galvanized cable you still have 15 years of life left."

After receiving your new cables, reinstall them in this order. Leave all the turnbuckles and connections loose for the moment:

- ❑ Feed the Air Rudder and Water Rudder cable through the side or top hand hole.
- ❑ Assemble the "Junctions" as shown in the photos you took.
- ❑ Feed the cables through their respective fare lead openings in the tail wheel bulkhead.

Caution: Be sure the cables are not twisted around any other cables or wiring.

- ❑ Route the Air Rudder cables through the aft tail wheel bulkhead.
- ❑ Route the Air Rudder cables through the fare leads above the Water Rudder
- ❑ Route the Air Rudder cables through the aft rudder pulleys below the vertical fin.
- ❑ Install the aft Air Rudder pulleys making sure the clevis nuts are safetied. Cables go on the top of these pulleys.
- ❑ Be sure the pulleys turn smoothly. Check that the pulley does not rub on the pulley brackets. Replace the pulley bracket if it is rubbing.
- ❑ Feed the Air Rudder cables through the aft tail bulkhead where the Air Rudder control horn is located.
- ❑ Install the Air Rudder cables onto the control horn and install the control horn.
- ❑ Safety the control horn clevis bolt nut.
- ❑ Attach the forward Air Rudder cable turnbuckle to the “Junction”.
- ❑ Make sure the forward Rudder cables are not twisted around other cables or wiring.
- ❑ Loosely attach the Water Rudder cables to the springs.
- ❑ Attach the tail wheel steering turnbuckles but do not tighten yet.
- ❑ Install the forward Air Rudder cables on the rudder pedal control arms. Do not safety yet.
- ❑ Install the forward 2” pulleys but do not safety them yet.

WARNING: The Air Rudder cables must be “stretched” around the Air Rudder control horn before final cable tension is adjusted. Tighten turnbuckles to about 50# tension and check that the Air Rudder cables are tight around the control horn cable channels. The ball end of the Air Rudder cable makes a very sharp turn around the ball socket and the cables must be tight against the control horn.

- ❑ With the tail wheel jacked up, move the rudder pedals back and forth a few times to seat the cables.
- ❑ Check that the ball ends of the Air Rudder cables go tightly around the control horn.
- ❑ Center the Rudder Pedals up front. (I use two pieces of wood and a clamp to keep the rudder pedals aligned evenly).
- ❑ Install the vertical fin (and rubber molding) with the five bolts mentioned above.

NOTE: You may need the help of another person to push down on the leading edge of the vertical fin to get the spar bolt in place. Check that the rubber molding is not pinched between the vertical fin and airframe.

- ❑ Carefully lift the Air Rudder in place and feed the electrical wire(s) through the hole in the tail bulkhead.
- ❑ Install the Air Rudder with the hinge bolts and safety.
- ❑ Connect any wires going to the Air Rudder (tail light, etc.)
- ❑ Loosen the Air Rudder turnbuckles then slowly tighten them until the Air Rudder is centered.

- ❑ Tighten the Air Rudder cable turnbuckles to specifications (20# +- 5#). Err on the high side (i.e. 25#) as the tension will most likely be reduced after a few flights.
- ❑ Check the alignment of the Air Rudder to the Rudder Pedals. Adjust turnbuckles if necessary.
- ❑ Remove the forward rudder cable from the control arms up front and remove the forward pulleys.
- ❑ Without adjusting anything, safety the Air Rudder turnbuckles as noted below.

> **Note**: The Air Rudder turnbuckles are much easier to safety through the side hand holes. Without turning the turnbuckles, the "Junctions" can be pulled out of the left or right hand holes and safetied from outside the fuselage. There must not be more than three threads showing on any turnbuckle end. Use 0.041" safety wire and double wrap according to AC 43.13.

- ❑ Attach the forward Air Rudder cables to the rudder control arms and safety.
- ❑ Install the forward 2" rudder pulleys and safety.
- ❑ Check that the Air Rudder cable tension is within limits (20# +- 5#). Readjust if necessary.

> **Warning:** If the tail wheel steering and water rudder cables are too tight, they will affect the aft Air Rudder cable tension. Check the tension on the Air Rudder cables in two places (forward Air Rudder cable and Aft Air Rudder cable) after the tail wheel and water rudder cables are hand tight.

- ❑ Attach the Tail Wheel Steering turnbuckles to the "Junction".
- ❑ Tighten them just hand tight.
- ❑ Jack up the tail.
- ❑ Check the alignment of the tail Wheel with the Air Rudder. They should match.
- ❑ Adjust them if necessary using the Tail Wheel turnbuckles.
- ❑ Safety the Tail Wheel turnbuckles. (0.032" safety wire)
- ❑ Attach the Water Rudder cables with the associated turnbuckles.
- ❑ Tighten them hand tight.

> **Note**: The Water Rudder cables and tail wheel steering cables are tightened "hand tight"; just enough to take the slack out of the cables.

- ❑ Check the alignment of the Water Rudder to the Air Rudder. They should match.
- ❑ Adjust turnbuckles if necessary.
- ❑ Safety the Water Rudder turnbuckles (0.025" or 0.032" safety wire).
- ❑ Check the movement of the rudder pedals. There should be no binding.
- ❑ If all is well, install the four fare leads.
- ❑ Check that the Air Rudder, Tail Wheel and Water Rudder move in the correct direction and are in alignment.
- ❑ Lower the tail.
- ❑ Using a flashlight and a mirror through the hand holes, check that the cables are not twisted around other cables or wiring.
- ❑ Close all hand hole covers securely.

- ❑ Check that the forward pulleys and control arms are safetied.
- ❑ Install all interior panels and seats.

New cables tend to stretch a bit so check the cable tensions after your first flight. Then check them again after 10 hours or so. After that you are probably good to go until the next annual inspection. **YOU MUST** check the Air Rudder cable tension in two places; on the forward Air Rudder cable and on the aft Air Rudder cable. As mentioned above, the tail wheel cables and water rudder cables can affect the Air Rudder cable tension.

This isn't an easy job and two people make it much easier but if you gotta do it, you gotta do it. Make sure your mechanic signs the logbook and you are pretty much done.

BE SURE TO CHECK FOR CORRECT MOVEMENT OF THE AIR RUDDER, TAIL WHEEL STEERING AND WATER RUDDER BEFORE YOU FLY!!