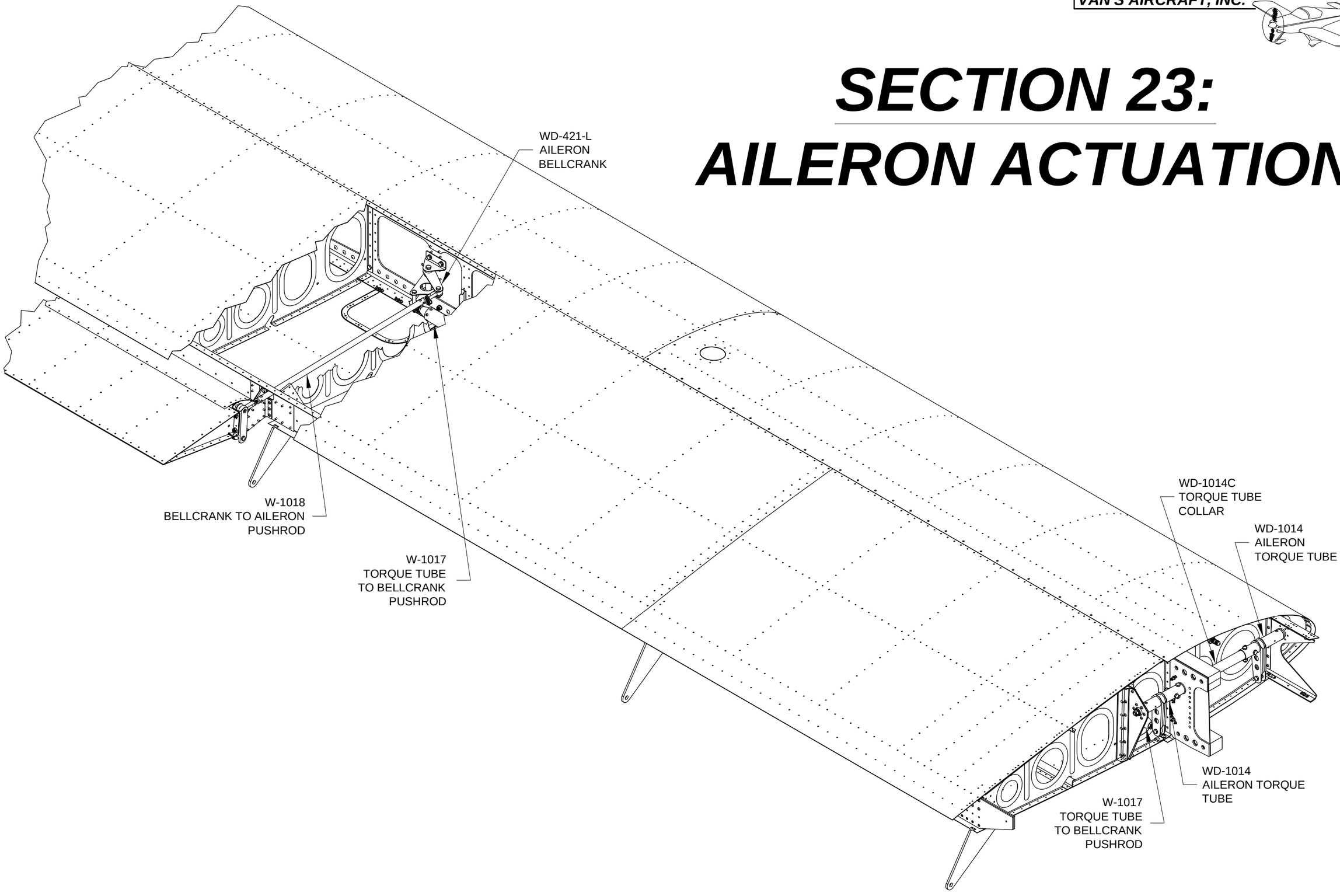
# SECTION 23:
# AILERON ACTUATION



Step 1: Fabricate two W-1017A Torque Tube to Bellcrank Pushrods by cutting two pieces of AT6-049 X 1 1/4 to the length shown in Figure 1.

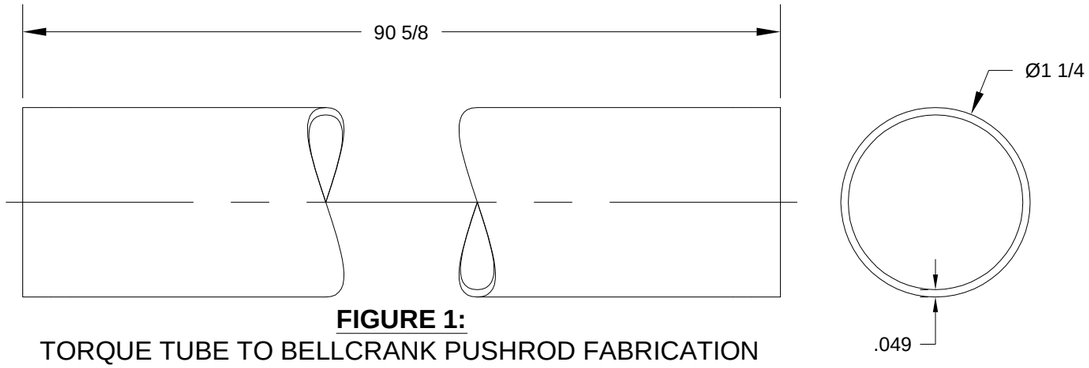



**FIGURE 1:**
TORQUE TUBE TO BELLCRANK PUSHROD FABRICATION

Step 2: Cut-out Page 23-10, Figure 1 and use it as a wrap-around template for locating the rivet holes in both ends of both W-1017A 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 and use a #40 drill to make six pilot holes in each end of both torque tube to bellcrank pushrods. Deburr the hole edges on the inside of the pushrod tubes.

Step 3: Insert a VA-169 Threaded Rod End into the end of one of the W-1017A 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.

Using a #30 bit, match-drill 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 threaded rod ends have been match-drilled to both ends of both torque tube to bellcrank pushrods.

Step 3 (continued): 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 all holes in all parts and prime all parts inside and out.

