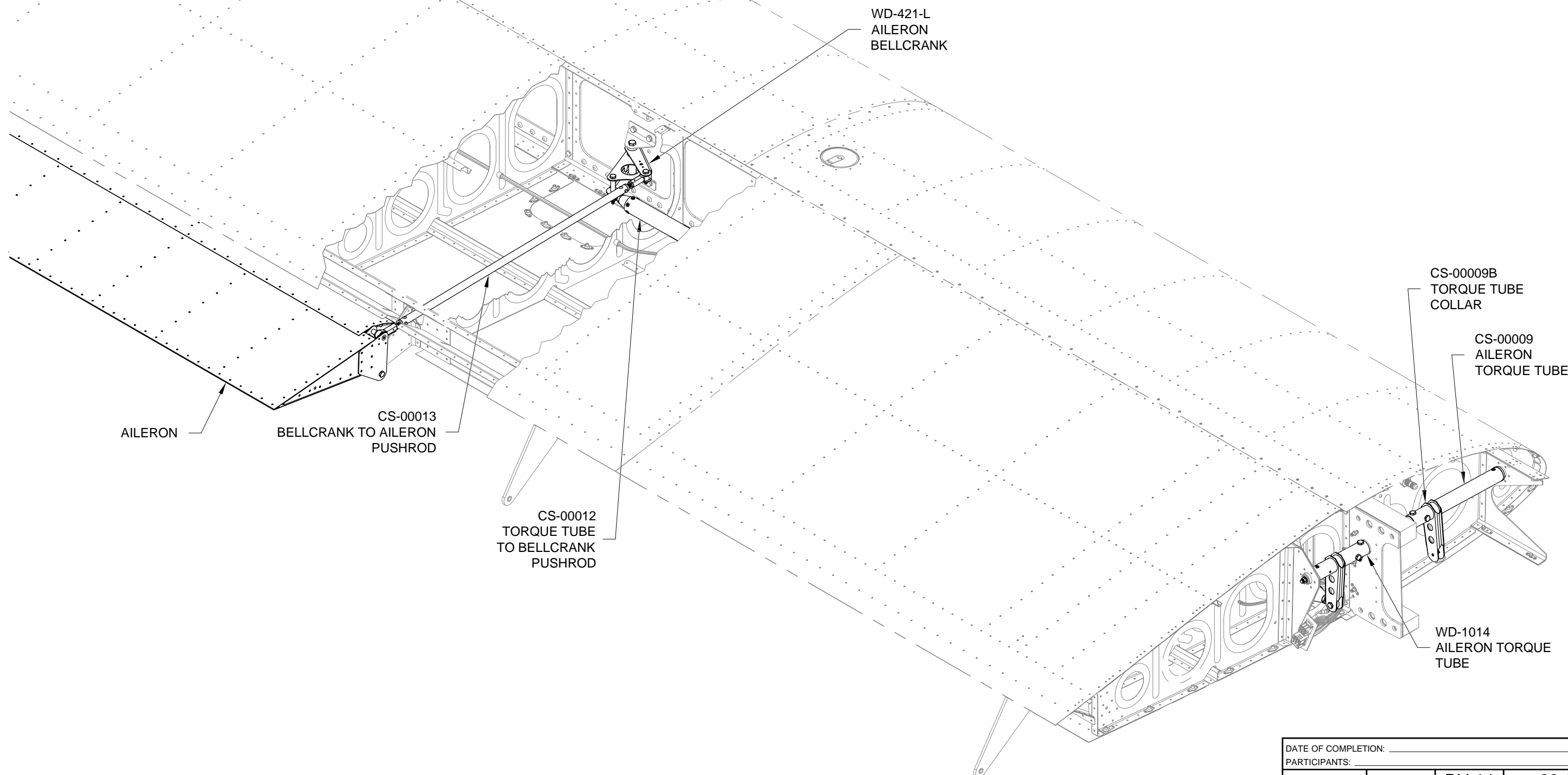




# SECTION 23:

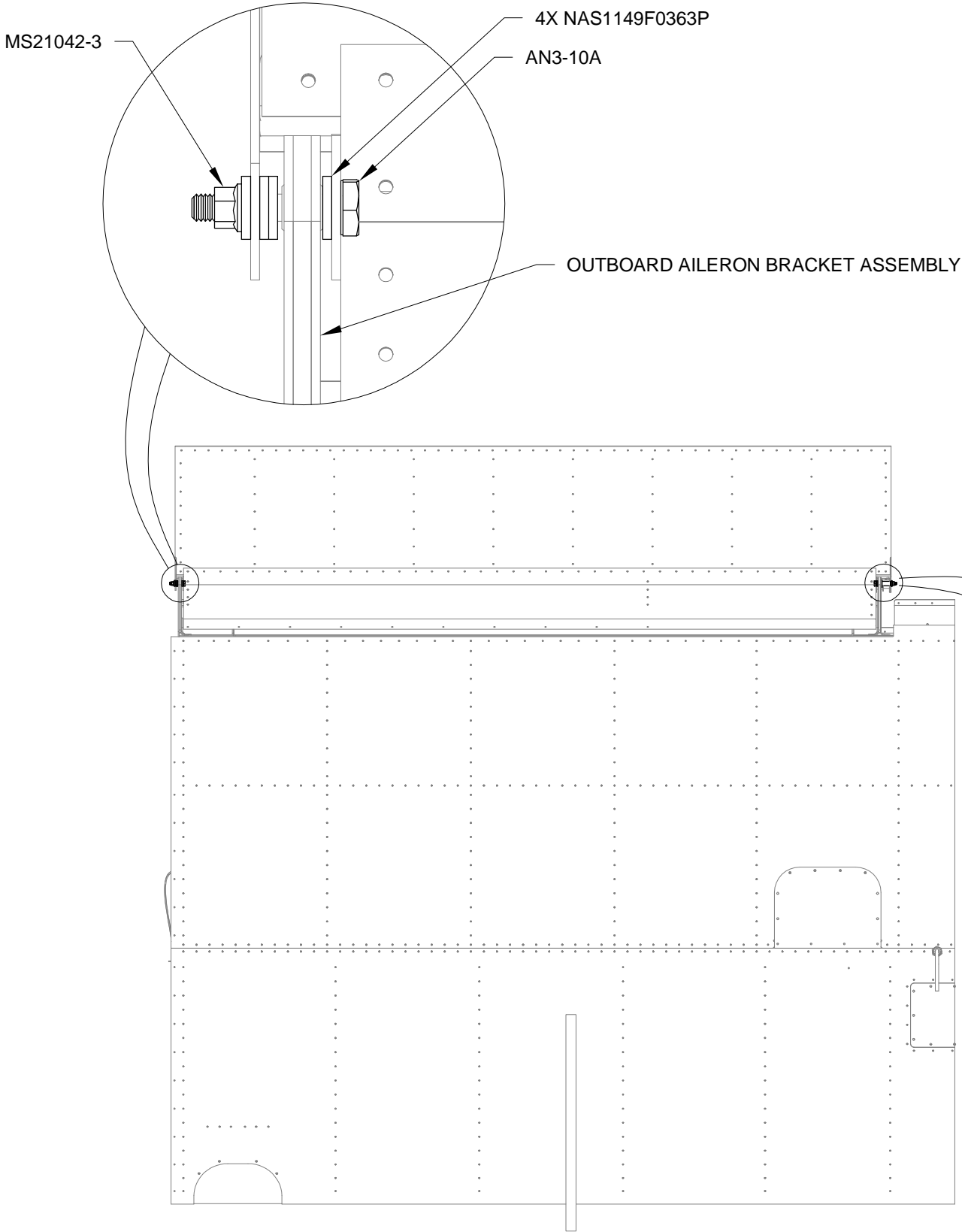
# AILERON ACTUATION



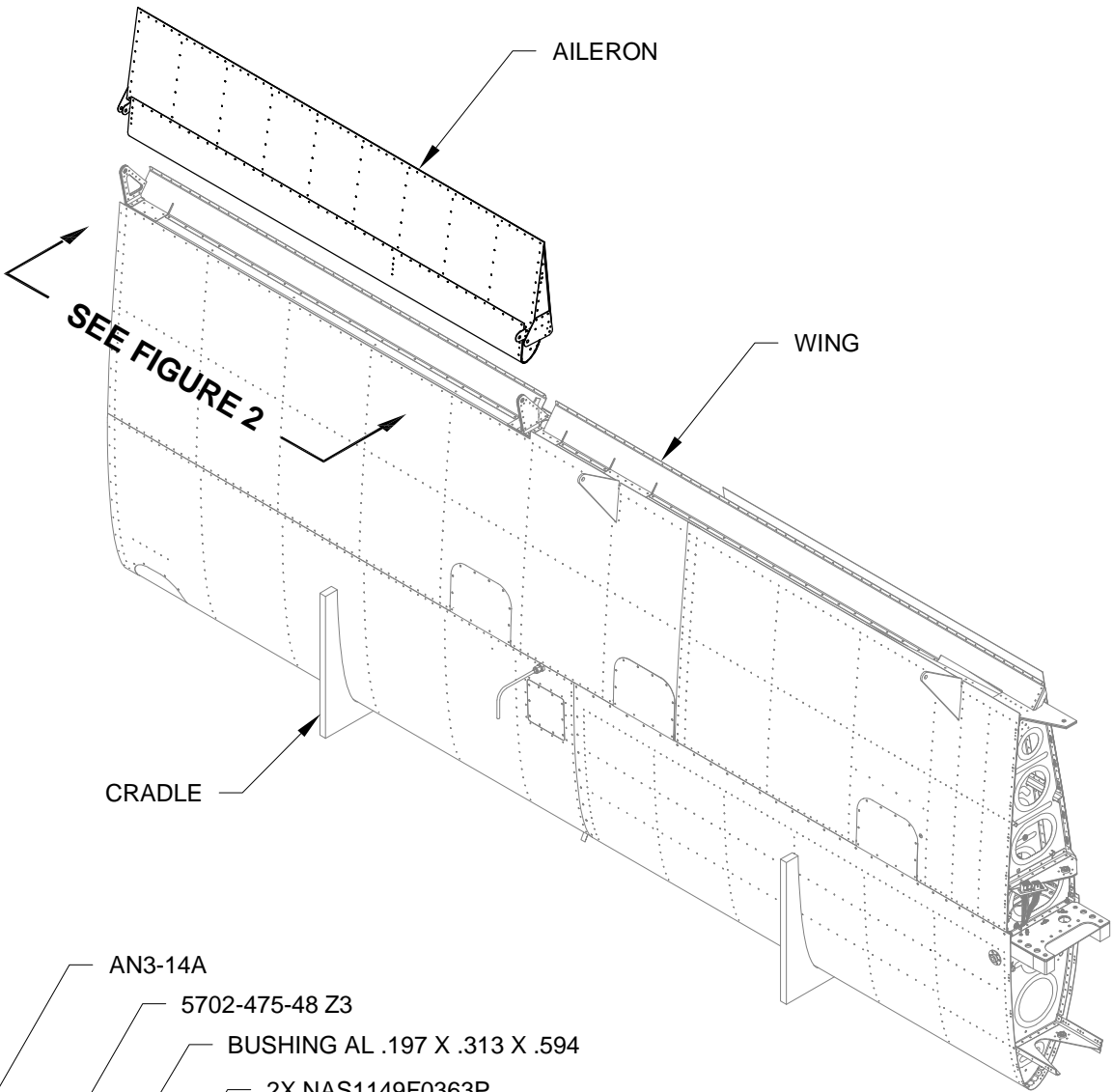


Step 1: Secure the Left Wing in the Cradle assembled on Page 17-02. See Figure 1.

