PART 1 : SECTION 1

CHAPTER 9

TRIMMING AND BALANCE TABS

Introduction

1. A tab is the small hinged surface forming part of the trailing edge of a primary control surface. If an aircraft is out of trim and requires, say a constant pull force on the control column to maintain level flight, this effort would soon tire the pilot. A tab can be used to trim out the holding force and ease the task of the pilot.

2. Assume that the aircraft is slightly tail heavy and therefore requires a constant push force to maintain level flight. If the position of the elevator trimming tab is then adjusted so that it is moved upwards, the result is a down load on the elevator trailing edge which moves the elevator down. The downward movement continues until the downward moment of the tab is balanced by the upward moment of the elevator. Fig. 1 illustrates this effect and the simple principle of any form of tab.

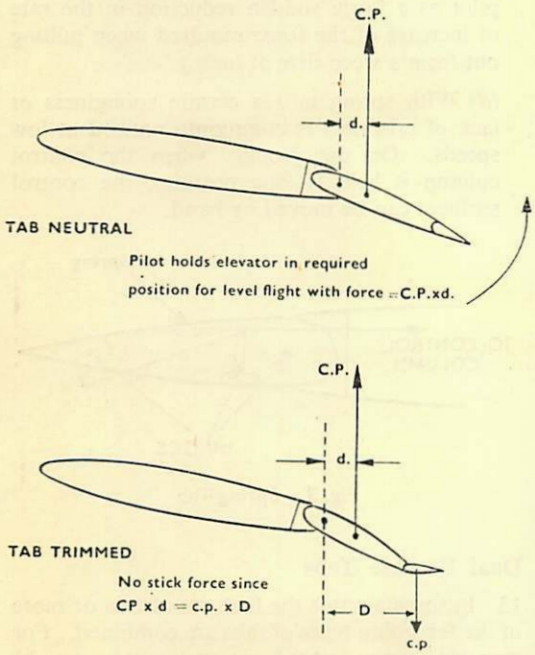

Fig. 1. Principle of the Tab

3. Besides their use for trimming, tabs have been adapted to a large variety of shapes, sizes, applications, and methods of operation, giving the designer a broad range of solutions to a particular problem. Some of the more important types of tabs are outlined below.

Fixed Tabs

4. Fixed tabs can only be adjusted on the ground and their setting determined by one or more test flights. Thus under conditions of no stick force, the trailing position of the control surfaces is governed by the position of the tab. This type of tab is used on the ailerons of some aircraft, and sometimes on the rudders of single-engined jet aircraft.

5. An early form of fixed tab, sometimes still used on light aircraft, consists of small strips of cord doped above or below the trailing edge of the control surface. A strip of cord above the trailing edge deflects the surface downwards, the amount of deflection depending on the length of cord used.

Servo Tabs

6. Servo tabs are operated directly by the control column or rudder bar ; the control surface itself is not connected to the pilot's controls. When the aircraft is stationary, movement of the control column or rudder bar moves the tabs only, the control surface is unaffected. During flight, assuming a servo tab on the rudder, when right rudder is applied, the tab is moved to the left and so deflects the control surface itself to the right. One of the chief disadvantages of the simple servo tab is that it lacks effectiveness at low speeds, since any tab loses most of its effect when deflected through an angle of more than about 20°. The large control surface deflections required at low speeds need correspondingly large tab deflections; and therefore this system is not always satisfactory. A refinement of the simple servo tab, the spring tab, is used to overcome this fault.

Trimming Tabs

7. Trimming tabs are used to trim out any holding forces encountered in flight, such as those occurring after a change of power or speed, or when the C.G. position changes owing to fuel

consumption, or after dropping bombs or expending ammunition. Whenever the speed, power, or C.G. position is altered, one at a time or in combination, the changed trim of the aircraft necessitates resetting of the tabs.

8. **Operation of Trimming Tabs.** Trimming tabs are pilot-operated, usually by handwheels in the cockpit which operate in the natural sense. On later aircraft, however, some or all of the trimming tabs may be electrically-operated by small switches, spring-loaded to the central (off) position ; to eliminate a holding force the pilot moves the appropriate switch in the same direction as the holding force until the stick load is zero, and then releases the switch.

9. **Variation of Tab Effectiveness with Speed.** The sensitivity and power of a trimming tab varies with speed in the same way as the control surfaces. At low speeds large tab deflections may be required to trim an aircraft, but at high speeds small movements have a marked and immediate effect on the trim. Until familiar with electrically-operated trimming tabs it is recommended that at high speed the switch is operated in a series of short "blipping" movements.

