# Servo Installation and Setup

The servo unit incorporates important safety features:

- The internal gears are pulled into the engaged position by an electric solenoid. When the gears are not engaged, the output crank arm rotates freely and the aircraft controls can be operated normally without friction. When the servo is engaged, the solenoid pulls the gears into place so the servo positions the control surfaces. Disengaging the servo allows free movement of the controls.

- We also recommend installing a remote **SERVO DISCONNECT** switch on the control stick (or other remote location). Installation of a remote switch is highly recommended, as it allows an immediate way to disengage the servos - even in heavy turbulence.

- The servos also employ a clutch, which allows the pilot to override the servos by applying moderate force to the control stick. Even though the solenoid will hold the gears in place, the clutch will then slip and allow the control surfaces to move. In the event of strong turbulence, conflicting traffic or an altitude anomaly, the pilot can thus override the servos to control the airplane. In such an instance, the servos should normally be disengaged as soon as possible.

**NOTE:** The clutch function does not rely on a shear pin failure mechanism as is employed on some other popular autopilot servos. Activation of the "clutch" function in no way damages the servo drive system although prolonged operation in this condition should be avoided.

## Installing a Servo

Begin by looking for a point on your aircraft bell crank, control pushrod or cable where pushing or pulling the aileron or elevator control linkage a distance of 1.5 to 2.4 inches will do the job. Then find a place to mount the servo nearby to accomplish this by means of the pushrod.

You will mount the servo and pushrod so that the control surface is in a neutral position when the servo crank arm is at mid position. That's it, aside from carefully checking that **the required range of control movement is available within the limits of the servo travel range, and that no "over center" condition can exist. Also, assure that the aircraft control system hits its "stops" before the servo crank arm hits its "stops."**

## OVER-CENTER TESTING

An over-center condition will result in a complete locking of the control system during operation. The result of this is that you will lose all control of the airplane.

When installing the servo, ensure that under **any** flight conditions, including inverted flight, control system flexing, airframe flexing, extreme turbulence or any other abnormal flight conditions,

**IT IS CRITICAL TO ENSURE NO POSSIBILITY THAT AN OVERCENTER CONDITION CAN OCCUR**.

Close is not good enough in this case. If you have any questions of doubts, please consult a qualified technical counselor or call Trio Avionics for consultation.

The servo crank arm uses a pushrod terminated by rod end bearings to link the servo arm to the aircraft control system. The pushrod provided in the installation kit should be trimmed to the correct length for your particular installation.

The servo must be mounted on a solid platform that will not buckle or "oilcan" and attached to a firm existing support. It is recommended that the servo platform not be mounted to the aircraft "skin" without a doublers and some other additional support**. Rigidity of the servo mount is critical to proper servo operation**. If you do not have the experience required to fabricate the required bracket please contact Trio Avionics for guidance.

In your installation, it may be more convenient to rotate the crank arm to a new orientation that will give a neutral (servo center position) at +/- 90 degrees or 180 degrees from that as supplied from the factory. The servo crank arm is secured to a flange by four machine screws that can be removed for indexing the crank arm in 90 degree increments.

*When shipped, the crank arm and screws are not attached to the servo. This allows easy installation of the crank arm for each particular installation. The appropriate Loctite compound is pre-applied to the screws accompanying the crank arm.*