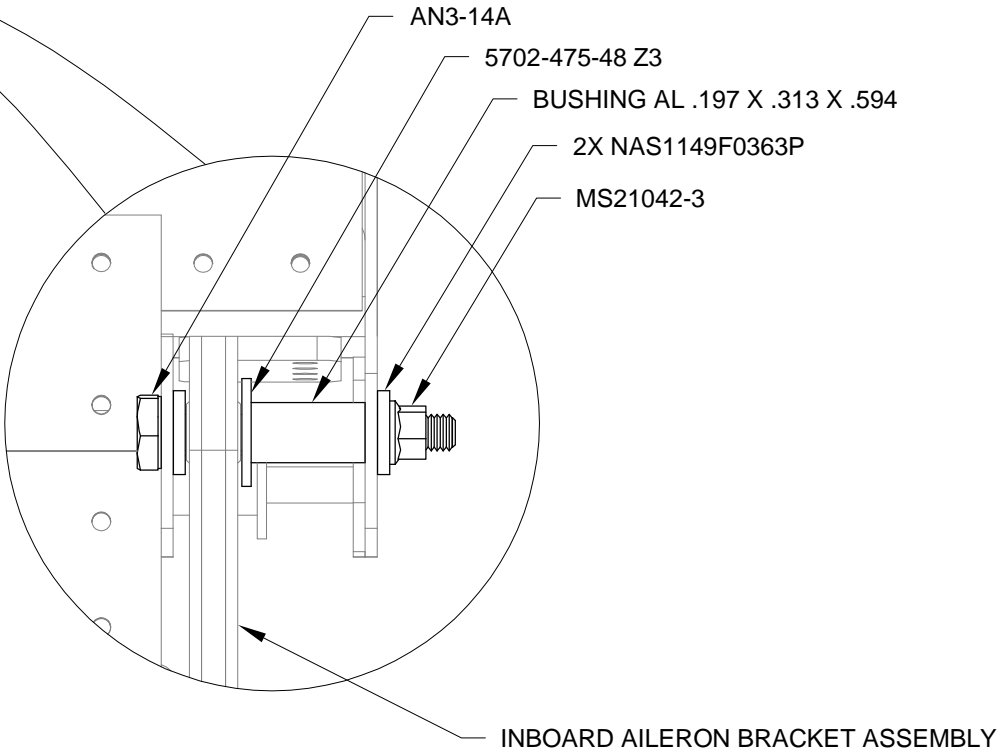
Attach the Aileron to the W-1014 Outboard Aileron Hinge Bracket and W-1013 Inboard Aileron Hinge Bracket in the Wing as shown in Figure 1 and Figure 2.



**FIGURE 2: AILERON ATTACH HARDWARE**

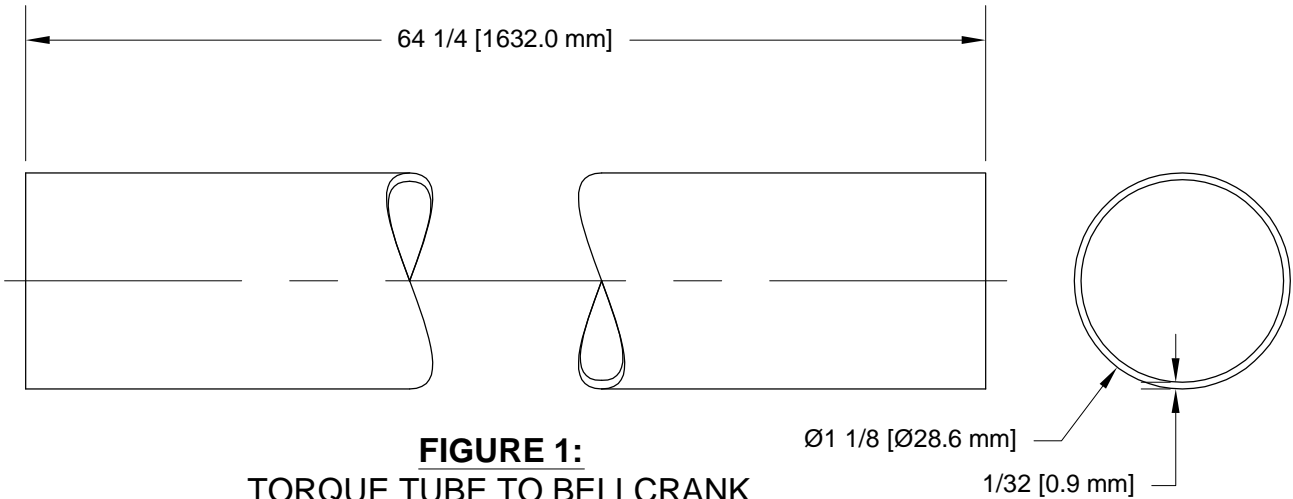


**FIGURE 1: AILERON & WING**



Step 1: Fabricate two CS-00012 Torque Tube to Bellcrank Pushrods by cutting two pieces of AT6-035 X 1 1/8 to the length shown in Figure 1.

A hacksaw with a fine tooth blade or die grinder with an abrasive cutting disc works well here.



**FIGURE 1:**  
TORQUE TUBE TO BELLCRANK  
PUSHROD FABRICATION

Step 2: Cut-out Page 23-11, Figure 1 and use it as a wrap-around template for locating the rivet holes in both ends of both CS-00012 Torque Tube to Bellcrank Pushrods.

Use clear tape to make the template into a ring and align it with the end of the pushrod.

Center-punch the "cross hairs" in the wrap-around template. Remove the template.

Drill #40 the six pilot holes in each end of both torque tube to bellcrank pushrods using the center-punch marks as drill guides.

Deburr the holes in the torque tube to bellcrank pushrods.

Step 3: Sand the outer diameter of a VA-111 Threaded Rod End as required to allow a tight slip fit into the end of one of the CS-00012 Torque Tube to Bellcrank Pushrods.

Proper engagement of the threaded rod end in the torque tube to bellcrank pushrod is when the end of the tube coincides with the edge of the taper in the threaded rod end. See Figure 2.

Match-Drill #30 the threaded rod end using the pilot holes in the torque tube to bellcrank pushrod as drill guides. Insert clecos in the holes as match-drilling progresses around the circumference of the torque tube to bellcrank pushrod.

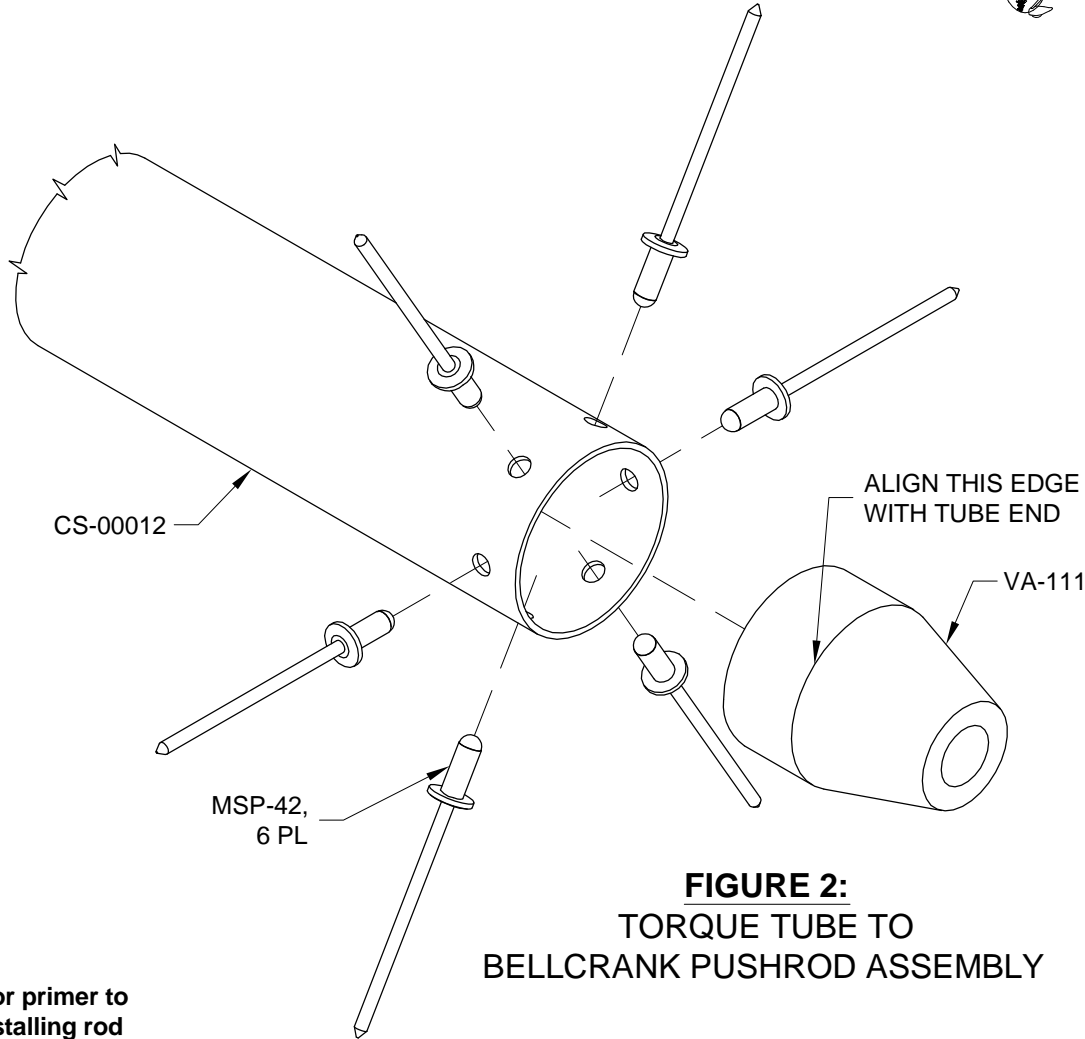
Repeat until the threaded rod ends have been match-drilled to both ends of the torque tube to bellcrank pushrods.

Mark the threaded rod ends so that they can be re-installed in the same position as when they were match-drilled.

Remove the threaded rod ends from the torque tube to bellcrank pushrods and deburr the holes.

Prime the interior, exterior and tube ends of the threaded rod ends and torque tube to bellcrank pushrods.

Permanently install the threaded rod ends to the torque tube to bellcrank pushrods using the rivets called-out in Figure 2.