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

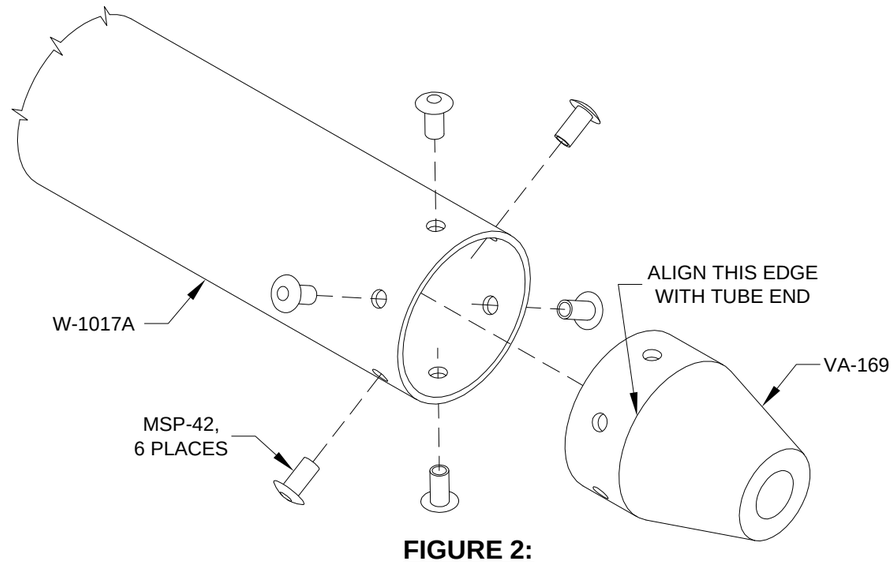



**FIGURE 2:**
THREADED ROD END INSTALLATION

Step 4: Install rod end bearings and jam nuts into the VA-169 Threaded Rod Ends as shown in Figure 3. Theoretically the correct engagement of the rod end bearings yields a bearing center-to-bearing center length of 94 7/16 inches. The rod end bearing engagement may be adjusted during installation of the W-1017 Torque Tube to Bellcrank Pushrod.

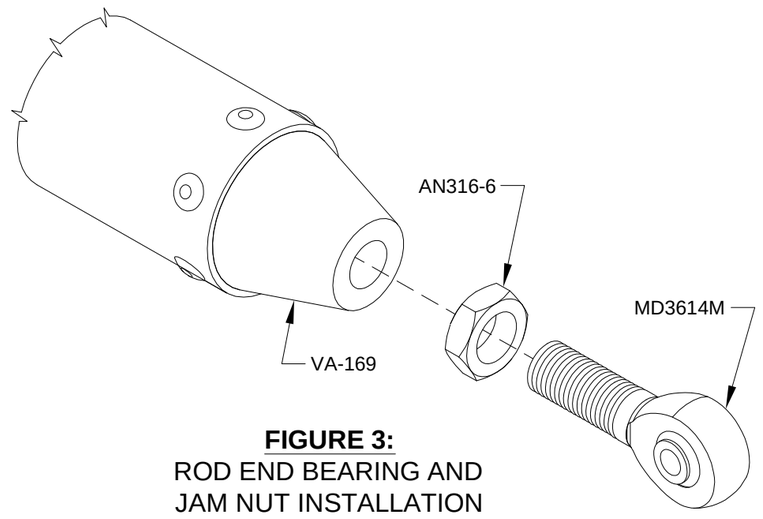



**FIGURE 3:**
ROD END BEARING AND
JAM NUT INSTALLATION

Step 1: Fabricate two W-1018A Bellcrank to Aileron Pushrods by cutting two pieces of ST4130-035 X 1/2 to the length shown in Figure 1.

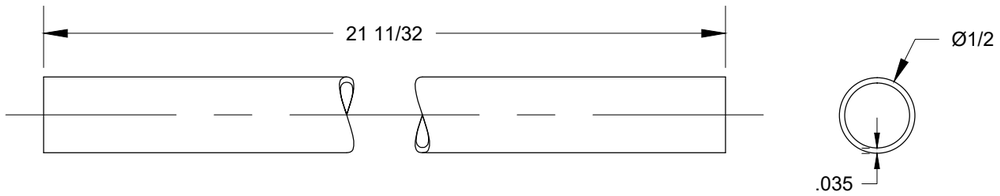



**FIGURE 1:**
BELLCRANK TO AILERON PUSHROD FABRICATION

Step 2: Use a #40 drill to make four pilot holes in each end of both W-1018A 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 hole edges on the inside of the pushrod tubes.

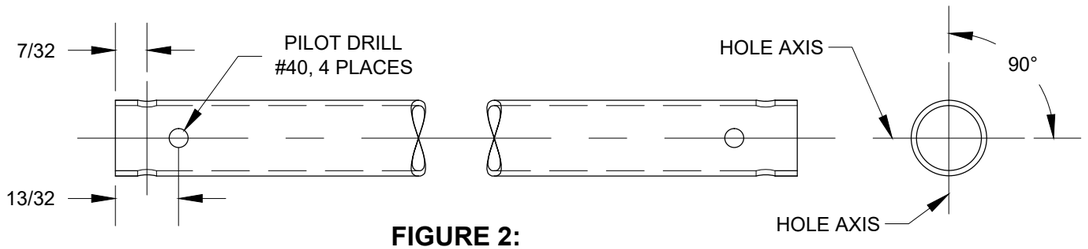



**FIGURE 2:**
PILOT-DRILL BELLCRANK TO AILERON PUSHROD

Step 3: Insert an VA-4908P Threaded Rod End into the end of one of the W-1018A Bellcrank to Aileron Pushrods until the step on the threaded rod end rests on the end of the bellcrank to aileron pushrod.

Using a #30 bit, match-drill 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 both 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 all holes in all parts. Prime the bellcrank to aileron pushrod inside and out.

Permanently install the threaded rod ends to the bellcrank to aileron pushrods using the rivets called-out in Figure 3.

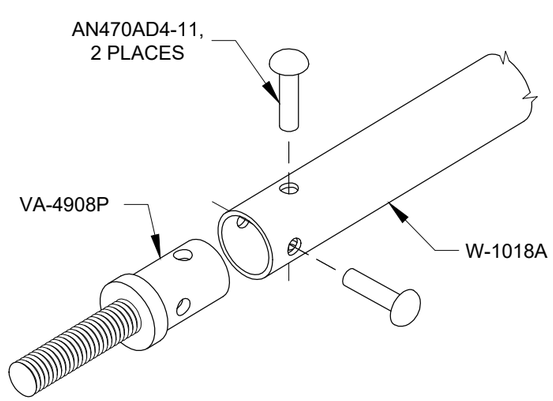



**FIGURE 3:**
THREADED ROD END INSTALLATION

Step 4: Install rod end bearings and jam nuts into the VA-4908P Threaded Rod Ends as shown in Figure 4. Theoretically the correct engagement of the rod end bearings yields a bearing center-to-bearing center length of 25 1/4 inches. The rod end bearing engagement may be adjusted during installation of the W-1018 Bellcrank to Aileron Pushrod.

