Supplement–ES/IV Internal Rudder Bellcrank Assembly

S.1 Introduction

This supplement, the *ES/IV Internal Rudder Bellcrank Assembly*, replaces the instructions provided in INS-RD-066. This also replaces the external rudder cable controls described in Chapter 12 of the *ES Assembly Manual*.

Installing the internal push-pull tube rudder controls is a valuable enhancement to your aircraft. Although this option adds weight to your plane, moving the controls rods inside the fuselage will reduce drag and will also reduce the travel in the rudder pedals.

Steps to Completion

- Install a replacement hinge at the bottom hinge in the rudder.
- Build a phenolic shelf for the bellcrank.
- Install the bellcrank on the new shelf.
- Assemble all the rod ends.
- Connect the rudder to the bellcrank.
- Connect the rudder pedal cables to the bellcrank.

Parts List

The optional kit (RD-066-B) contains a separate parts list. All the parts required for the installation of this option are included in kit RD-066-B.

A Word about Sanding and Cleaning

The instructions in this chapter refer to preparing a surface or preparing a bonding area. When we recommend preparing a surface or a bonding area, we expect each of the following steps to be completed every time.

1. Sand the area using 40-grit sandpaper.
2. Vacuum all sanded areas.
3. Clean all sanded surfaces with Acetone.

S.2 Construction Procedures

S.2.A Replacing the Rudder's Bottom Hinge

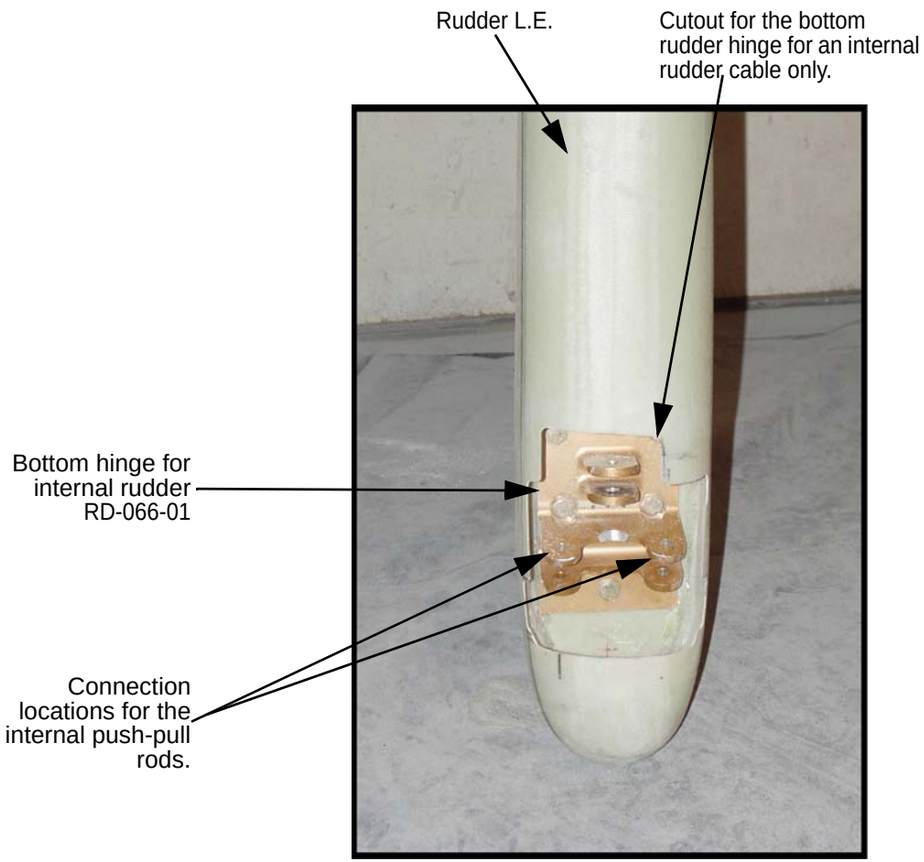
The internal rudder bellcrank requires a new hinge to replace the existing hinge on the bottom of the rudder. But first some adjustments need to be made.

Steps...

1. Remove the bottom hinge from the rudder.

   Tip: The new hinge will mount 1" higher than the original hinge.
2. Prepare the surface of the rudder spar for mounting the new bottom hinge (RD-066-01). The area you are preparing needs to be 1" higher than the original hinge's location.
3. Secure the new hinge using the hardware from the old hinge you removed.
4. Hang the rudder from the v. stab. by inserting a rod through the hinge connections.
5. Use a level to locate the position where the push-pull rods, extending forward from the new rudder hinge, will need to pass through the v. stab. bulkhead.
6. Mark two circles, one for each push-pull rod, on the v. stab. bulkhead.
7. Cut two holes in the v. stab. bulkhead where you marked the circles. Refer to Figure S.2.B.1 on the next page.
   - Each rod needs a minimum of 1/8" (3 mm) clearance through the full rod/rudder travel.
   - Holes need to maintain the same separation as the connections on the rudder hinge.
8. Seal the edges of the holes with micro or flox, keeping a tight 1/8" (3 mm) tolerance around the tube.