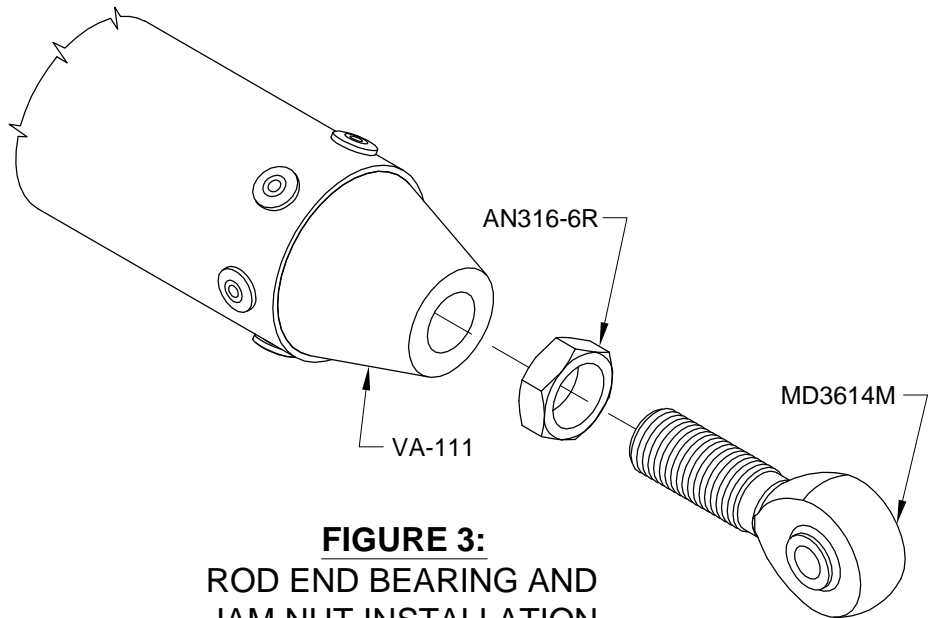
**FIGURE 2:**  
TORQUE TUBE TO  
BELLCRANK PUSHROD ASSEMBLY

**NOTE:** Allow time for primer to fully cure before installing rod end bearings.

Step 4: Install rod end bearings and jam nuts into the VA-111 Threaded Rod Ends as shown in Figure 3.

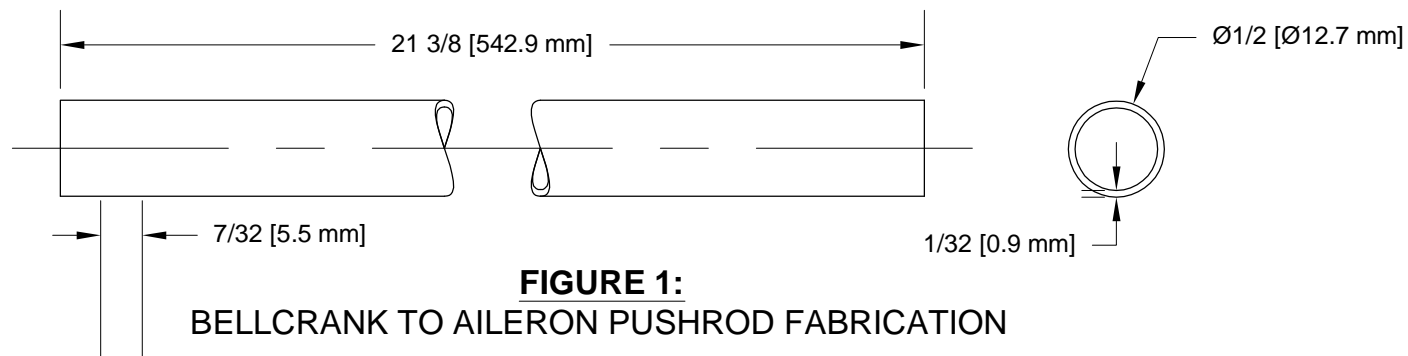
The correct engagement of the rod end bearings yields a bearing center-to-bearing center length of 67 7/16 [1712.9 mm].

The rod end bearing engagement may be adjusted during installation of the CS-00012 Torque Tube to Bellcrank Pushrod.



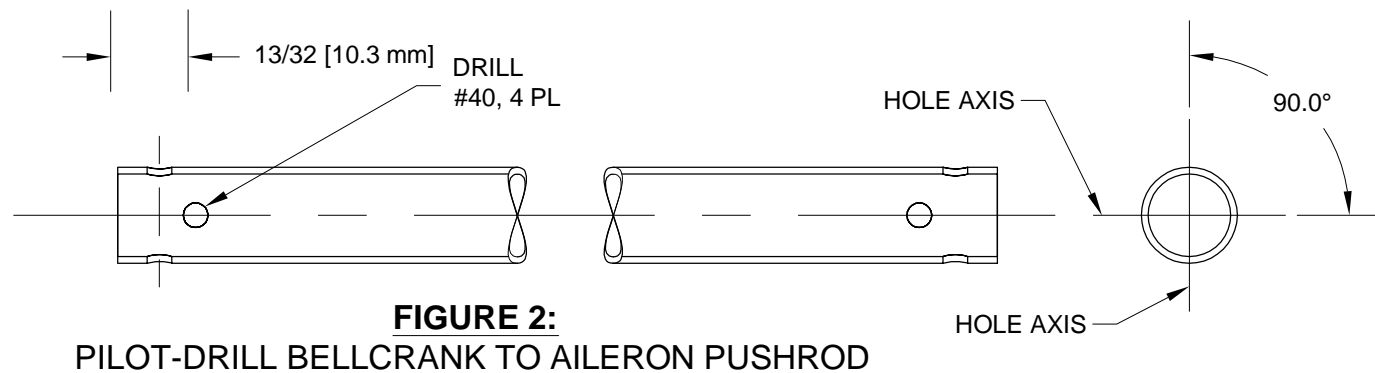
**FIGURE 3:**  
ROD END BEARING AND  
JAM NUT INSTALLATION

Step 1: Fabricate two CS-00013 Bellcrank to Aileron Pushrods by cutting two pieces of ST4130-035 X 1/2 (powder coated) to the length shown in Figure 1.



Step 2: Drill #40 the four pilot holes in each end of both CS-00013 Bellcrank to Aileron Pushrods as shown in Figure 2. Use a drill press to drill the holes and use a vee-block to support the pushrod tube while drilling.

Deburr the holes in the bellcrank to aileron pushrods.



Step 3: Insert an AN490-HT8P Threaded Rod End into the end of one of the CS-00013 Bellcrank to Aileron Pushrods until the step on the threaded rod end rests on the end of the bellcrank to aileron pushrod.

Match-Drill #30 the threaded rod end using the pilot holes in the bellcrank to aileron pushrod as drill guides. Insert clecos in the holes as match-drilling progresses.

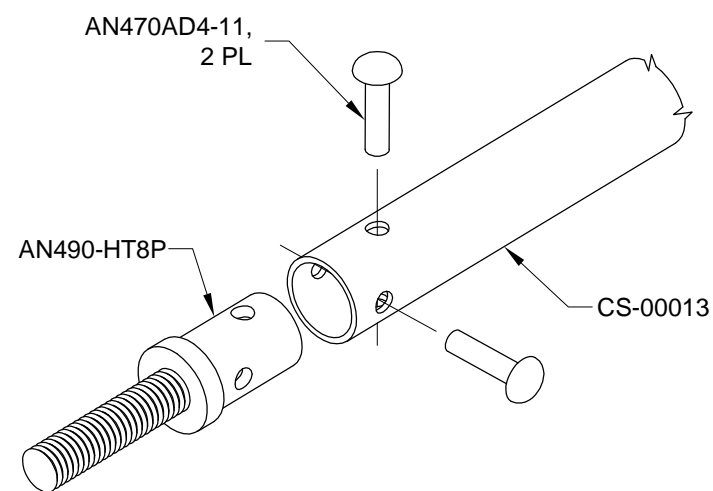
Repeat until threaded rod ends have been match-drilled to both ends of the bellcrank to aileron pushrods.

Mark the threaded rod ends so that they can be re-installed in the same position as when they were match-drilled.

Remove the threaded rod ends from the bellcrank to aileron pushrods and deburr the holes.

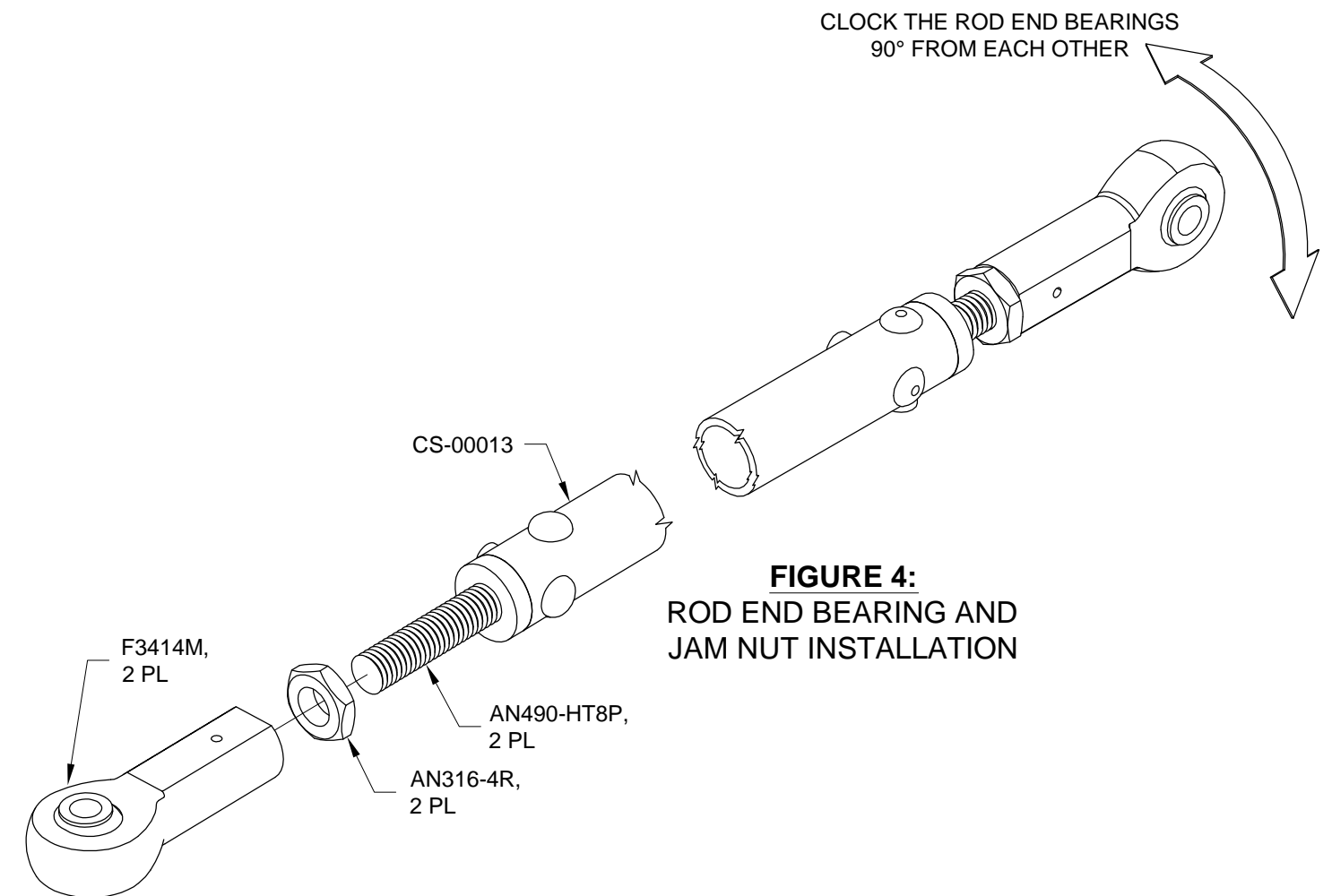
Prime the inside of the bellcrank to aileron pushrod.