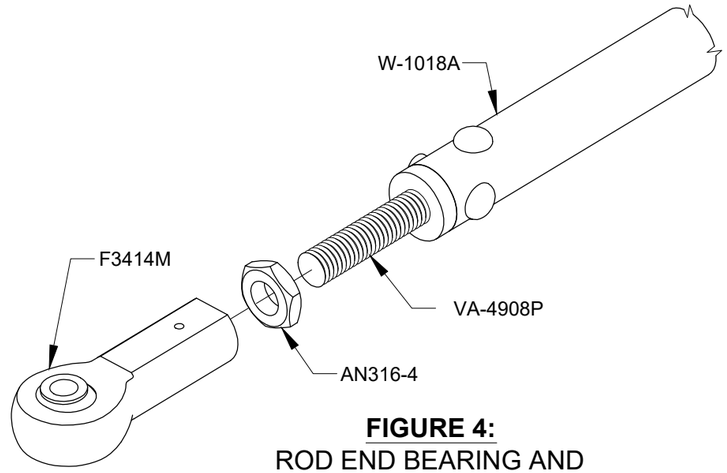



**FIGURE 4:**
ROD END BEARING AND
JAM NUT INSTALLATION

Step 5: Fabricate two W-1031 Aileron Bellcrank Spacers by cutting two pieces of AT6-058 X 5/16 to the length shown in Figure 5.

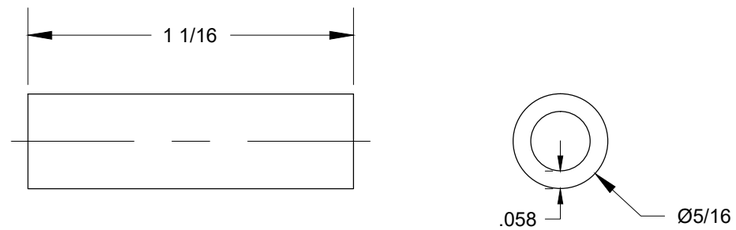



**FIGURE 5:**
AILERON BELLCRANK SPACER FABRICATION

Step 1: Check that the length of both of the BUSH-BS.245X375X2.781 Aileron Bellcrank Bushings is between 2 3/4 inches and 2 25/32 inches. Check that an AN4 bolt will fit the inside diameter of the aileron bellcrank bushings and ream if required. Deburr the ends of the aileron bellcrank bushings so that they slide easily inside the WD-421 Aileron Bellcranks. See Figure 1.

The pivot tube of the aileron bellcrank must be 1/32 inch to 1/16 inch shorter than the aileron bellcrank bushing. File the ends of the aileron bellcrank pivot tubes if/as required to achieve the correct length. Deburr the inside edges of the aileron bellcrank pivot tubes. See Figure 1.

Insert an aileron bellcrank bushing into each aileron bellcrank as shown in Figure 1.

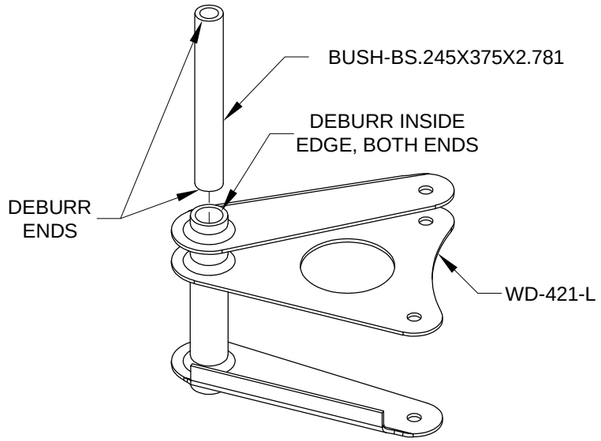



**FIGURE 1:**
AILERON BELLCRANK BUSHING INSTALLATION

Step 2: Install the WD-421-L Aileron Bellcrank/BUSH-BS.245X375X2.781 Aileron Bellcrank Bushing subassembly into the left wing as shown in Figure 2.

Install the WD-421-R Aileron Bellcrank/BUSH-BS.245X375X2.781 Aileron Bellcrank Bushing subassembly into the right wing.

When the nuts are torqued to the value called-out in Section 5V, the aileron bellcranks must rotate freely on their aileron bellcrank bushings.

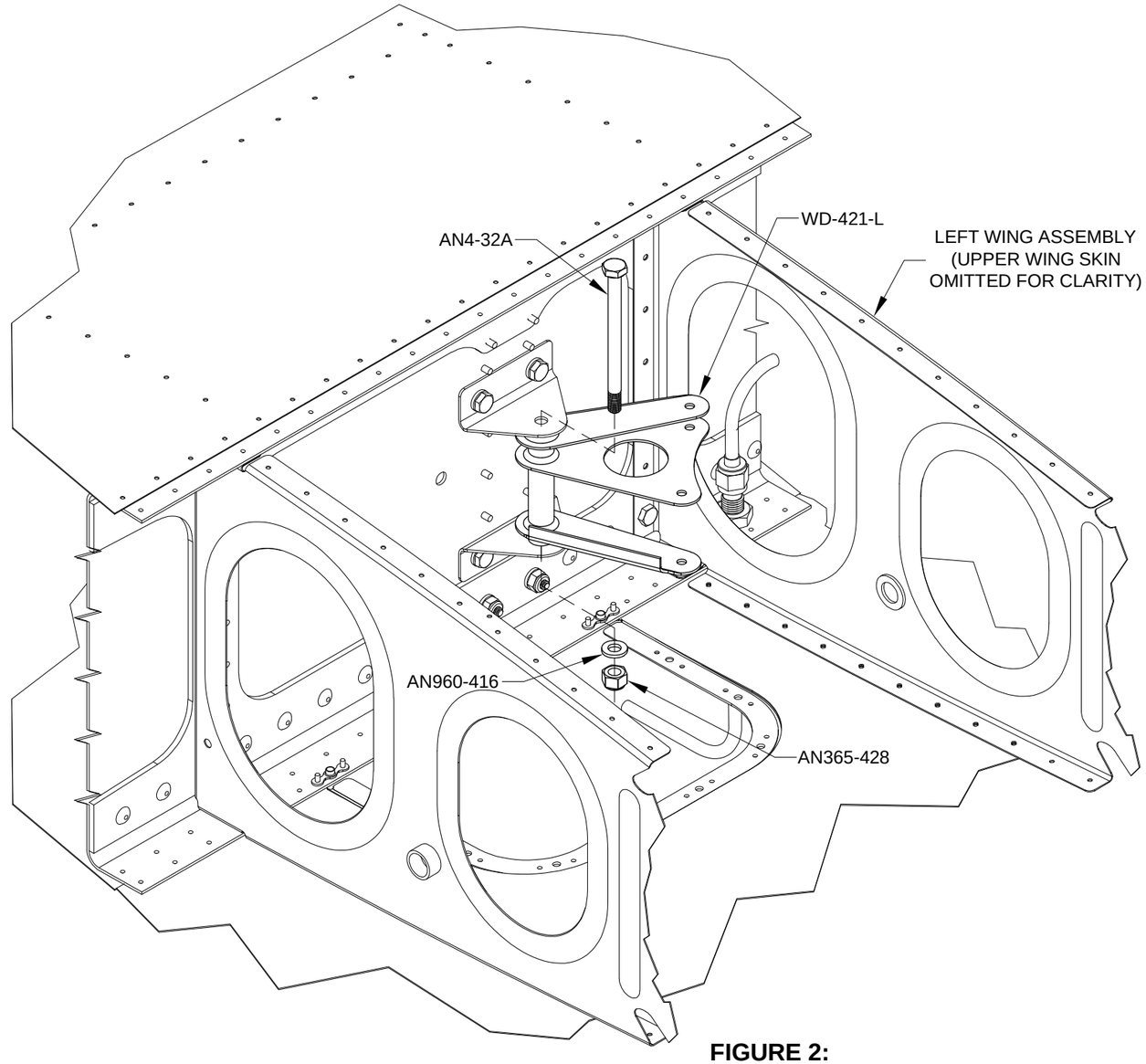



**FIGURE 2:**
AILERON BELLCRANK INSTALLATION

Step 1: Insert a VA-162 Pushrod End in the "long" end of two WD-1014 Aileron Torque Tubes until the step on the pushrod end rests on the end of the aileron torque tube. See Figure 1.

