What is an Anti-Servo Tab?

Darrell W. Contreras, Esq., CFI, MEI

When I was doing my CFI check ride, my examiner asked me to explain an anti-servo tab; my heart sank. Having flown Pipers a lot, I was familiar with the basics: (1) pitch is controlled by a horizontal stabilator that moves as a single unit instead of having an elevator; (2) the tab on the trailing edge of the horizontal stabilator is called an anti-servo tab; (3) the anti-servo tab moves with the direction of the horizontal stabilator; and (4) the trim wheel in the cockpit moves the anti-servo tab to allow us to maintain a desired pitch. In addition, during my exam preparation, I found that an anti-servo tab helps enhance the controllability of the stabilator, but I could not find any single resource that put everything together to answer three basic questions: (1) why is it called an anti-servo tab, (2) what is a servo, and (3) why is it different from a trim tab?

I told my examiner what I knew and told him I did not know the answer to the three questions above. That drove me to research the topic, ask CFIs and examiners for perspective, and put together what I hope is a single, comprehensive explanation of an anti-servo tab. So instead of hoping your examiner does not ask you to explain an anti-servo tab, let's understand what an anti-servo tab is and how it works.

Anti-Servo Tab – The Overview

Some airplanes are equipped with an anti-servo tab (think Pipers) instead of an elevator trim tab (think Cessnas). To understand what an anti-servo tab is, we need to start with the mechanics of the location and movement of the elevator trim tab and the anti-servo tab, then we can dive into the name, anti-servo tab, and what that means to you as a pilot.

Elevator Trim Tab v. Anti-Servo Tab

Let's first look at the elevator trim tab. The horizontal stabilizer is the airfoil mounted aft of the main wings and fixed horizontally on the empennage of the airplane. At the trailing edge of the horizontal stabilizer is the elevator. The elevator is the movable portion of the horizontal stabilizer that is connected by a hinge to horizontal stabilizer and is used to change the pitch of the airplane. At the trailing edge of the elevator is a section that is connected by another hinge and movable in response to changes in the trim control wheel. (***See Figure 1***). This section is called the elevator trim tab and is used to adjust the airflow to allow the airplane to maintain a constant pitch without a control input from the yoke.

Figure 1 - Horizontal stabilizer with elevator and trim tab

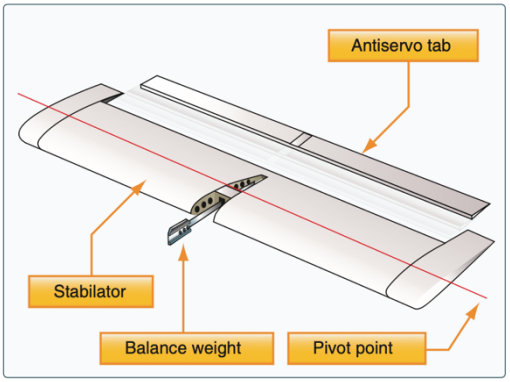

Figure 2 - Horizontal stabilator with anti-servo tab

Now for the anti-servo tab. Airplanes with an anti-servo tab have a horizontal stabilator instead of a horizontal stabilizer. The anti-servo tab is connected to the horizontal stabilator. A horizontal stabilator is a movable airfoil that is mounted horizontally and aft of the main wings on the empennage of the airplane. In contrast to the horizontal stabilizer, the horizontal stabilator moves as an entire unit, pivoting around a central hinge point. Along the trailing edge of the horizontal stabilator and connected by a hinge is the anti-servo tab. (***See Figure 2***). The movement of the anti-servo tab is controlled by a trim wheel just like the elevator trim tab. However, unlike the elevator trim tab, the anti-servo tab is also moved with movement of the horizontal stabilator increasing the upward or downward deflection of the airflow over the horizontal stabilator.

Both the horizontal stabilizer and the horizontal stabilator were designed to counter the lift of the wing. The center of gravity (CG) is always placed ahead of the center of lift of the airplane. Even at the rearmost CG limit, the CG is forward of the center of lift. Thus, a downward force is needed to counter the lift generated by the main wings. Think about the horizontal stabilizer and horizontal stabilator as an inverted wing that generates lift in the opposite direction of the main wings. As an aside, in a canard design, i.e., a horizontal stabilizer in front of the main wings, both the canard and the main wings generate lift.

When the elevator or the stabilator is moved, it increases or decreases the deflection of the air over the airfoil. Because the stabilator moves as an entire single unit and pivots around a single hinge point, in contrast to the elevator that only moves the rear portion of the horizontal stabilizer, any movement of the horizontal stabilator has a greater effect on the airflow than the same movement of an elevator. In addition, the stabilator moving as an entire unit is free to continue movement in the direction of the deflection. If, for example, the stabilator is deflected down, there is airflow that now hits the deflected surface. We think of this as induced drag but the addition of the airflow contacting the downward deflected surface also tends to "push" the surface further down. That is why we say that the stabilator is free to continue movement in the direction of the deflection. As a result, stabilators are extremely sensitive to control inputs and aerodynamic loads.

<u>What is a servo, a servo tab, and an anti-servo tab?</u>
Simply stated, a servo on an airplane is a hinged surface. Remember that the stabilator is an airfoil that pivots around a central hinge point. Thus, a stabilator is a servo. A servo tab, therefore, is a tab that is connected to the servo. For reference, let's refer to the direction of movement based on what the aft portion of the servo and the servo tab is doing. If we say the servo or servo tab moves in the upward direction, that means that the aft portion of the servo goes up. This is important because our horizontal stabilator rotates around a central pivot point and thus the forward part of the stabilator moves in the downward direction while the aft portion of the stabilator moves in the upward direction.

A servo tab, sometimes referred to as a "balance tab," moves in the opposite direction of the control surface to which it is attached in order to *counter* the movement of the control surface. If the servo moves in the upward direction, a servo tab will move in the downward direction.

The anti-servo tab, on the other hand, moves in the same direction as the control surface to which it is attached. When the servo moves in the upward direction, the anti-servo tab also moves in the upward direction. (***See Figure 3***). That means that the movement of the anti-servo tab is intended to *un-counter* or "unbalance" the movement of the control surface to which it is attached, which is why it is referred to as an *anti*-servo tab.

Figure 3 – Anti-servo tab and stabilator (servo) in the upward direction.

<u>The Anti-Servo Tab in Action</u>

Without an anti-servo tab, a slight movement of the stabilator would increase or decrease the (inverted) lift produced by the stabilator. With an anti-servo tab, however, when the stabilator is moved, the anti-servo tab moves in the same direction but above or below the stabilator (***See Figure 3***). Because the movement of the stabilator results in the anti-servo tab moving above or below the stabilator, the anti-servo tab creates an additional drag that must be overcome in order for the stabilator to achieve the same amount of (inverted) lift. In addition, the drag from the anti-servo tab also prevents the servo from continuing movement in the direction of the deflection because it slows the speed of the airflow over the servo, which reduces the (inverted) lift generated by the servo.

Putting it all together, because the anti-servo tab creates drag, and an additional force on the control surface in the form of movement of the yoke forward or backward will be required to counter the additional drag. That additional force means that instead of the stabilator being extremely sensitive to control inputs, the pilot can use greater movement of the yoke to produce the same effect from the stabilator. This results in greater control of the pitch of the airplane, which is why we say that the anti-servo tab increases the controllability of the pitch of the airplane.