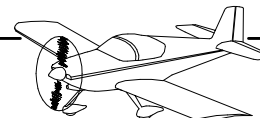
Permanently install the threaded rod ends to the bellcrank to aileron pushrods as shown in Figure 3. These rivets can be difficult to set without them leaning over. Use a hand squeezer to squeeze them a little at a time. If the rivet begins to lean over, adjust the position of the rivet in the squeezer dies to oppose the leaning tendency.



Step 4: Install rod end bearings and jam nuts into the AN490-HT8P Threaded Rod Ends as shown in Figure 4.

The correct engagement of the rod end bearings yields a bearing center-to-bearing center length of 25 1/4 inches [641.2 mm]. The rod end bearing engagement may be adjusted later during installation of the CS-00013 Bellcrank to Aileron Pushrod.





**Step 1:** Cleco a nutplate to the W-421-R Aileron Bellcrank through the screw hole. This nutplate allows for attachment of an autopilot servo pushrod and is installed on the right aileron bellcrank only.

Final-Drill #40 the nutplate rivet holes in the right aileron bellcrank.

Rivet a nutplate to the Aileron Bellcrank as shown in Figure 1.

Final-Drill #12 the .188 [4.8 mm] holes in both aileron bellcranks.

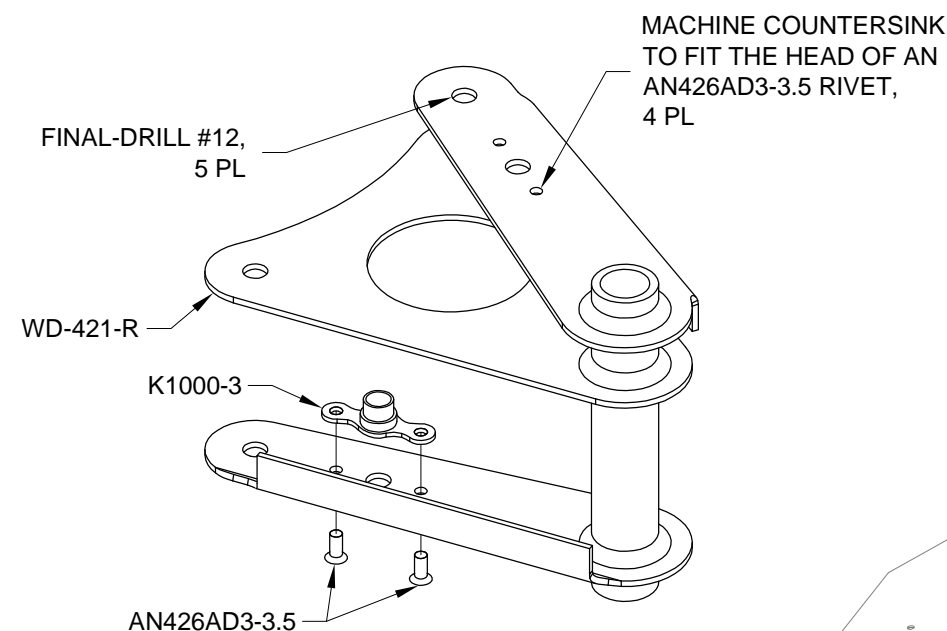
**Step 2:** Check that the length of both of the BUSH BS-.245 X .375 X 2.781 Aileron Bellcrank Bushings are between 2 3/4 inches [69.9 mm] and 2 25/32 inches [70.6 mm]. Trim if/as required.

Check that an AN4 bolt will fit the inside diameter of the aileron bellcrank bushings. If required, enlarge the inside diameter of the bushings using a 1/4 [6.4 mm] drill or reamer.

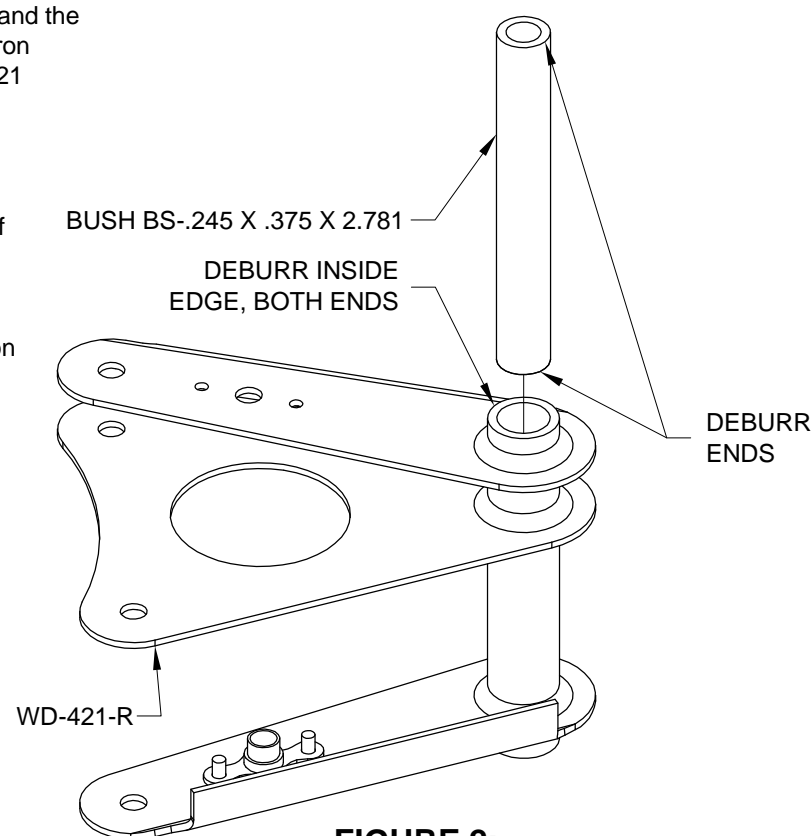
Deburr the ends of the aileron bellcrank bushings and the inside edge and ends of the pivot tubes in the aileron bellcrank so that they slide easily inside the WD-421 Aileron Bellcranks as shown in Figure 2.

The pivot tube of the aileron bellcrank must be 1/32 [0.8 mm] to 1/16 [1.6 mm] shorter than the aileron bellcrank bushing. File the ends of the aileron bellcrank pivot tubes if/as required to achieve the correct length.

Insert an aileron bellcrank bushing into each aileron bellcrank as shown in Figure 2.



**FIGURE 1:**  
AILERON BELLCRANK  
NUTPLATE INSTALLATION

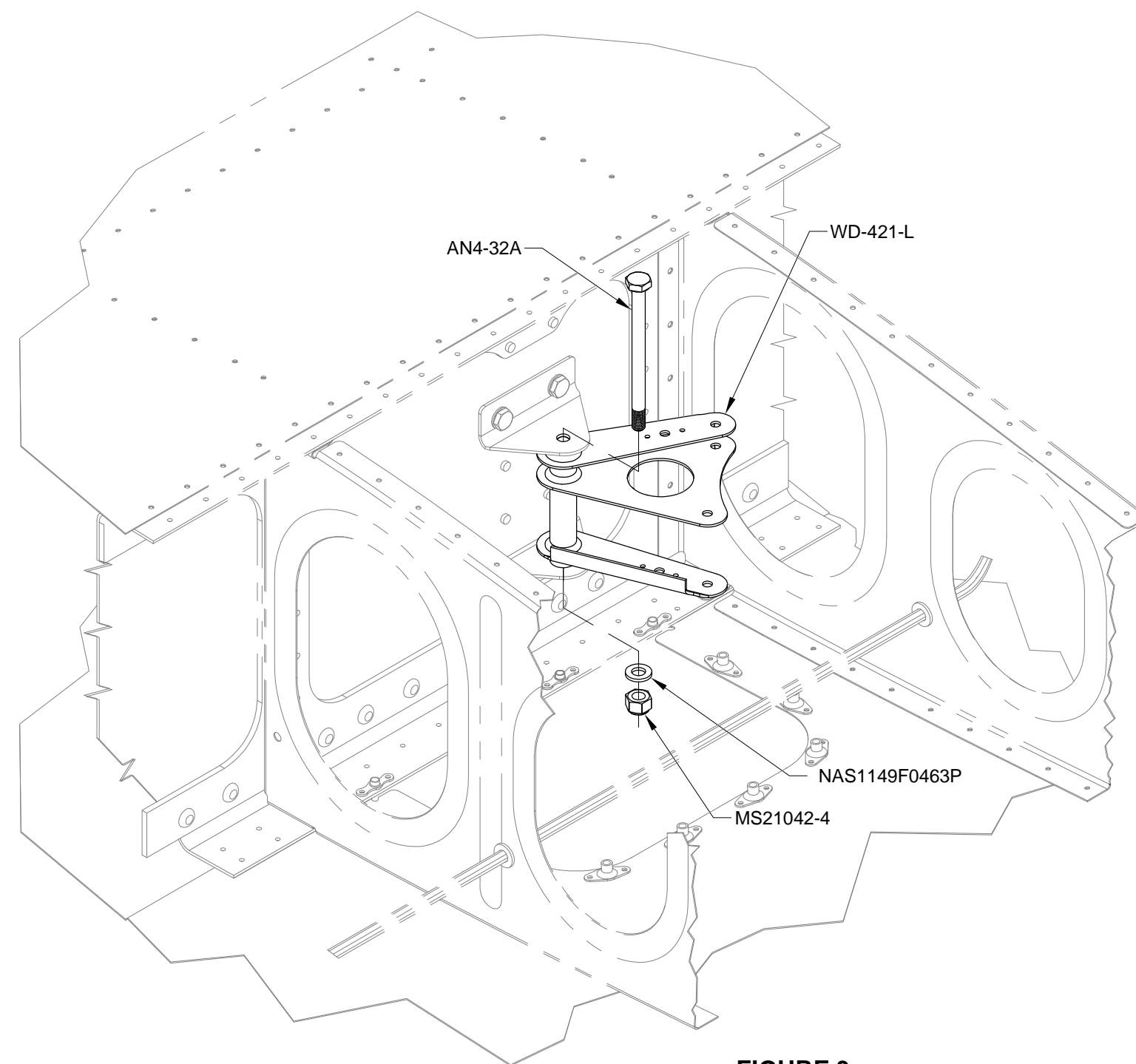


**FIGURE 2:**  
AILERON BELLCRANK  
BUSHING INSTALLATION

**Step 3:** Install the WD-421-L Aileron Bellcrank and BUSH BS-.245 X .375 X 2.781 Aileron Bellcrank Bushing subassembly into the left wing as shown in Figure 2.

Install the WD-421-R Aileron Bellcrank and BUSH BS-.245 X .375 X 2.781 Aileron Bellcrank Bushing subassembly into the right wing.

When the nuts are torqued to the value called-out in Section 5.20, the aileron bellcranks must rotate freely on their aileron bellcrank bushings.



**FIGURE 3:**  
AILERON BELLCRANK INSTALLATION  
(LEFT UPPER WING SKIN OMITTED FOR CLARITY)

Step 1: Insert a VA-162 Pushrod End in the "long" end of each CS-00009 Aileron Torque Tube until the step on the pushrod end rests on the end of the aileron torque tube. See Figure 1.