Using a #30 bit, match-drill the pushrod ends using the holes in the aileron torque tubes as drill guides. See Figure 1. Install a cleco in each hole as it is match-drilled.

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. Attach the pushrod ends to the aileron torque tubes using the hardware called out in Figure 1.

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

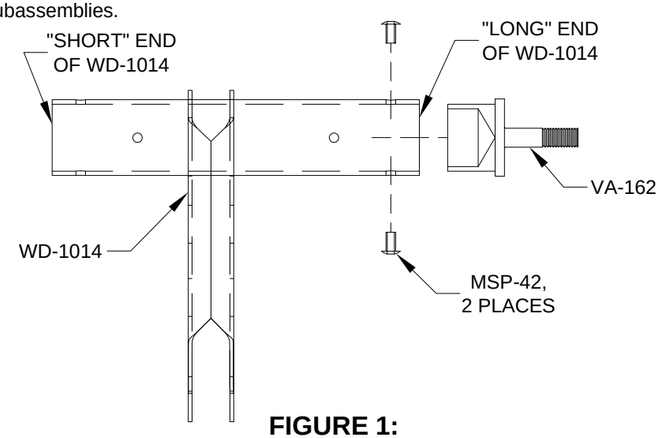



**FIGURE 1:**
FORWARD TORQUE TUBE SUBASSEMBLY

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

Using a #30 bit, match-drill the pushrod ends using the holes in the aileron torque tubes as drill guides. See Figure 2. Install a cleco in each hole as it is match-drilled.

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. Attach the pushrod ends to the torque tubes using the hardware called out in Figure 2.

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

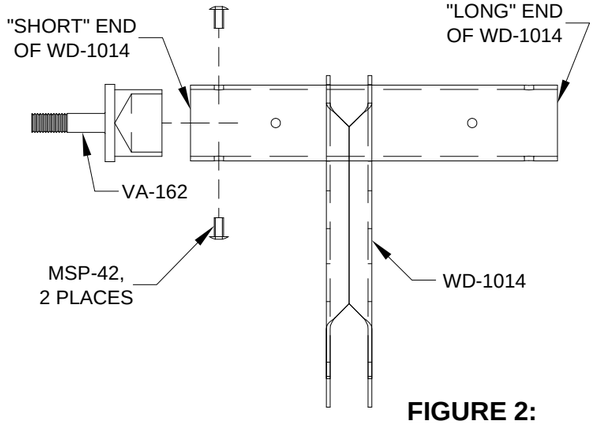



**FIGURE 2:**
AFT TORQUE TUBE SUBASSEMBLY

Step 3: Insert WD-1014C Torque Tube Collars in the open ends of the WD-1014 FORWARD Forward Torque Tube Subassemblies as shown in Figure 3.

Using a #30 bit, match-drill the torque tube collar using the holes in the forward torque tube subassemblies as drill guides. See Figure 3. Install a cleco in each hole as it is match-drilled. Using a #12 bit, final-drill through both sides of the forward torque tube subassembly and torque tube collar. Install a bolt, washer, and nut as shown in Figure 4 to hold alignment while the other bolt hole is final-drilled #12.

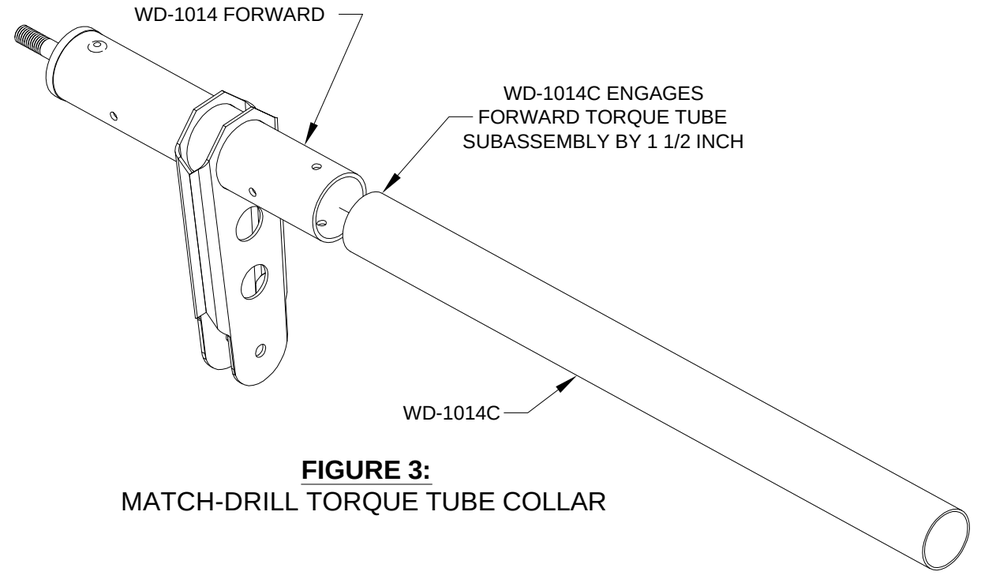



**FIGURE 3:**
MATCH-DRILL TORQUE TUBE COLLAR

Step 4: Mark the WD-1014 FORWARD Forward Torque Tube Subassemblies and WD-1014C 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 match-drilling. 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 forward torque tube subassemblies.

Attach the forward torque tube subassemblies to the torque tube collars using the hardware called out in Figure 4.