Figure S.2.A.1 Cutout for the bottom rudder hinge only. This is for the internal rudder cable.



S.2.B Building the Shelf for the Internal Rudder Bellcrank

Now you need to fit and install the shelf that will support the internal rudder bellcrank. The bellcrank will bolt to the shelf after the shelf is bonded in place.

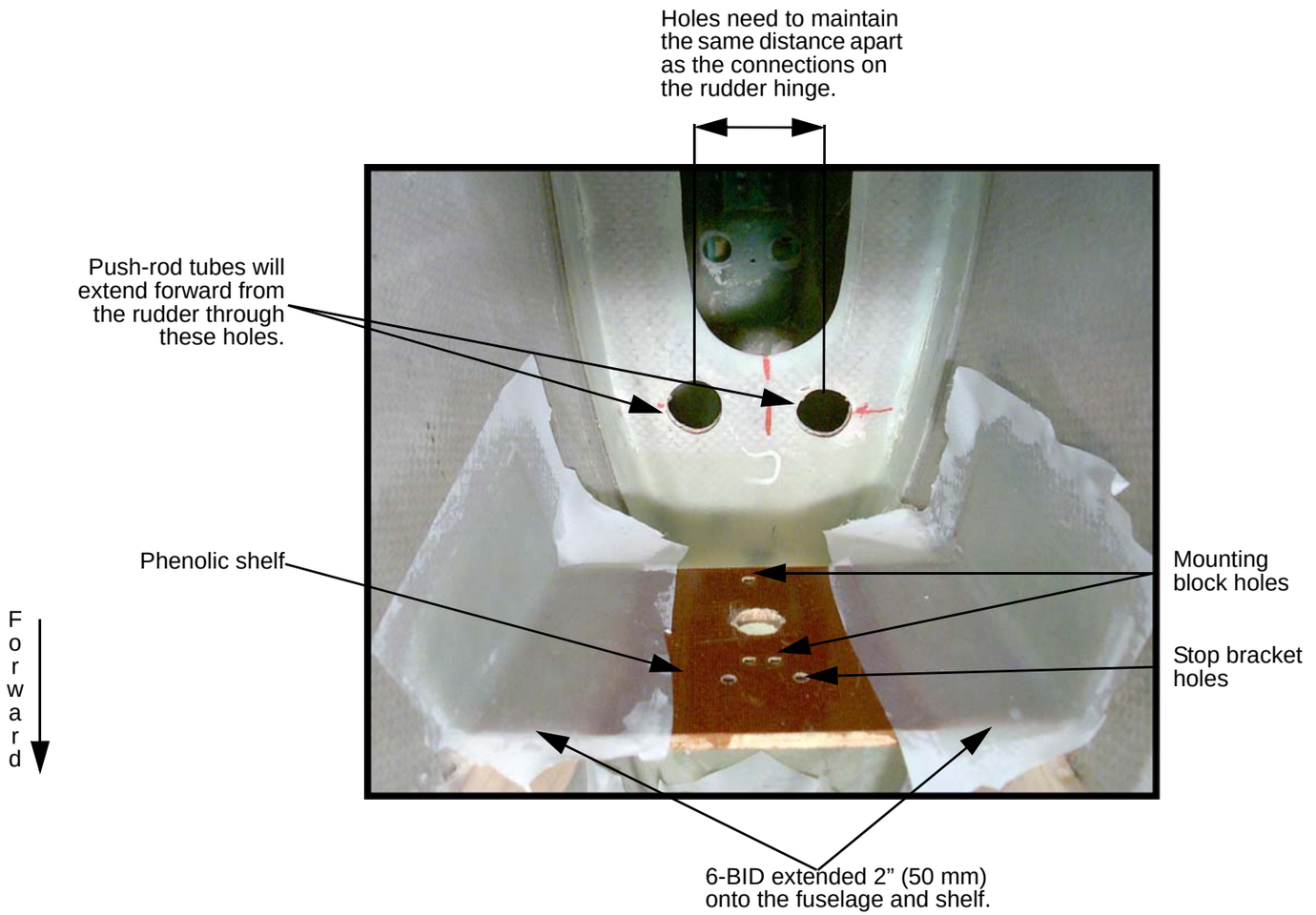
Steps...

1. Using the piece of phenolic (PH-250-8x10) included in the internal rudder kit (RD-066-B) perform a prefit of the shelf.