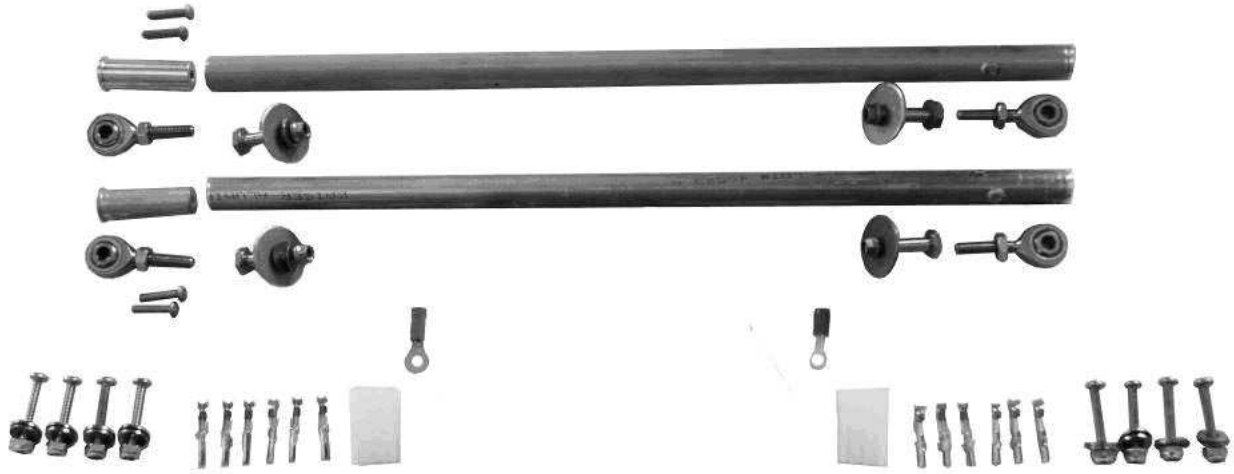
*If the screws need to be removed to reposition the crank arm, after repositioning, Loctite Number 222 must be reapplied (very sparingly) to prevent loosening of the screws.*

**Note**: It is important to assure that the proper direction of travel is preserved when modifying the crank arm orientation. Changing the crank arm mounting by 180 degrees will essentially reverse the direction of travel for the servo arm. In the event unusual pitch changes occur in the first flight, the first check on the ground should be to be certain the servo direction of travel is correct.

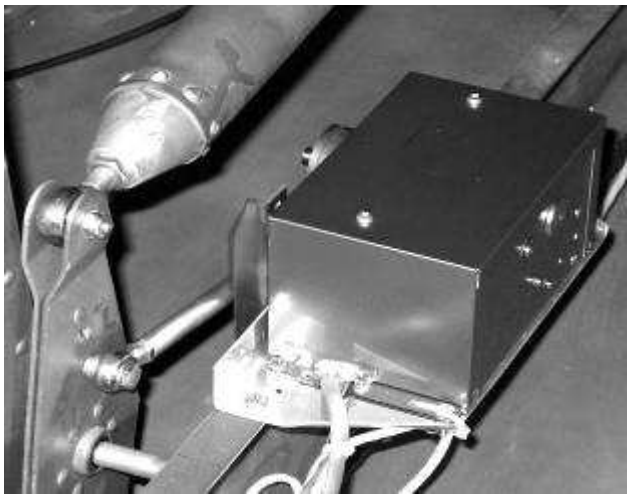
Choose an operating radius on the servo crank arm that allows full elevator movement (control stop to control stop) without driving the servo crank arm into its limits. Most aircraft get best performance in the outermost hole. In the event the servo rotation is insufficient, the servo mechanical stops may be removed. Contact Trio Avionics if this appears to be necessary.

## Servo Mounting Hardware

The following picture shows the electrical and mechanical installation kit that is provided for the servos. A pushrod is provided for each servo, along with two rod end bearings. Typically, one of these connects to the servo crank arm and the other is connected to the aileron or elevator bell crank. When the servo is connected to the control system it should be installed so that the servo crank arm is at a right angle to the control rod. This mechanically centers the servo mechanism to the control system so that there is *equal displacement in either direction* when the servo is actuated.



## Selecting a Site for the Servo



For most aircraft, it's relatively easy to find a suitable site for locating the crank arm servo. The length of the pushrod and the angle it makes with the driven element are user selectable.

The rod end bearing allows some misalignment, typically about 8 degrees, between the servo pushrod and the plane of rotation of the crank arm. This limit on angular displacement often determines the minimum pushrod length. Any side-to-side movement must not jam the rod end bearing. A suitable hard point must be found, or built, for mounting the servo. The mounting place needs to be as accessible as possible, and there must be a means of linking to the control system. (The photo above shows an elevator servo installation in a RV-6).