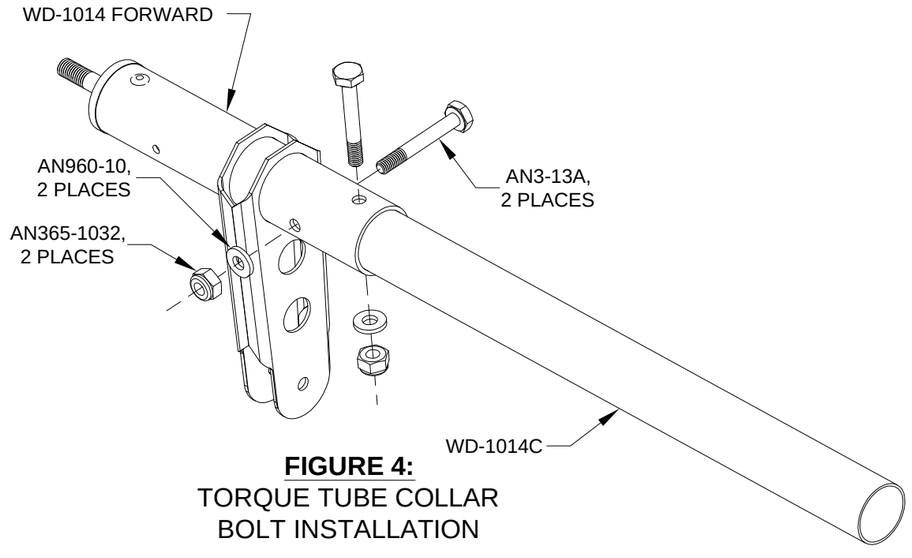



**FIGURE 4:**
TORQUE TUBE COLLAR
BOLT INSTALLATION

Step 1: Create the left side torque tube assembly by inserting the aft end of one of the WD-1014C Torque Tube Collars (which are bolted to the WD-1014 FORWARD Forward Torque Tube Subassemblies) into the open end of one of the WD-1014 AFT Aft Torque Tube Subassemblies as shown in Figure 1.

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.

Adjust the clocking of the torque tube collar and the aft torque tube subassembly such that when a 5/16 inch thick spacer block is placed under 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, use a #30 bit to match-drill the torque tube collar using the holes in the aft torque tube subassembly as drill guides. Install a cleco in each hole as it is match-drilled. 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. Using a #12 bit, final-drill through both sides of the torque tube and torque tube collar. Install a bolt, washer, and nut as shown in Page 23-7, Figure 1 to hold alignment while the other bolt hole is final drilled #12.

Step 3: Create the right side torque tube assembly by inserting the aft end of the remaining WD-1014C Torque Tube Collar into the open end of the remaining WD-1014 AFT Aft Torque Tube Subassembly as shown in Figure 1.

Place the torque tube assembly on a flat surface as shown in Figure 4.

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.

Adjust the clocking of the torque tube collar and the aft torque tube subassembly such that when a 5/16 inch thick spacer block is placed under the arm of the aft torque tube sub-assembly, the arm of the forward torque tube subassembly is flat on the table. See Figures 2 and 4.

Step 4: Drill the right side torque tube subassembly as previously described in Step 2.

Step 5: Remove the nuts, washers, and bolts that were installed during final-drilling. Remove the WD-1014 AFT Aft Torque Tube Subassemblies from the WD-1014C Torque Tube Collars and deburr the holes.