   Shelf location guidelines:

   - Use push-rod tubes extended forward from the new rudder hinge and inserted through the holes in the v. stab. bulkhead to help locate the height of the shelf.
   - Set the bottom of the shelf so it is approximately in line with the bottom of the access panel opening.
   - Shelf is just aft of the access panel opening.
   - Set the bellcrank on the shelf and check that the push-rod tubes can connect to the bellcrank and the tubes are also level.
2. Carefully trim the shelf until it sits in this position.
3. Center the stop bracket (RD-066-03) and the mounting block (RD-066-04) on the phenolic and mark the six holes where bolts will secure the bellcrank to the shelf.
4. Drill the six holes in the shelf at the marked locations for the bolt size needed for each hole.
   - One aft hole – for mounting block bolt AN3-20A
   - Large hole in middle – for pivot arm bolt AN5-16A
   - Two holes close together – for mounting block bolts AN3-20A
   - Two most forward holes – for stop bracket bolts AN3-12A
5. Mount the phenolic shelf to the fuselage using flox.
6. Make a flox fillet where the shelf meets the fuselage.
7. Secure the self using a 6-BID along the top and bottom of the board, along the fuselage, extending 2” (50 mm) onto the board and onto the fuselage.

Figure S.2.B.1 Installing the shelf for the internal bellcrank



S.2.C Installing the Bellcrank

Now you will begin the installation of the bellcrank.

Steps...

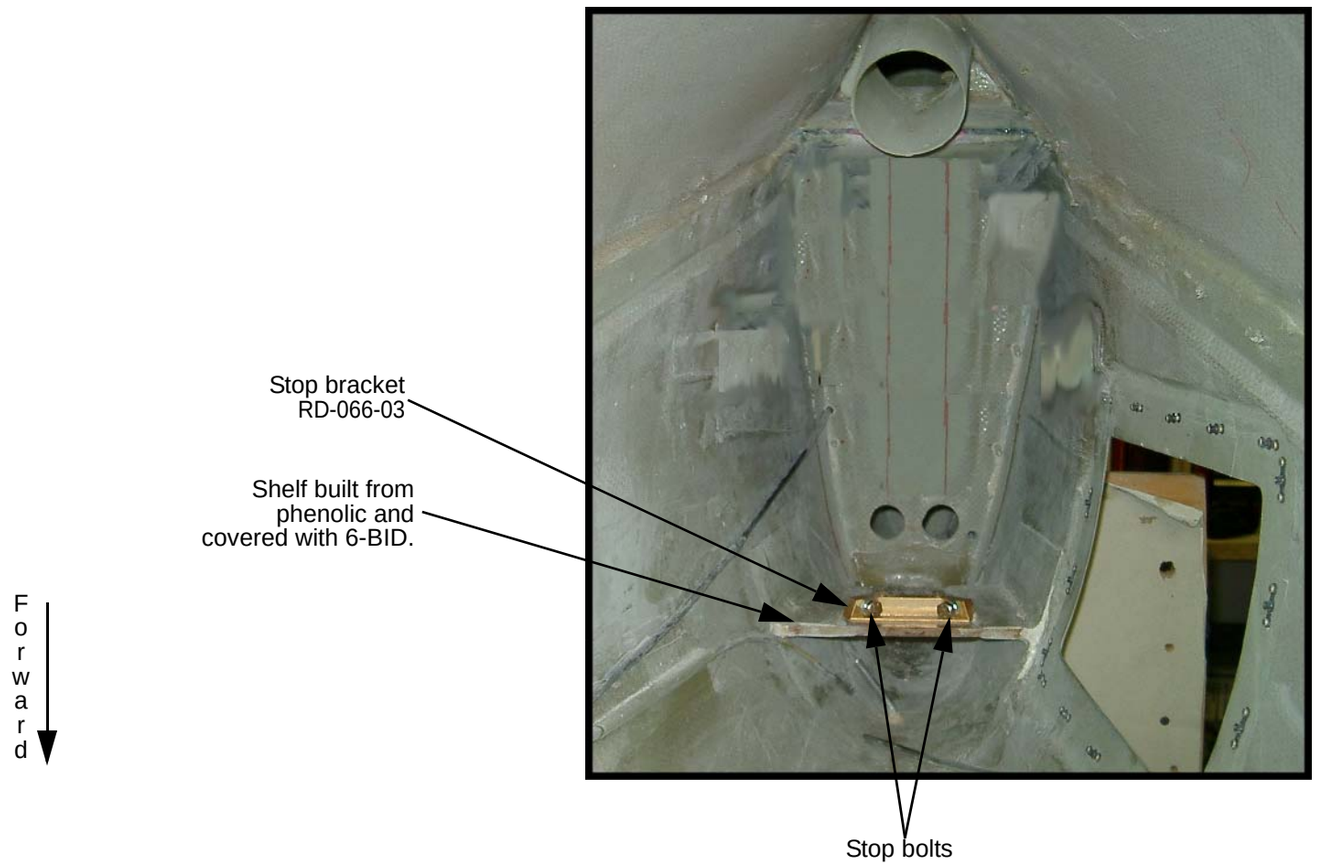
1. Locate the stop bracket (RD-066-03) over the holes you drilled in the shelf.