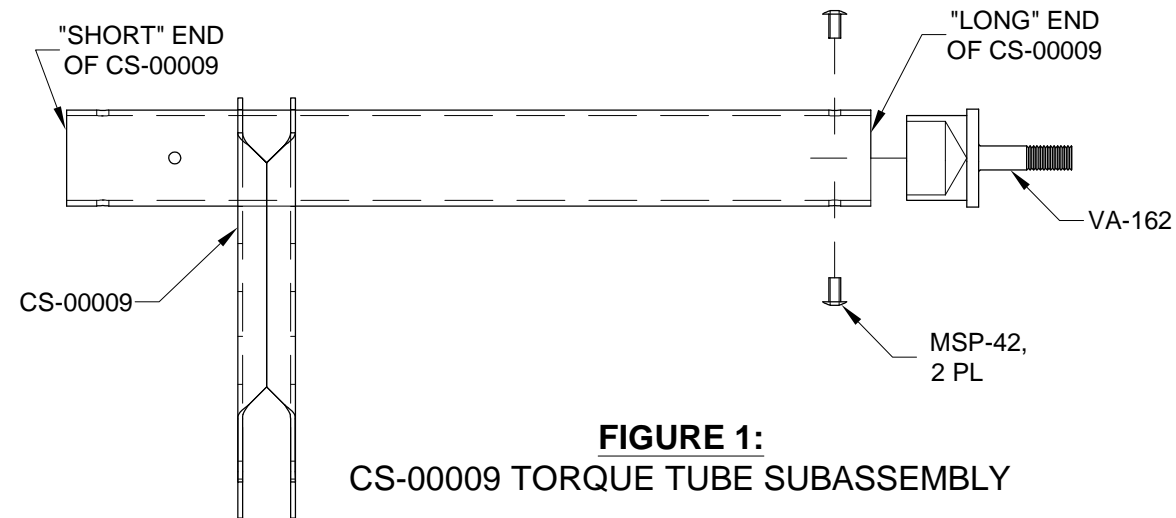
Match-Drill #30 the pushrod ends, using the holes in the aileron torque tubes as drill guides. See Figure 1. Insert clecos in the holes as match-drilling progresses.

Mark the pushrod ends and aileron torque tubes so that the pushrod ends can be re-installed in the same orientation as when they were match-drilled.

Remove the pushrod ends from the aileron torque tubes and deburr the holes.

Rivet the pushrod ends to the aileron torque tubes as shown in Figure 1.

The subassemblies created in this step will subsequently be referred to as the CS-00009 Torque Tube Subassemblies.



**FIGURE 1:**  
CS-00009 TORQUE TUBE SUBASSEMBLY

Step 2: Insert a VA-162 Pushrod End in the "short" end of each WD-1014 Aileron Torque Tube until the step on the pushrod end rests on the end of the aileron torque tube. See Figure 2.

Match-Drill #30 the pushrod ends using the holes in the aileron torque tubes as drill guides. See Figure 2. Insert clecos in the holes as match-drilling progresses.

Final-Drill #30 the two unused holes in the aft torque tube. See Figure 2.

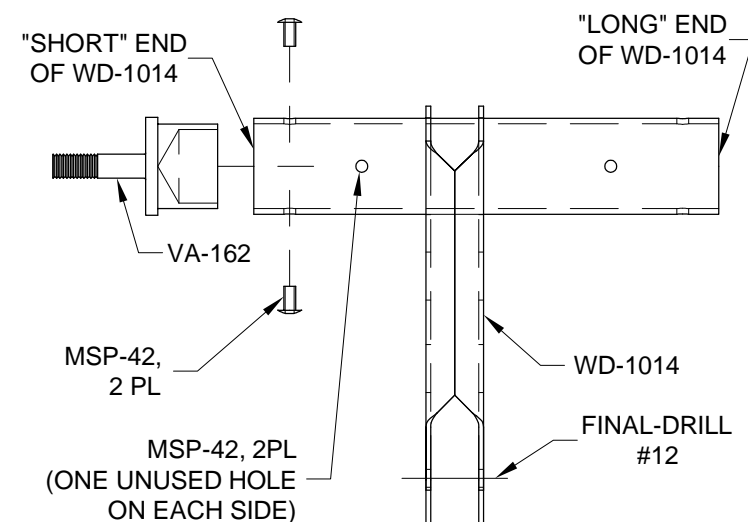
Mark the pushrod ends and aileron torque tubes so that the pushrod ends can be re-installed in the same orientation as when they were match-drilled.

Remove the pushrod ends from the aileron torque tubes and deburr the holes.

Rivet the pushrod ends to the torque tubes as shown in Figure 2.

Install rivets in the unused holes in the aft torque tubes as shown in Figure 2.

The aileron torque tube subassemblies created in this step will subsequently be referred to as the WD-1014 Torque Tube Subassemblies.



**FIGURE 2:**  
WD-1014 TORQUE TUBE SUBASSEMBLY

Step 3: Fabricate two CS-00009B Torque Tube Collars by cutting ST4130-.035x7/8x22" into two 7 5/16 inches [185.7 mm] long pieces.

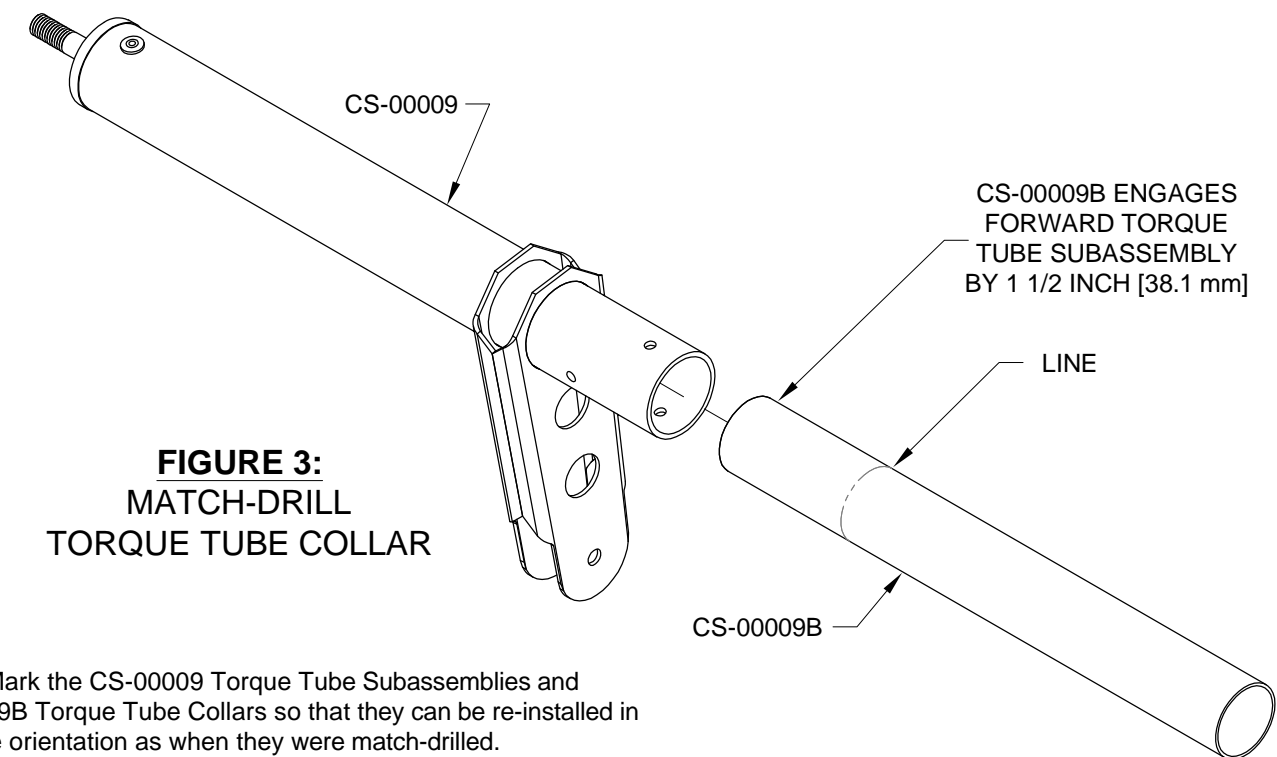
Measure 1 1/2 inches [38.1 mm] from one end of each torque tube collar and draw a line around the circumference.

Insert the CS-00009B Torque Tube Collars in to the open ends of the CS-00009 Torque Tube Subassemblies as shown in Figure 3.

Match-Drill #30 the torque tube collar using the holes in the Torque Tube Subassemblies as drill guides. See Figure 3. Insert clecos in the holes as match-drilling progresses.

Final-Drill #12 through both sides of the Torque Tube Subassembly and torque tube collar.

Install a bolt, washer, and nut as shown in Figure 4 to hold alignment then final-drill #12 the remaining bolt hole.



**FIGURE 3:**  
MATCH-DRILL  
TORQUE TUBE COLLAR

Step 4: Mark the CS-00009 Torque Tube Subassemblies and CS-00009B Torque Tube Collars so that they can be re-installed in the same orientation as when they were match-drilled.

Remove the nut, washer, and bolt that were installed during Step 3.

Remove the torque tube collars from the forward torque tube subassemblies and deburr the holes.

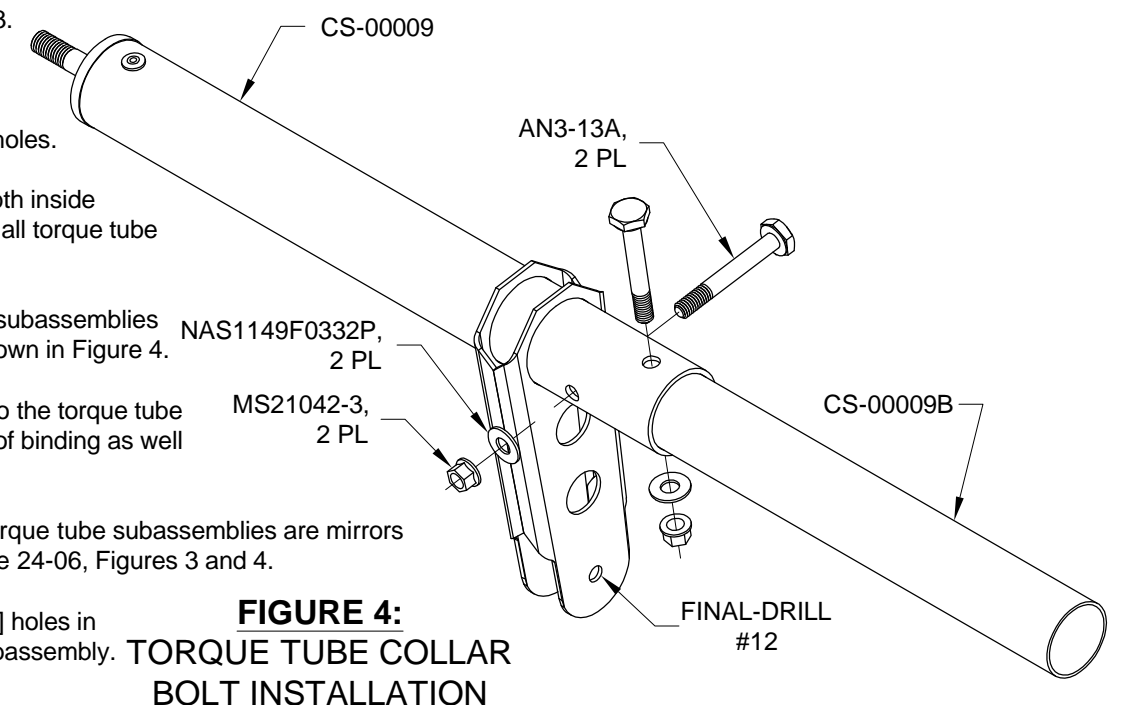
Prime the torque tube collars both inside and out; prime the inside of the all torque tube subassemblies.