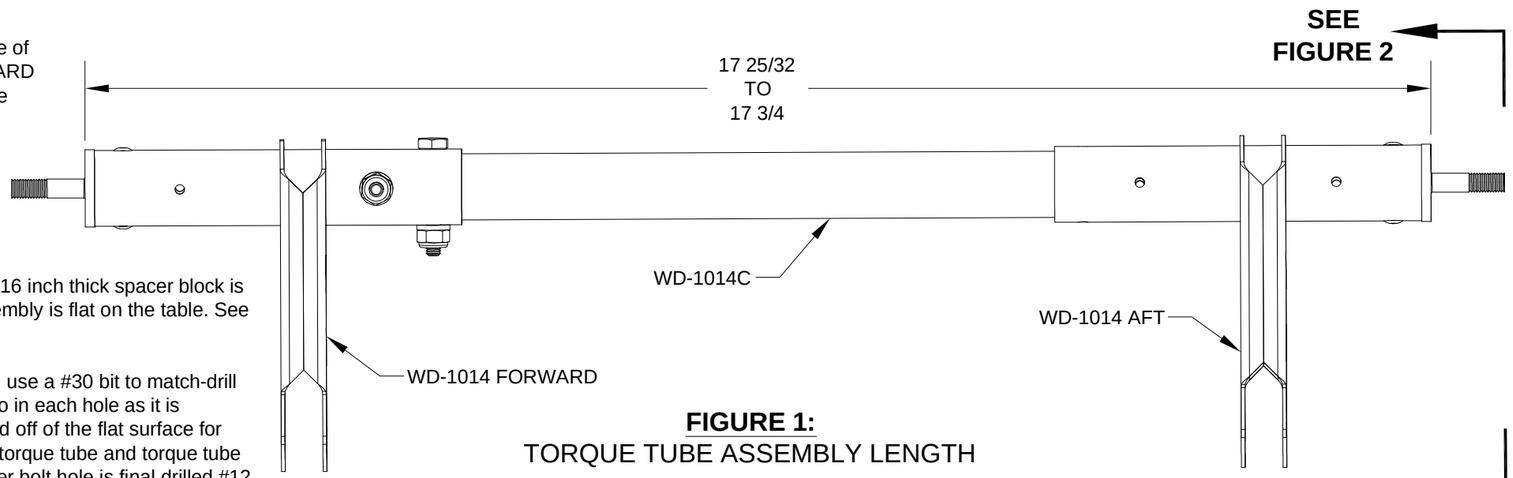



**FIGURE 1:**
TORQUE TUBE ASSEMBLY LENGTH

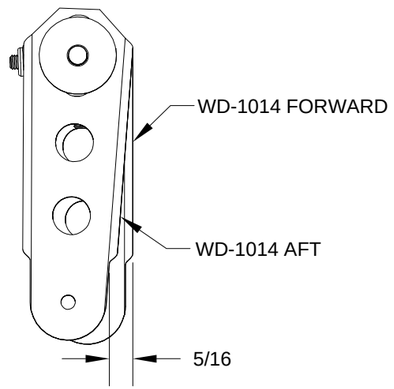



**FIGURE 2:**
TORQUE TUBE ASSEMBLY CLOCKING
(LEFT SIDE SHOWN)

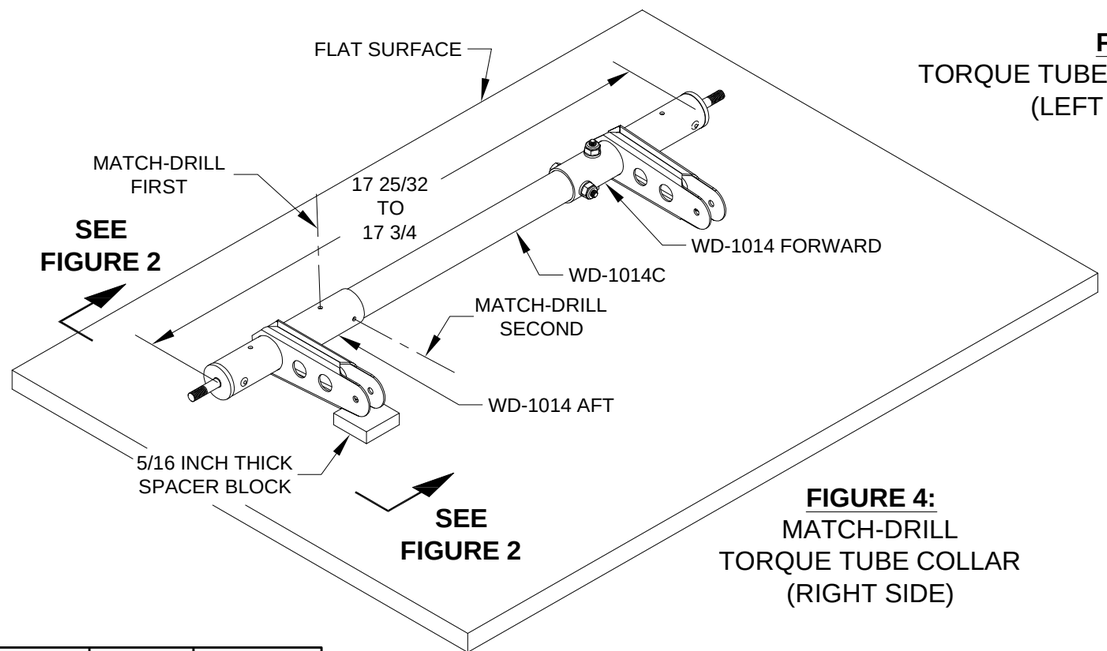



**FIGURE 4:**
MATCH-DRILL
TORQUE TUBE COLLAR
(RIGHT SIDE)

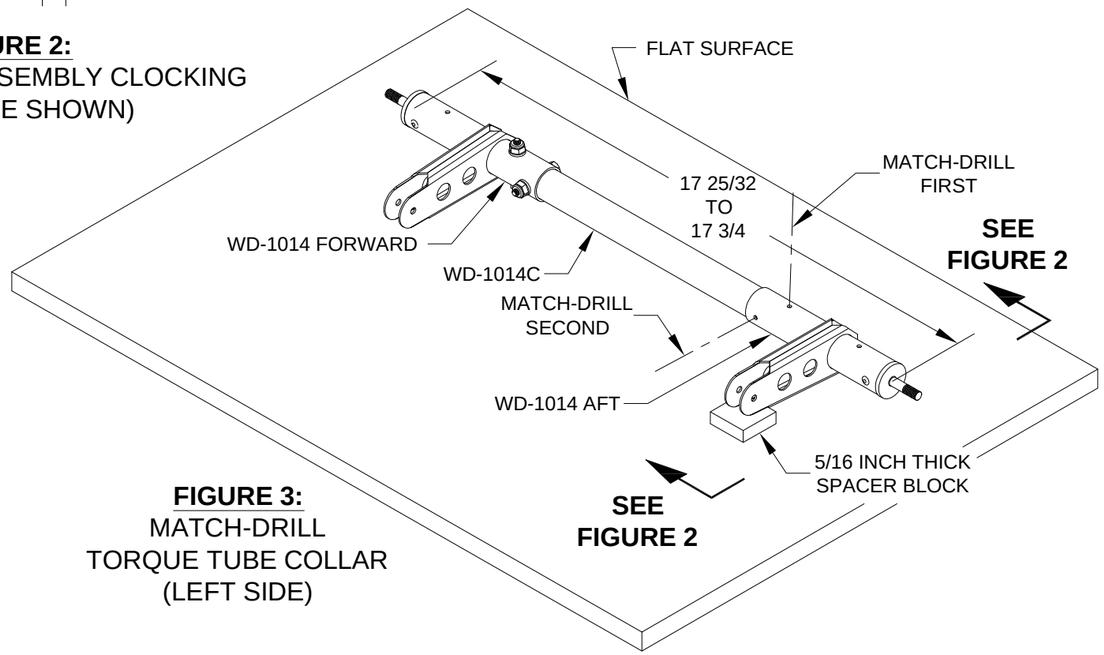



**FIGURE 3:**
MATCH-DRILL
TORQUE TUBE COLLAR
(LEFT SIDE)

Step 1: Insert WD-1014C Torque Tube Collar (which is bolted to the WD-1014 FORWARD Forward Torque Tube Subassembly) through the forward side of the 1 1/8 inch diameter hole in the spar web. See Figure 1.

Step 2: Angle the WD-1014C Torque Tube Collar down as it extends aft through the hole in the spar web and slip the WD-1014 AFT Aft Torque Tube Subassembly over the torque tube collar. Engage the WD-1014 AFT Aft Torque Tube Subassembly and the torque tube collar far enough to allow the threaded ends of the torque tube subasemblies 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 WD-1014 FORWARD and WD-1014 AFT Torque Tube Subassemblies as shown in Figure 1.

Step 4: Check to see if the bolt holes in the WD-1014 AFT Aft Torque Tube Subassembly and WD-1014C 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 AN960-416 or AN960-416L 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.