   Refer to Figure S.2.C.1 to correctly position the stop bracket.
2. Insert a bolt (AN3-12A) through each of the holes in the top of the stop bracket.

   The bolts should extend through to the bottom of the shelf.
3. Secure each bolt with a washer (AN960-10) and a check nut (AN365-1032A).

   Tip: Later in these instructions you will insert and adjust the stop bolt and nut.

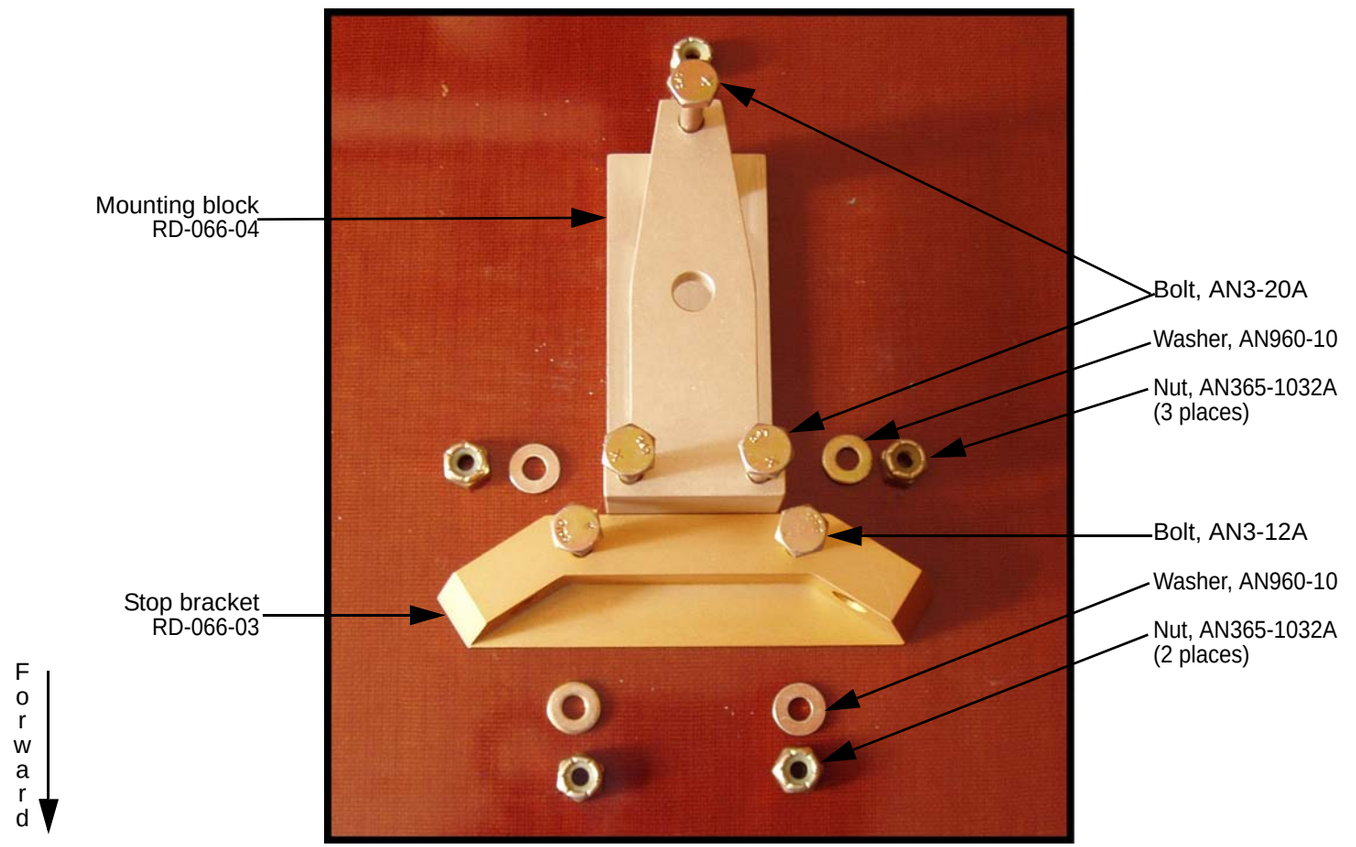
Figure S.2.C.1 Installing the stop bracket to the shelf



4. Position the forward end of the mounting block (RD-066-04) against the aft side of the stop bracket.
5. Insert a bolt (AN3-20A) through each of the holes in the top of the mounting block.