Attach the forward torque tube subassemblies to the torque tube collars as shown in Figure 4.

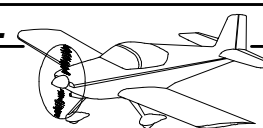
Apply a thin coating of grease to the torque tube collars to minimize the chance of binding as well as to prevent rust.

Install bolts such that the two torque tube subassemblies are mirrors of each other as shown on Page 24-06, Figures 3 and 4.

Final-Drill #12 the .188 [4.8 mm] holes in the arm of each torque tube subassembly. See Figures 2 and 4.



**FIGURE 4:**  
TORQUE TUBE COLLAR  
BOLT INSTALLATION



Step 1: Assemble the Left Side Torque Tube Assembly by inserting the aft end of one of the CS-00009B Torque Tube Collars (which are bolted to the CS-00009 Forward Torque Tube Subassemblies) into the open end of one of the WD-1014 Aft Torque Tube Subassemblies as shown in Figure 1.

Apply a thin coating of grease to the torque tube collars to minimize the chance of binding as well as to prevent rust.

Place the Torque Tube Assembly on a flat surface as shown in Figure 3.

Adjust the engagement of the torque tube collar and the aft torque tube subassembly such that the overall length is as shown in Figure 1.

Insert an AN3 bolt through the holes in the arm of the aft torque tube subassembly as shown in Figure 3.

Adjust the clocking of the torque tube collar and the aft torque tube subassembly such that when a 1 1/64 [25.8 mm] thick spacer block is placed under the bolt in the arm of the aft torque tube subassembly, the arm of the forward torque tube subassembly is flat on the table. See Figures 2 and 3.

Step 2: When assured that both the engagement and clocking of the torque tube assembly is correct, match-drill #30 the torque tube collar using the holes in the aft torque tube subassembly as drill guides. Insert clecos in the holes as match-drilling progresses.

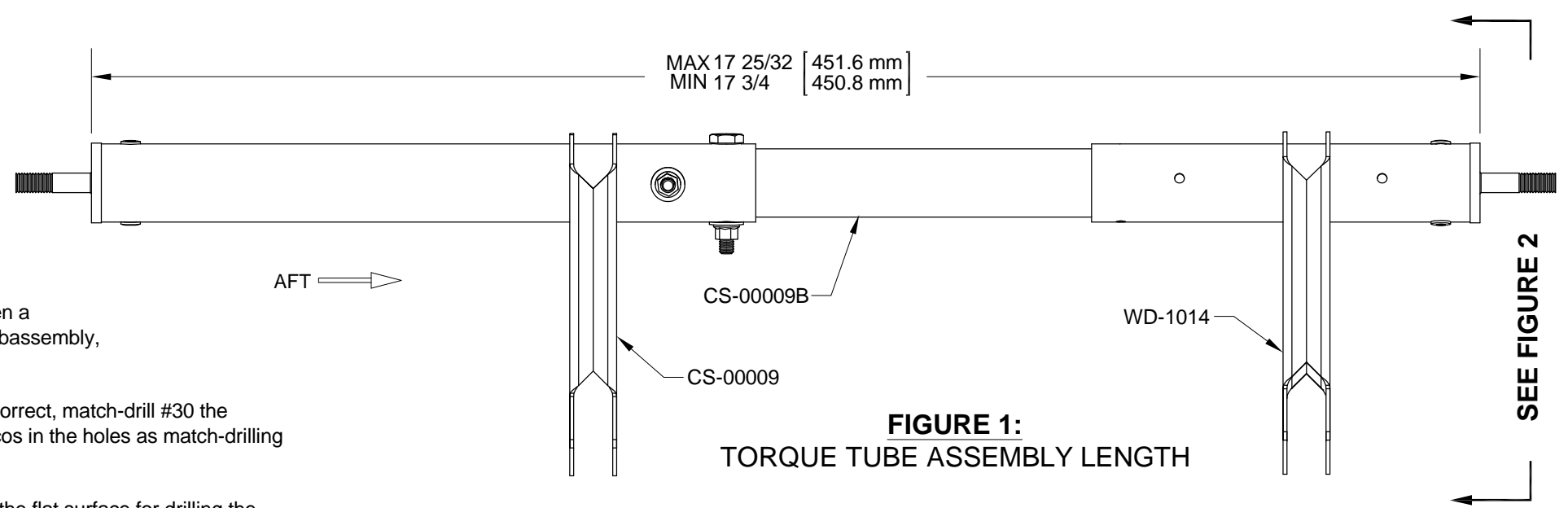
After the first hole is match-drilled and clecoed, the torque tube assembly can be moved off of the flat surface for drilling the remaining holes. See Figures 3 and 4.

Final-Drill #12 through both sides of the torque tube and torque tube collar. Install a bolt, washer, and nut as shown on Page 23-08, Figure 1 to hold alignment while the other bolt hole is final drilled #12. Mark this assembly "Left".

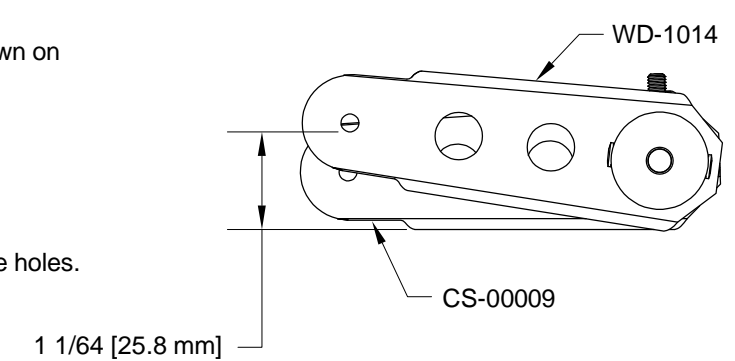
Step 3: Repeat Steps 1 and 2 to assemble the Right Side Torque Tube Subassembly. See Figure 4.

Step 4: Remove the nuts, washers, and bolts installed during Step 2.

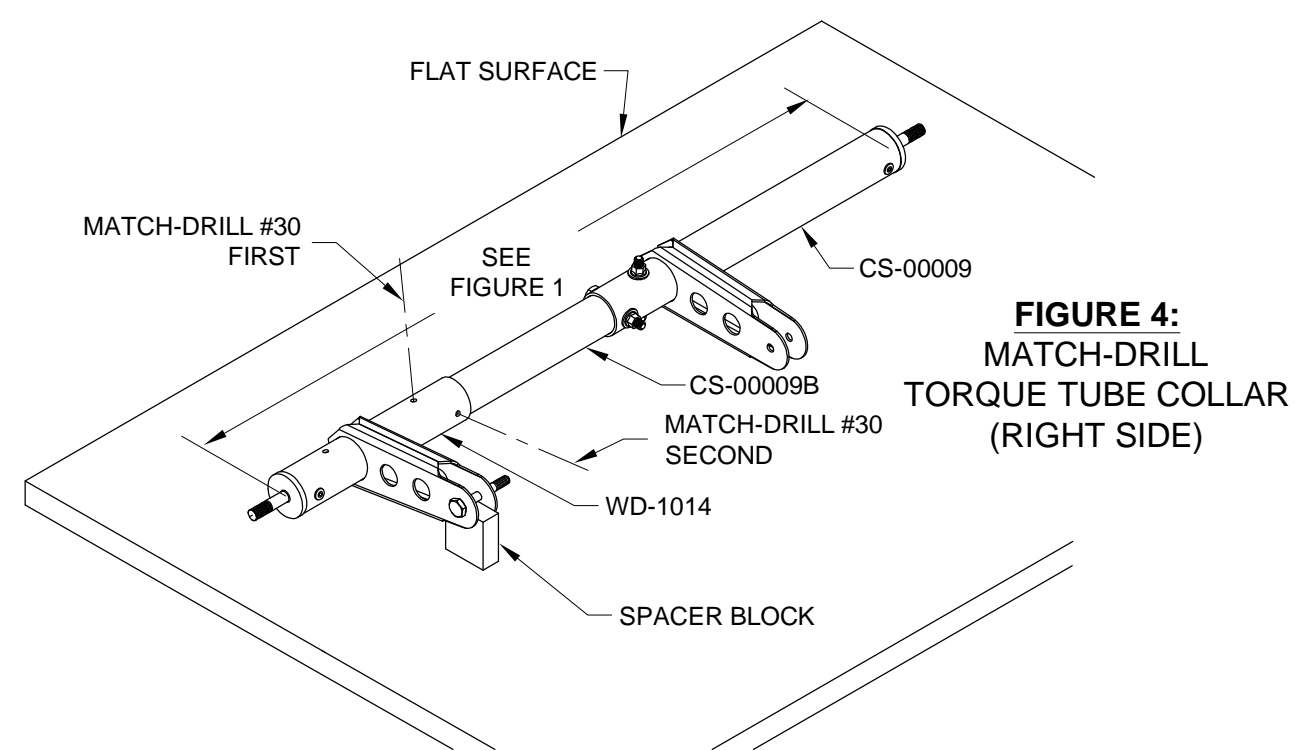
Remove the WD-1014 Aft Torque Tube Subassemblies from the CS-00009B Torque Tube Collars and deburr the holes.