**Note:** The controls must travel from control stop to control stop within the range of movement allowed by the servo stops which limit crank arm rotation.

⚠ When the above conditions are met, the system usually performs best when the pushrod is attached to the outermost hole in the servo crank arm. If your aircraft employs a control system bell crank, you should ideally attach the pushrod to the bell crank at a distance from its pivot point that allows full control system travel along with maximum travel of the crank arm without contacting the servo mechanical stops.

**Never allow the servo to limit aircraft control travel**

The servo mounting location must be strong and rigid. If, for example, you need to mount the servo on the skin of an airplane, it will be necessary to use additional bracing or a "doubler" to provide appropriate rigidity. You do not want the movement (rocking) of the servo to fatigue the mounting structure.

When mounting the servo, be careful not to drill mounting holes into critical load bearing members. It may be best to construct a mounting plate, place and bond machine screws so that they will interface with the case mounting holes, and then secure the assembly into place. For a composite aircraft installation, the bottom of the plate (shown) should be floxed and the holes in the plate filled with flox before applying fiberglass layers over it to secure it to the fiberglass structure.

**NOTE** : It is important that the servo mounting plate surface be flat and smooth. If it is not, this can distort the servo frame when the servo is secured to the mounting plate.

Usually the servo pushrod will terminate on a control pushrod or a bell crank. If you are connecting to a pushrod **care should be taken to keep the pushrod from being free to rotate.** (To repeat, the pushrod should **NOT** rotate.)

The reasoning for this is that as the pushrod rotates there is "lost motion" in the system, i.e., movement of the crank arm does not result in movement of the control system. **The control movements are so small that it takes very little slop in the system to make the airplane not track properly**.

It will simplify installation adjustments if there is enough overhead clearance to allow removal and replacement of the servo lid with the servo remaining in place (for instance, you will possibly want to adjust the slip clutch). The servo lid is secured by two screws on the top of the servo.

## Positioning the Servo Crank Arm

The crank arm is not attached to the servo when shipped. To suit your particular installation, you will need to position the servo crank arm to get the correct geometry to drive the control system. It can be installed in one of 4 positions, in 90 degree increments. The screws that are supplied have Loctite® applied to the threads. Once these screw are tightened, the will be very difficult to remove – so be sure that the crank arm orientation is correct.

Should it be necessary to remove the screws, once installed, it is required to apply heat with a heat gun before attempting to loosen the four screws. The heat should be applied for at least one minute to allow the Loctite® to soften. Failure to heat the assembly will more than likely cause the screws to break off when being removed.

If it is necessary to reposition the servo Crank Arm, perform the following steps:

1. Use a #2 Phillips screwdriver to remove the screws. Ensure sufficient pressure is used to prevent slippage of the screwdriver and subsequent rounding of the screw heads.
2. Rotate the crank arm to the correct position for your installation.
3. When satisfied with the positioning, apply a small amount of Loctite® 222 to the screws, reinsert and tighten the screws.

## Install the Servo Pushrod

Cut the pushrod to the proper length so that, when the servo is at neutral, or centered in its full rotation stop to stop, the aircraft aileron or elevator is also neutral (see note).

Choose the longest possible crank arm radius that accommodates a pushrod range of movement equal to or exceeding that required for full aileron or elevator travel.

**Be sure that the rod end bearings never jam due to misalignment as the pushrod angle is varied by different combinations of control system input**. Push the control stick (or control wheel) in all four corners to test this.