   The bolts should extend through to the bottom of the shelf.
6. Secure each bolt with a washer (AN960-10) and a check nut (AN365-1032A).

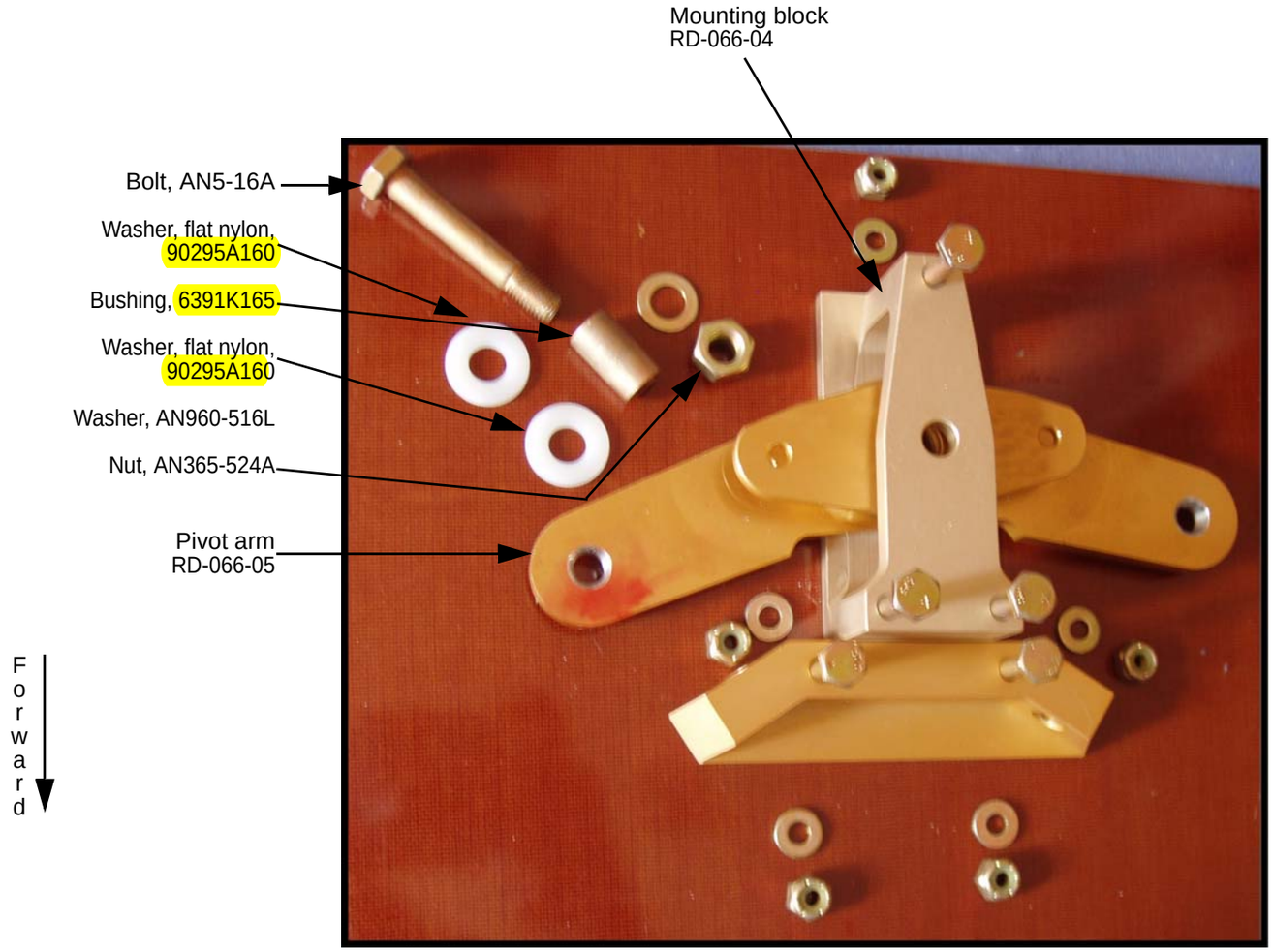
Figure S.2.C.2 Detailed view of the stop bracket and the mounting block



7. Insert the pivot arm (RD-066-05) through the center of the mounting block.
8. Align the holes and assemble the hardware referred to in Figure S.2.C.3 in the following order.
   - Slide the bolt (AN5-16A) through the mounting block only.
   - Slip a flat, nylon washer (90295A160) between the mounting block and the pivot arm.
   - Slide the bolt through the pivot arm and the bottom of the mounting bolt and push the bushing (6391K165) onto the bolt and up into the pivot arm.
   - Pull the bolt up just enough to slide the second flat, nylon washer (90295A160) between the base of the mounting block and the bottom of the pivot arm.
   - Drop the bolt down into place and secure it on the bottom of the phenolic with a nut (AN365-524A).