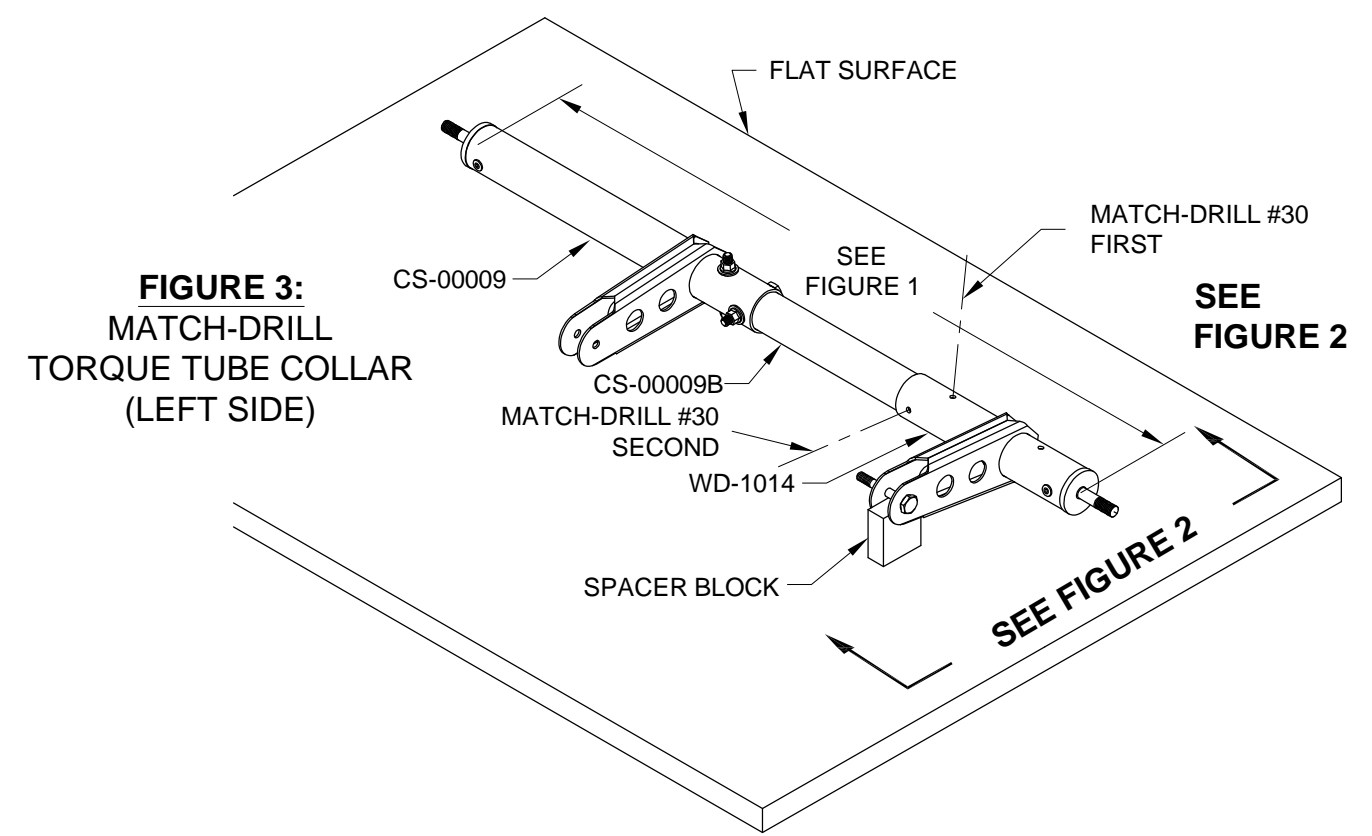
**FIGURE 1:**  
TORQUE TUBE ASSEMBLY LENGTH



**FIGURE 2:**  
TORQUE TUBE ASSEMBLY CLOCKING  
(LEFT SIDE SHOWN)



**FIGURE 4:**  
MATCH-DRILL  
TORQUE TUBE COLLAR  
(RIGHT SIDE)



**FIGURE 3:**  
MATCH-DRILL  
TORQUE TUBE COLLAR  
(LEFT SIDE)



Step 1: Insert CS-00009B Torque Tube Collar through the forward side of the 1 1/8 inch [28.6 mm] diameter hole in the spar web. See Figure 1.

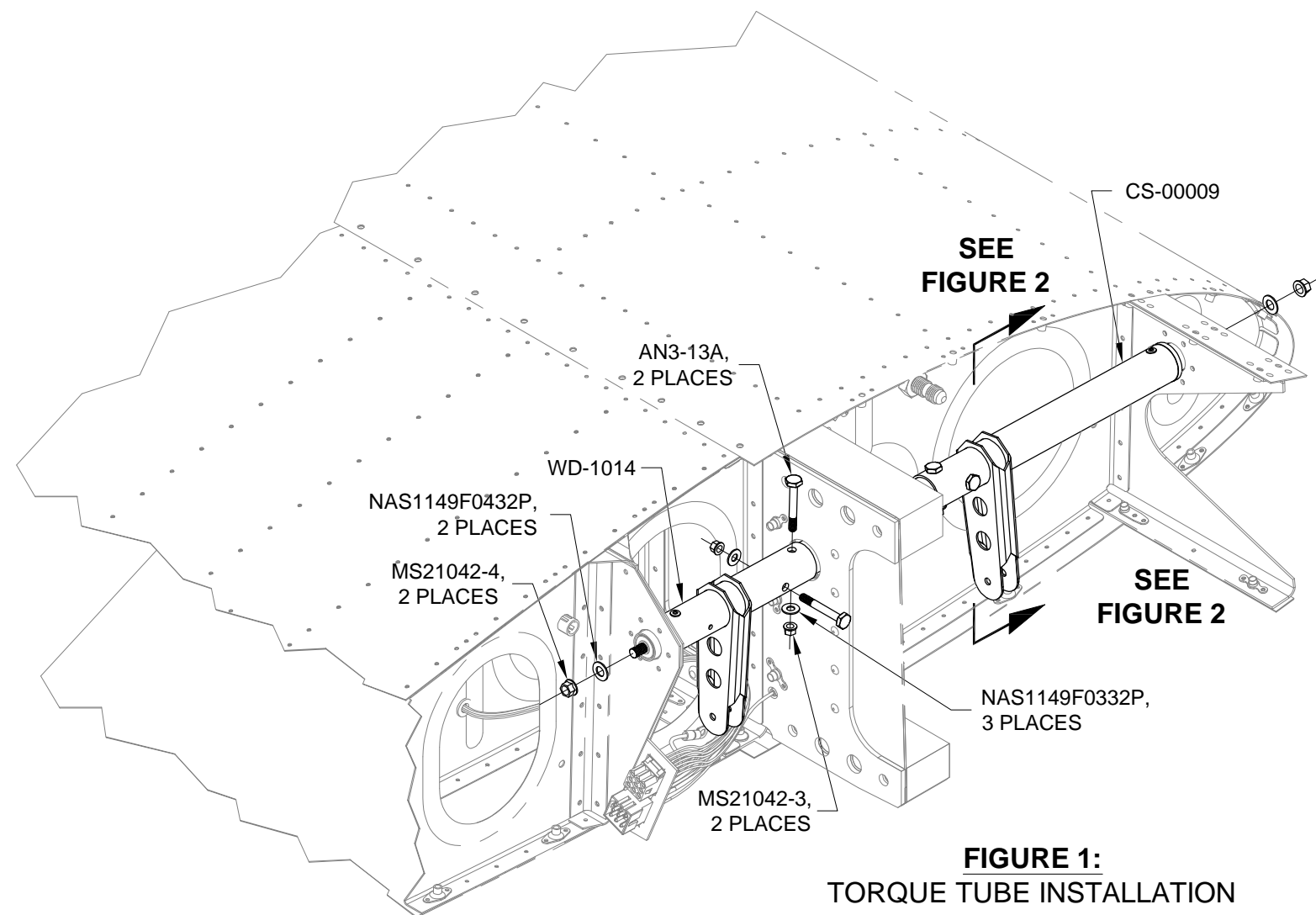
Step 2: Angle the CS-00009B Torque Tube Collar down as it extends aft through the hole in the spar web and slip the WD-1014 Aft Torque Tube Subassembly over the torque tube collar. Engage the WD-1014 Aft Torque Tube Subassembly and the torque tube collar far enough to allow the threaded ends of the torque tube subassemblies to be inserted into the flanged bearings riveted into the wing structure. Disengage the aft torque tube subassembly and torque tube collar slightly as the threaded ends of the torque tube subassemblies are inserted into the bearings. See Figure 1.

Step 3: Install washers and nuts on the pushrod ends of the CS-00009 and WD-1014 Torque Tube Subassemblies as shown in Figure 1.

Step 4: Check to see if the bolt holes in the WD-1014 Aft Torque Tube Subassembly and CS-00009B Torque Tube Collar line-up properly.

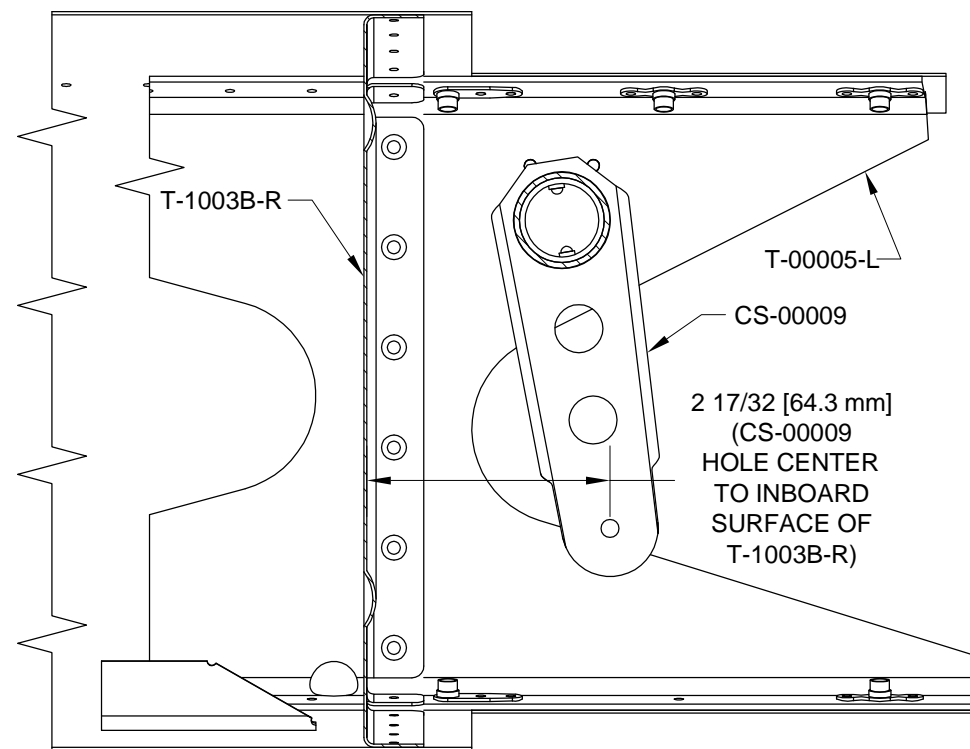
If the bolt holes in the aft torque tube subassembly and torque tube collar misalign in the forward/aft direction then NAS1149F0463 or NAS1149F0432 washers should be installed between the torque tube subassemblies and the flanged bearings as required to eliminate the forward/aft hole misalignment. There should be little or no pre-load on the wing structure when the aileron torque tube installation is complete.

Install bolts, washers, and nuts as shown in Figure 1 to attach the aft torque tube subassembly to the torque tube collar.



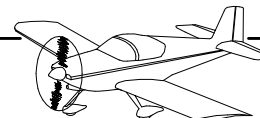
**FIGURE 1:**  
TORQUE TUBE INSTALLATION

Step 5: Figure 2 shows the "neutral position" of the CS-00009 Forward Torque Tube Subassembly. The correct rigging of the aileron actuation system is defined by the forward torque tube subassembly, WD-421 Aileron Bellcrank, and Aileron all being in their neutral positions at the same time.



**FIGURE 2:**  
FORWARD TORQUE TUBE  
SUBASSEMBLY NEUTRAL POSITION





Step 1: Insert the CS-00012 Torque Tube to Bellcrank Pushrod into the wing through the most forward lightening hole in the W-1010-R Inbd Wing Rib.

Attach the torque tube to bellcrank pushrod to the WD-421-L Aileron Bellcrank as shown in Figure 1.

**NOTE:** There are two washers called-out; one washer is installed inside the torque tube clevis arm along with the pushrod rod end bearing and the other washer is installed under the nut. Do not tighten the nut at this time.