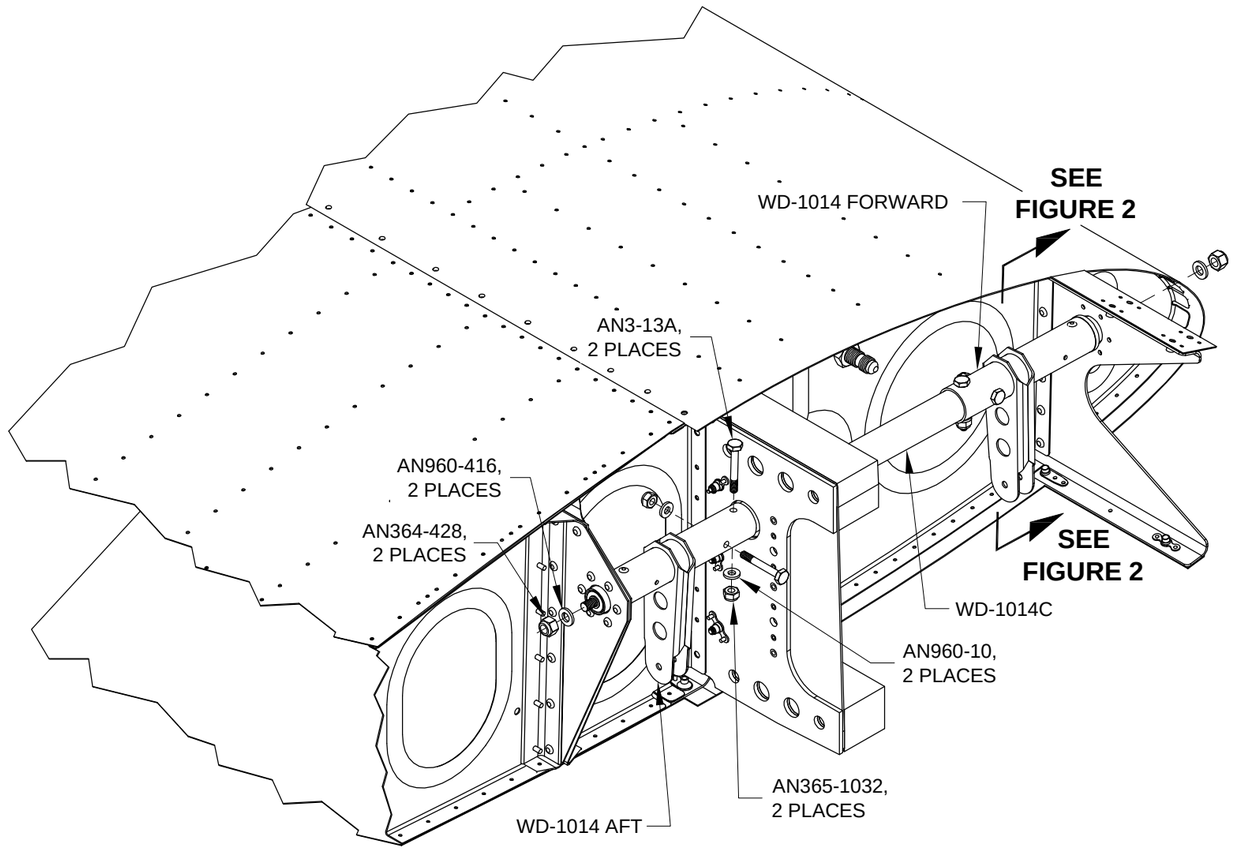



**FIGURE 1:**
TORQUE TUBE INSTALLATION

Step 5: Figure 2 shows the "neutral position" of the WD-1014 FORWARD 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.

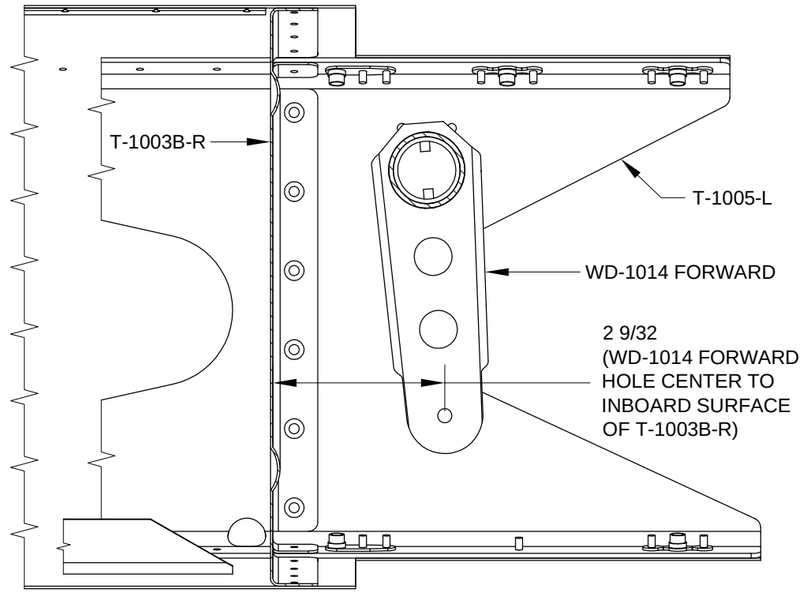



**FIGURE 2:**
FORWARD TORQUE TUBE
SUBASSEMBLY NEUTRAL POSITION

Step 1: Insert the W-1017 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.

Step 2: Attach the W-1017 Torque Tube to Bellcrank Pushrod to the WD-1014 AFT Aft Torque Tube Subassembly as shown on Figure 1. 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.

Step 3: Use the W-730 Bellcrank Jig to verify that when the WD-421-L Aileron Bellcrank is in it's neutral position, the WD-1014 FORWARD Forward Torque Tube Subassembly is also in it's neutral position.

See Figure 1 for proper position of the bellcrank jig. See Page 23-7, Figure 2 for depiction of the forward torque tube subassembly neutral position.

Adjust the engagement of the W-1017 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.