This completes the sections of the bellcrank that are bolted to the phenolic shelf.

Figure S.2.C.3 Securing the pivot arm to the bellcrank and the phenolic shelf



S.2.D Assembling the Rod-Ends

Now you need to assemble the rod-ends for the push-pull tubes and the rudder cables.

Refer to Figure S.2.D.1 on this page for a detailed view of these assemblies. The instructions are provided in the following order:

- assemble the turnbuckle rod-ends that will attach to the cables leading to the rudder pedals
- assemble the rod-ends that will attach to the rudder

Steps for assembling the rod-end with turnbuckle...

1. Thread a thin check nut (AN316-5) onto the rod-end bearing (110-0003).
2. Thread the same rod-end bearing into the turnbuckle barrel (AN170-46LS).
3. Thread a left-hand jam nut (103-0012) onto the turnbuckle (AN174-46LS).
4. Thread the same turnbuckle into the other end of the turnbuckle barrel.

Repeat these steps to assemble the second rod end.

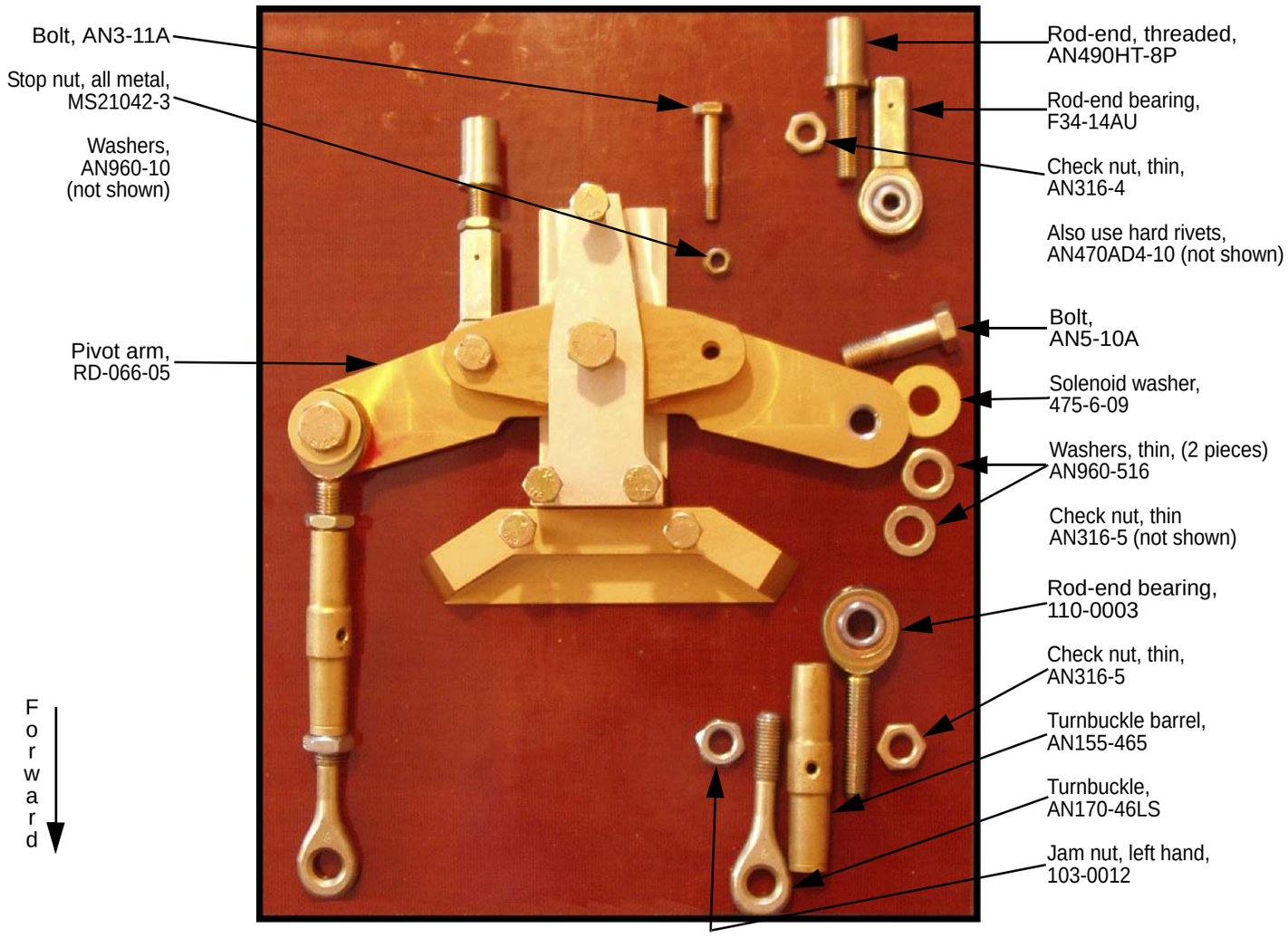
Steps for assembling the threaded rod-end...