Geared and Spring Tabs (Balance Tabs)

10. Geared and spring tabs are commonly known as balance tabs and their effect is to balance partially the aerodynamic loads on the control surfaces, thus reducing stick forces. In its basic form this type of tab is not under the control of the pilot, but the tab angle is automatically changed whenever the main surface is moved.

11. **Geared Balance Tabs.** These are linked to the main fixed surface ahead of the control surface so that when the control surface is moved the tab, by virtue of the linkage, is moved in the opposite direction through an amount proportional to the movement of the control surface (Fig. 2). Thus movement of the tab helps the control surface to move and reduces the stick forces. Occasionally anti-balance tabs are used to reduce the amount of aerodynamic balance and make the control heavier to move ; the tab then moves in the same direction as the control surface, tending to prevent movement.

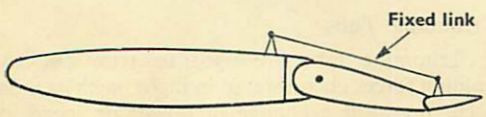

Fig. 2. Geared Balance Tab

12. **Spring Tabs.**

(*a*) In this system the cable from the control column is connected to one end of a spring, the other end of which is fixed to the control surface ; the cable is also linked to the tab itself. Fig. 3 illustrates the arrangement diagrammatically. The spring tab has advantages over the simple servo tab since, at low speeds, the spring tension is greater than the tension in the control cables and so the spring is not affected, *i.e.* the control surface moves as a plain manually-operated surface. At higher speeds, when the cable tension is greater than the spring tension, the spring is stretched and so brings the tab into play through its linkage to the control cable.

(*b*) In effect the spring tab acts as a geared tab except that the effective gear ratio changes with speed ; in other words the greater the stick force required for a given deflection of the control surface, the greater the assistance given by the tab. Spring tabs are commonly used on ailerons and occasionally on the elevator and rudder.

(*c*) Certain spring tab installations, usually on the elevators, are preloaded, *i.e.* the spring is tensioned so that it does not begin to stretch until a fairly high stick force is used. The use of preloaded spring tabs can be felt by the pilot as a fairly sudden reduction in the rate of increase of the force required when pulling out from a steep dive at high *g*.

(*d*) With spring tabs a certain sponginess or lack of crispness is commonly noticed at low speeds. On the ground, when the control column is held in one position, the control surfaces can be moved by hand.

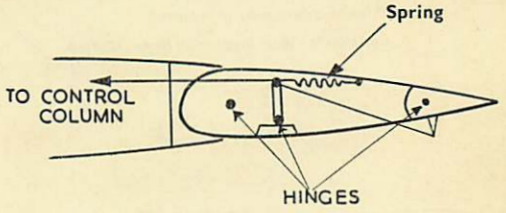

Fig. 3. Spring Tab

Dual Purpose Tabs

13. In some aircraft the features of two or more of the foregoing types of tabs are combined. For example, servo, geared, or spring tabs can be connected to the pilot-operated trim wheel so that the basic position of the tab in relation to the

control surface can be varied. In this way the tab functions both as a trim tab and as a pure servo, geared, or spring tab.

Other Methods of Trimming

14. **Spring-Bias Trimmers.** Trimming is also done on some light aircraft by adjusting the tension in springs which are connected directly to the pilot's controls. Thus an adjustment in the spring tension will bias the control column or rudder bar in any desired position.

15. **Variable-Incidence Tailplanes.** These are used to counter large changes in trim in the pitching plane. The variable-incidence tailplane is generally electrically-operated by a switch which is situated on the control column and spring-loaded to the central off position. For example, if a nose-down condition exists the trim switch is moved back to decrease the incidence on the tailplane and reduce the tailplane lift, so removing the nose-down tendency.

Control Locks on Servo and Spring Tab Control Surfaces

16. On aircraft using servo or spring tabs, locking the control column or rudder bar will not prevent high winds from moving the control surfaces. In these cases external control surface clamps are essential.

17. On certain spring tab installations, partial or full movement of the control column or rudder bar is possible when the external clamps are still in position. For this reason it is vital that the clamps are removed before flight and a visual check of the correct movement of the control surfaces is made when the control column is moved. If the surface cannot be seen from the cockpit, movement should be checked with the assistance of the ground crew. Any restriction in the movement of the control column, other than the normal friction, must be investigated before flight.