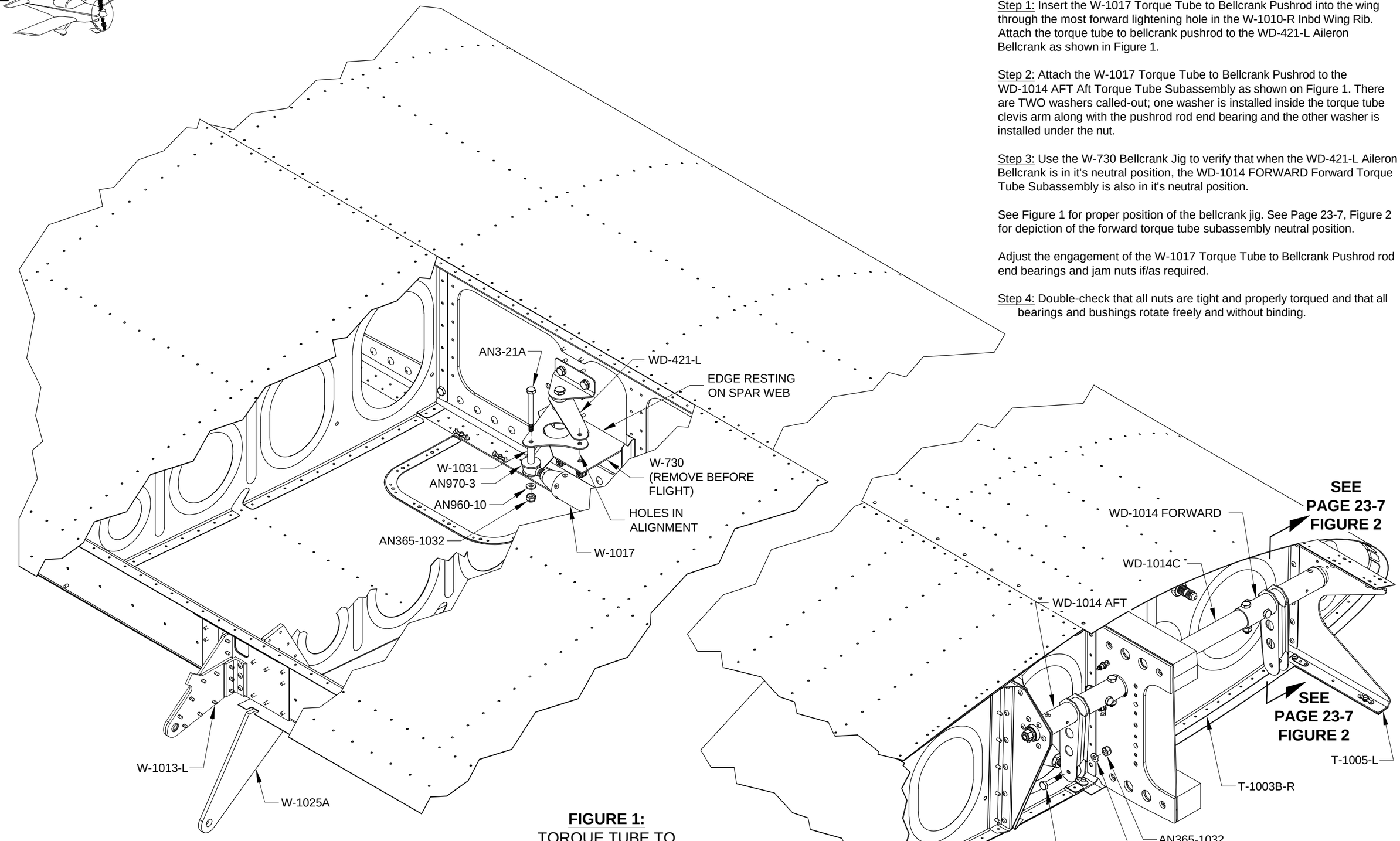



**FIGURE 1:**
TORQUE TUBE TO BELLCRANK PUSHROD INSTALLATION

Step 1: Insert the W-1018 Bellcrank to Aileron Pushrod into the wing through the hole in the W-1007 Rear Spar Assembly. Attach the bellcrank to aileron pushrod to the WD-421-L Aileron Bellcrank as shown in Figure 1.

Step 2: Attach the Aileron Assembly to the W-1014 Outboard Aileron Hinge Bracket and W-1013 Inboard Aileron Hinge Bracket using the hardware shown on Page 21-8, Figure 4 and Figure 3.

Step 3: Attach the W-1018 Bellcrank to Aileron Pushrod Assembly to the A-1007-L Inboard Attach Bracket as shown on Page 21-8, Figure 2.

Step 4: Temporarily attach the Flap Assembly to the three W-1025A Flap Hinge Brackets. See Page 22-8, Figure 4. 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 5: 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. Adjust the engagement of the W-1018 Bellcrank to Aileron Pushrod rod end bearings and jam nuts if/as required. Remove the bellcrank jig.

Step 6: Double-check that all nuts are tight and properly torqued and that all bearings and bushings rotate freely and without binding.

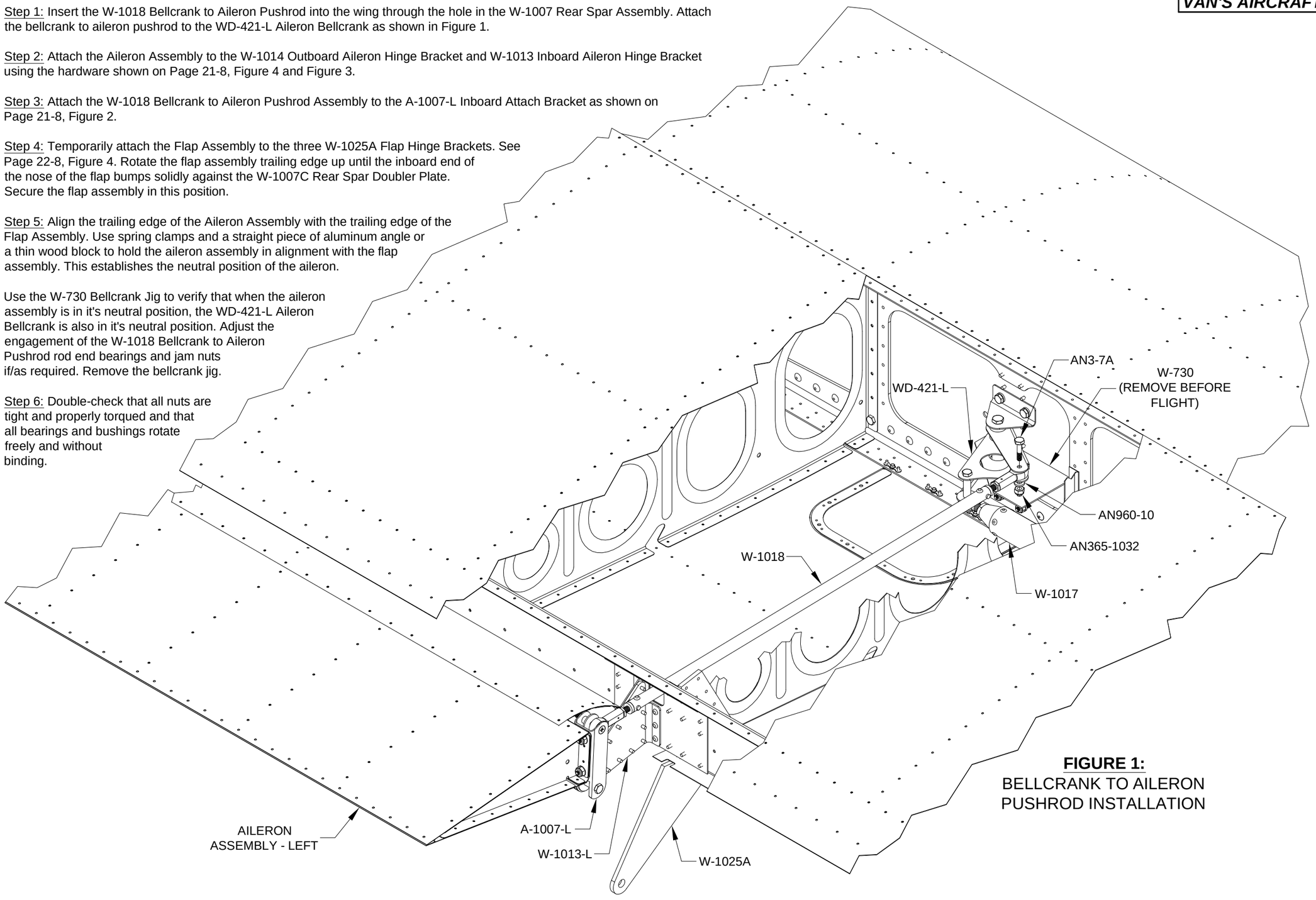



**FIGURE 1:**
BELLCRANK TO AILERON PUSHROD INSTALLATION

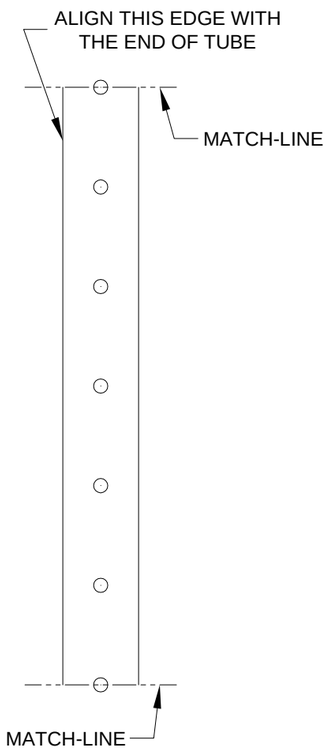



**FIGURE 1:**
PUSHROD RIVET HOLE LOCATION TEMPLATE

10 9/16
[268.29 mm]

16
[406.40 mm]

**NOTE: CHECK PRINTED SCALE 1:1 PER SECTION 3 BEFORE USING THE TEMPLATE!**