1. Thread a thin check nut (AN316-4) onto the threaded rod-end (AN490HT-8P).
2. Thread the same threaded rod-end into the rod-end bearing barrel (F34-14AU).

Repeat these steps to assemble the other three rod-ends, two will be attached to the pivot arm of the bellcrank and the other two will be attached to the hinge on the rudder.

Tip: Remember all of the threaded rod-ends will have tubes connected to them. See the *ES Assembly Manual*, page 7.14, Figure 7.3.C.4 to review how to finish the rod ends. You will use the rivets (AN470AD4-10) included in this optional kit to complete the rod ends.

Figure S.2.D.1 Assembly of all rod-ends and rod-end connections to the bellcrank



S.2.E Connecting the Rudder Push-Pull Tubes

Now you will temporarily connect the push-pull tubes extending from the rudder hinge to the pivot arm.

Steps for connecting the rod-ends to the rudder hinge...

1. Slide the push-pull tubes into the holes you made in the v. stab. bulkhead and line up the aft rod-ends with the rudder hinge.
2. Insert a bolt (AN3-12A) into the hinge.
3. Slide the bolt through the rod-end bearing.
4. Finish inserting the bolt through the hinge.

   For now do not secure the bolt. Later when you are through making adjustments you will secure the bolt with a stop nut (AN365-1032A).
5. Cut the rod to length from the forward end.
6. Connect a rod-end bearing to the other end of the rod and secure it as you did on the previous page.

Steps for connecting the rod-ends to the bellcrank's pivot arm...

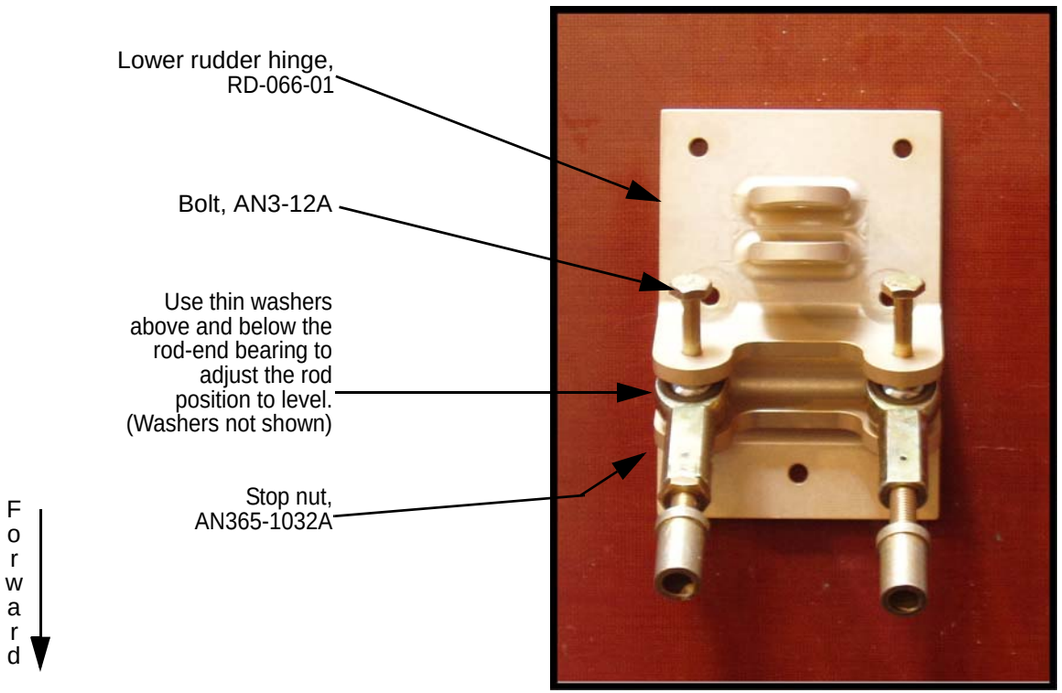
1. Slide a bolt (AN3-11A) through the pivot arm.
2. Slide a washer (AN960-10) onto the bolt.
3. Slide the bolt through the rod-end bearing
4. Add another washer (AN960-10) onto the bolt. This washer is between the rod-end bearing and the pivot arm.
5. Slide the bolt through the pivot arm and secure it with a stop nut (MS21042-3).