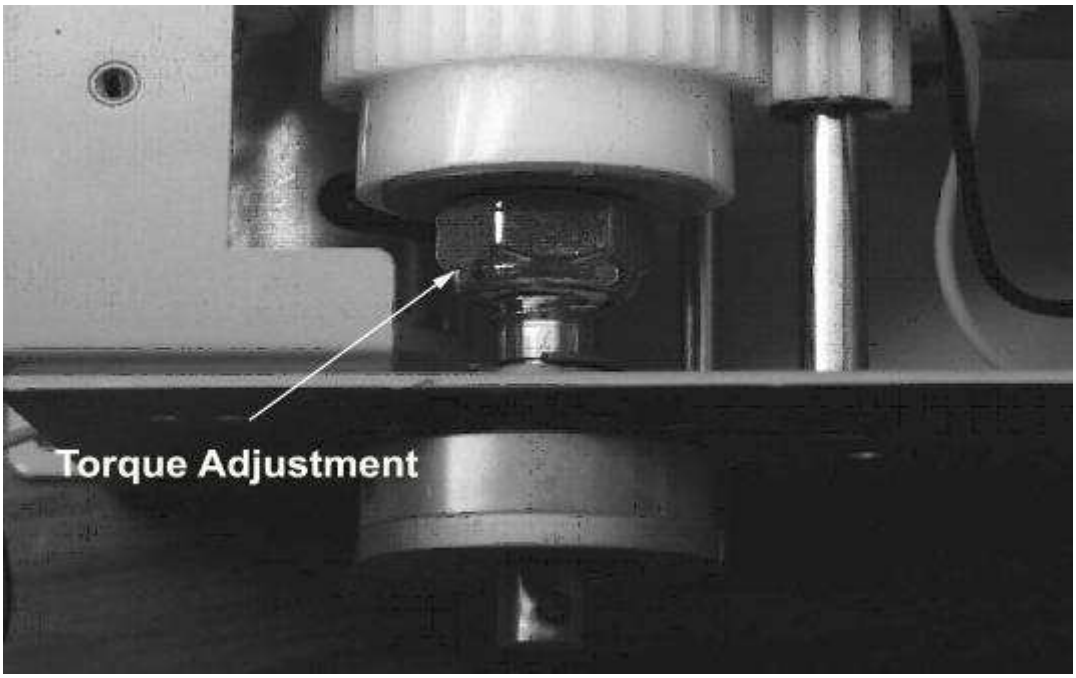
**NOTE:** The crank arm neutral position for your control systems will be dependent on the particular aircraft design.

For instance, many designs require more throw of the control system from the neutral position to the full stick back position (elevator up) than the other direction.

In this case when the elevators are positioned at their neutral position, the crank arm will not be at it's centered (exact vertical or horizontal) position. This is not of concern during operation of the system as the servo design compensates for this offset automatically during operation. Again, the important thing to remember is that the control system must contact its mechanical stops before the servo contacts its mechanical stops.

When attaching the servo pushrod to a control bell crank, it is important to keep the two lever arms equal. Measure the distance from the servo crank arm pivot point to the outermost hole in the crank arm. Then drill an attach point in the bell crank that is the same distance from its pivot point. This will assure proper servo operation.

## Setting Servo Override Force (Slip Clutch)




The servo Torque Control nut (the adjustment nut inside the servo on the output shaft) sets the override force - the force you will feel at the stick when the servo clutch begins to slip.

Engage the servo. You should hear the solenoid operate inside the servo housing and the servo crank arm should become firmly held in place by the gear train. Then push the control stick hard enough to override the servo. Using an 11/16 " or 17mm open end wrench set the override force to a value that seems strong enough to give a fairly good control authority, but not so strong as to be difficult to override with the control stick.

Work toward setting the servo slip clutch to the minimum torque necessary to give enough elevator authority to handle a reasonable amount of turbulence or trim error.

## Adjustment of Servo Rotation Direction

After installation wiring is complete the system servo direction check must be accomplished. This is a one time setting that must be accomplished while the aircraft is on the ground. Once done, it should never have to be changed unless you replace a control head, or perform a “default reset” that returns all settings to the factory defaults.

⚠ **NOTE:** This is a **CRITICAL** setting and **MUST** be verified before flight. If the command direction to the servo motor is not correct the aircraft will be forced into a divergent maneuver when the system is engaged.