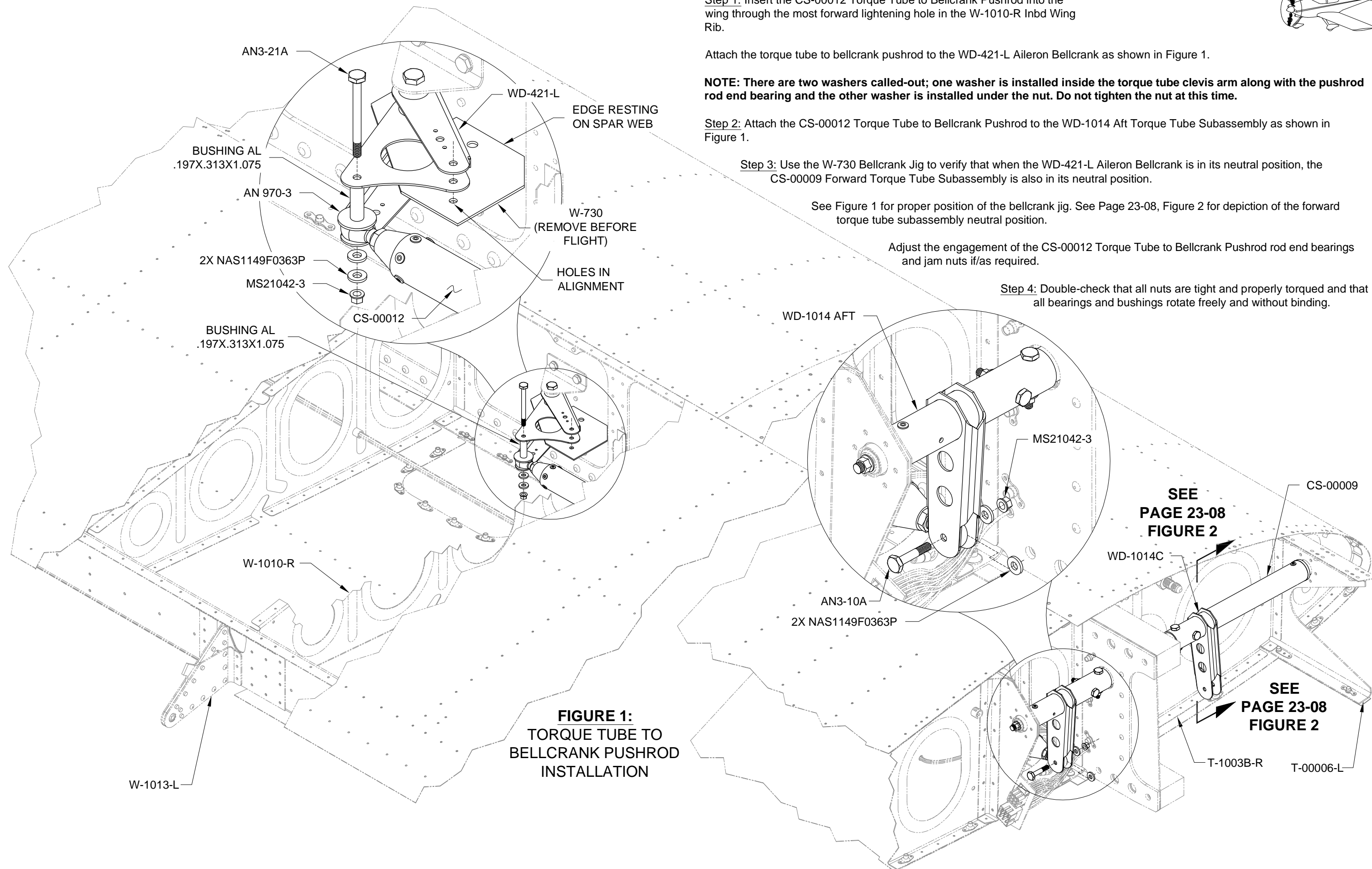
Step 2: Attach the CS-00012 Torque Tube to Bellcrank Pushrod to the WD-1014 Aft Torque Tube Subassembly as shown in Figure 1.

Step 3: Use the W-730 Bellcrank Jig to verify that when the WD-421-L Aileron Bellcrank is in its neutral position, the CS-00009 Forward Torque Tube Subassembly is also in its neutral position.

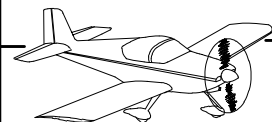
See Figure 1 for proper position of the bellcrank jig. See Page 23-08, Figure 2 for depiction of the forward torque tube subassembly neutral position.

Adjust the engagement of the CS-00012 Torque Tube to Bellcrank Pushrod rod end bearings and jam nuts if/as required.

Step 4: Double-check that all nuts are tight and properly torqued and that all bearings and bushings rotate freely and without binding.



**FIGURE 1:**  
TORQUE TUBE TO  
BELLCRANK PUSHROD  
INSTALLATION



**NOTE: Use blue Loctite to install the AN509-10R25 screw.**

**Step 1:** Insert the CS-00013 Bellcrank to Aileron Pushrod into the wing through the hole in the Rear Spar Assembly.

Attach the bellcrank to aileron pushrod to the WD-421-L Aileron Bellcrank as shown in Figure 1.

**Step 2:** Temporarily attach the Flap Assembly to the two W-1025A Flap Hinge Brackets. See Page 21-12, Figure 3. Rotate the flap assembly trailing edge up until the inboard end of the nose of the flap bumps solidly against the W-1007C Rear Spar Doubler Plate. Secure the flap assembly in this position.

**Step 3:** Align the trailing edge of the Aileron Assembly with the trailing edge of the Flap Assembly. Use spring clamps and a straight piece of aluminum angle or a thin wood block to hold the aileron assembly in alignment with the flap assembly. This establishes the neutral position of the aileron.

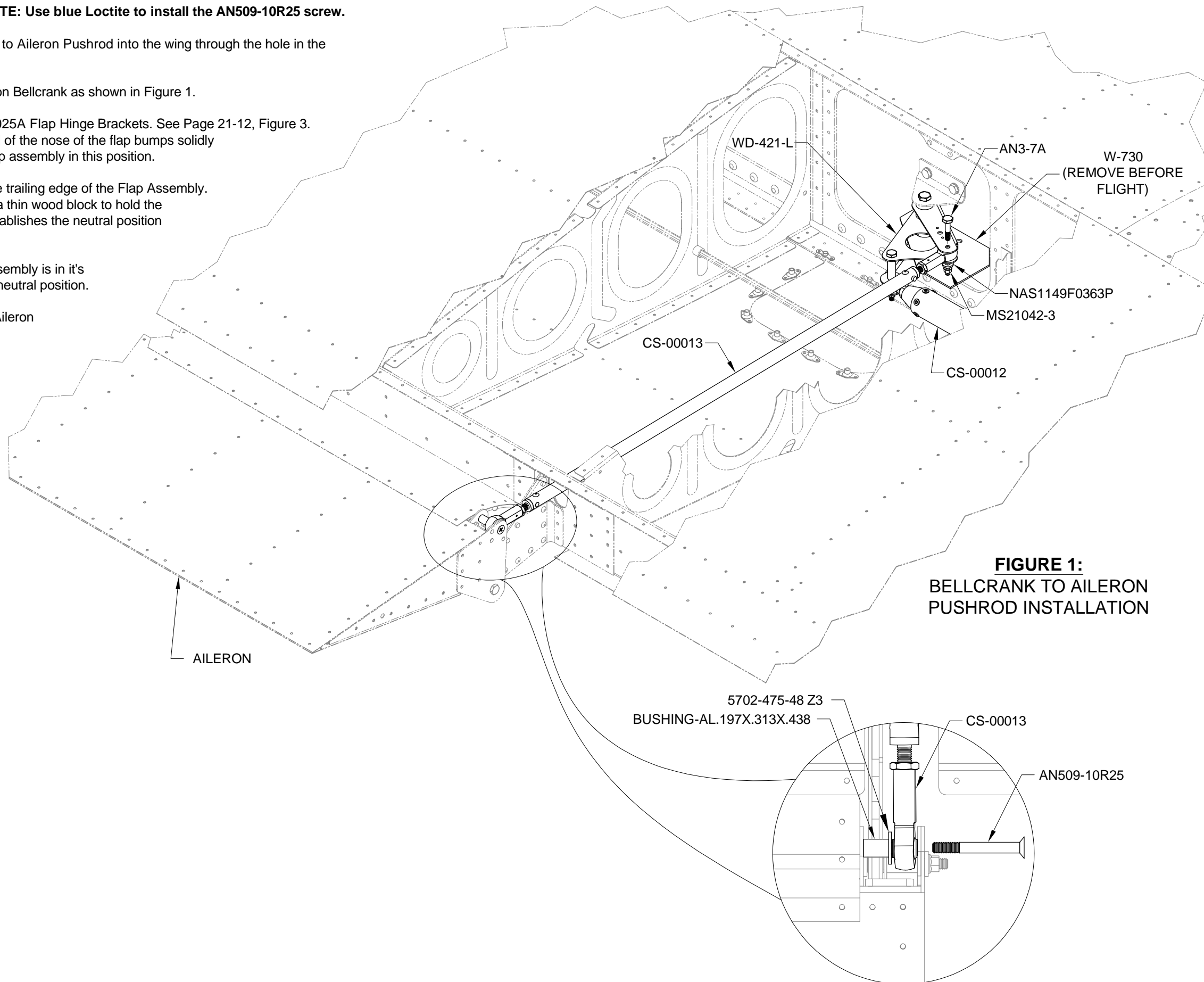
Use the W-730 Bellcrank Jig to verify that when the aileron assembly is in it's neutral position, the WD-421-L Aileron Bellcrank is also in it's neutral position.

**Step 4:** Adjust the engagement of the CS-00013 Bellcrank to Aileron Pushrod rod end bearings and jam nuts if/as required.

Attach the aileron pushrod to the aileron as shown in Figure 1.

Remove the W-730 Bellcrank Jig.

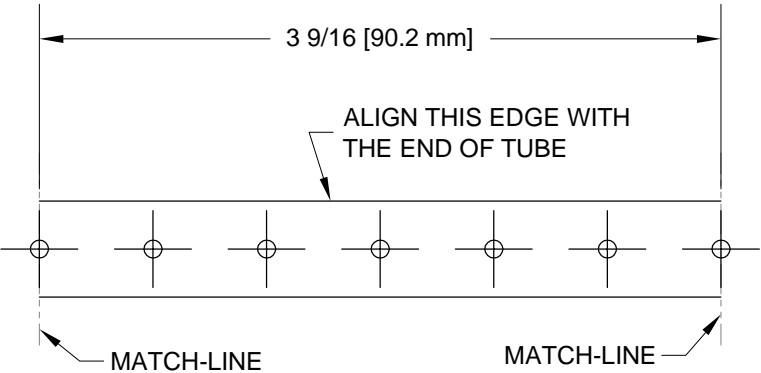
**Step 5:** Double-check that all nuts are tight and properly torqued. All bearings and bushings must rotate freely and without binding.



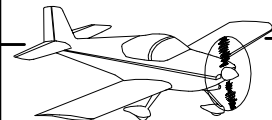
**FIGURE 1:**  
BELLCRANK TO AILERON  
PUSHROD INSTALLATION



NOTE: CHECK PRINTED SCALE 1:1  
BEFORE USING THE TEMPLATE!



**FIGURE 1:**  
PUSHROD RIVET  
HOLE LOCATION  
TEMPLATE



**THIS PAGE INTENTIONALLY LEFT BLANK**