Repeat both of these steps to connect the second push-pull tube to the rudder hinge and the pivot arm.

Adjustments...

- Adjust the level of the push-pull tube by adding washers (AN960-10) to the bolt (AN3-12A) that runs through the rudder hinge.
- Run the rudder through its full travel. Adjust the push-pull tube length if necessary.

Figure S.2.E.1 Rudder hinge connections



S.2.F Connecting the Rudder Pedal Cable

Now you will temporarily connect the rudder cable to the pivot arm.

Steps for connecting the turnbuckle rod-ends to the pivot arm...

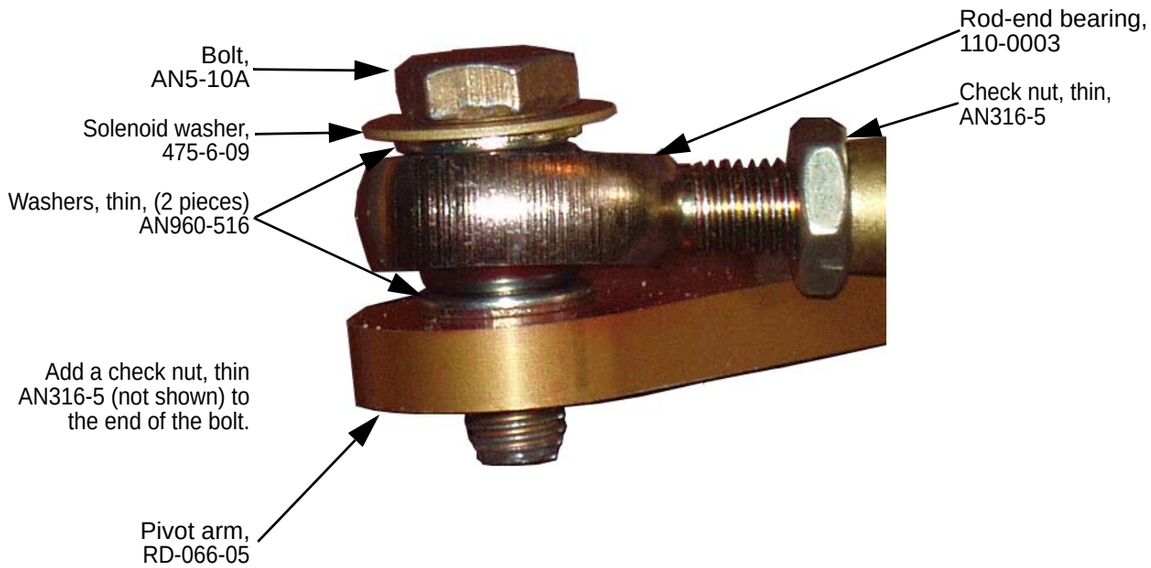
1. Slide a solenoid washer (475-6-09) followed by a thin washer (AN960-516) onto bolt (AN5-10A).
2. Slide the bolt containing the two washers through the rod-end bearing end of one of the two turnbuckle assemblies you completed earlier on page 6.7.
3. Add another washer (AN960-516) onto the bolt. This washer is between the rod-end and the pivot arm.
4. Slide the bolt through the pivot arm and secure it with a check nut (AN316-5).

Repeat these steps to connect the second turnbuckle rod-end to the pivot arm.

To determine the rudder cable length, refer to the *ES Assembly Manual*, section 12.3.I *Overview of the External Rudder Cable Installation* on page 12.18. This section of the manual will step you through the installation of the cable and how to adjust the cable.

Tip: You may prefer to position the turnbuckle connections at the forward end of the rudder cable, near the rudder pedals, so adjustments can be more easily made when needed. Refer to the figures on page 12.23 of the *ES Assembly Manual*.

Figure S.2.F.1 Connecting the rudder pedal cable to the pivot arm



S.2.G Setting the Stop Bolts

The bellcrank's pivot arm has two stop bolts that can be adjusted as needed.

Step...

1. Thread a jam nut (N-5/16-18) on each bolt (B-5/16-18).
2. Thread a bolt through each hole in the pivot bracket, from back to forward.

Adjustments...

The pivot arm hits the bolt as the arm moves. The bolt can be adjusted so the pivot arm moves more by:

- Backing the bolt off and then snugging the jam nut tight against the stop bracket.

Or the bolt can be set so the pivot arm moves less by:

- Loosening the jam nut, then turning the bolt further into the hole and snugging the jam nut right against the stop bracket.

Figure S.2.G.1 Setting the stop bolts