Setting Aileron, Elevator, Rudder, and Trim Tab limits

By John Propst with technical overview by Bill Pancake

Abstract: This article discusses methods for measuring and setting the rotational limits for the ailerons, elevator, trim tab and rudder on Aeronca Champs and Chiefs.

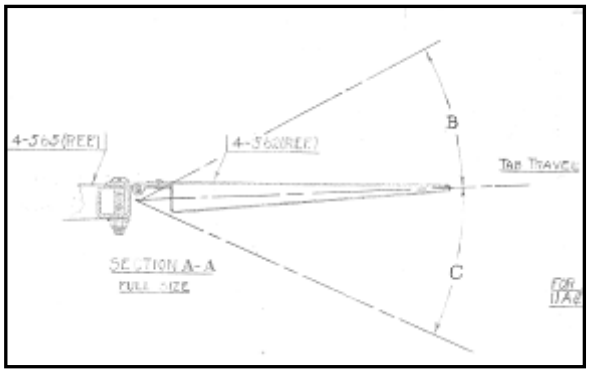
Drawing 7-437, titled “Installation Tail Surfaces” displays information related to the adjustment of the various tail surfaces on Aeronca model 7A, 11A, 11B, 7B, 11CC, 57DC, 7DC, 7BCM, and 7CCM aircraft.

MODEL	NEXT ASSEM	ASSEM NO. REQD.	PLANE PER	A	B	C	D	E
7CCM	7-783	1	1	25° L +0 −2 / 25° R +0 −2	17.5° +2 −0	37.5° +2 −0	24° +0 −2	24° ±2
7BCM	7-593	1	1	25° L +0 −2 / 24° R +0 −2	20° +2 −0	34.5° +2 −0	27° +0 −2	21.5 ±2
7DC	7-784	1	1	25° L +0° −2° / 25° R +0° −2°	17.5° +2 −0	37.5° ±2	24° ±2	24° ±2
57DC		1	1	25° L +0° −2° / 25° R +0° −2°	17.5° +2 −0	37.5 ±2	27° ±2	21.5° ±2
11CC	7-801	1	1	28° +0 −2	14° +2 −0	41.5° +2 −0	24° ±2	26° ±2
7B	7-522	1	1	25° L / 24° R +0 −2	20° +2° −0°	34.5 +2° −0	27° +2° −2°	21.5 ±2°
11B	7-495	1	1	28° +0° −2°	23° +2 −0	31° +2 −0	26° +2 −2	24.5° ±2°
11A	7-500	1	1	28° +0° −2°	23° ±2	31° +2 −0	26 +0 −2	24.5 ±2°
7A	7-484	1	1	25° L / 24° R +0° −2°	20 ±2	34.5 ±2	25 ±2	155 ±2°

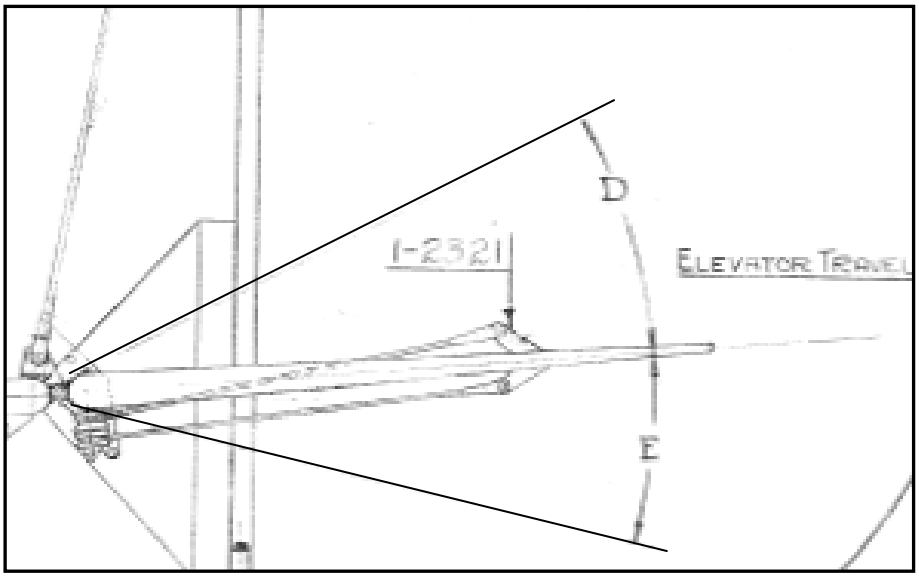
Table from drawing 7-437 displaying the limits for various models.

A = Rudder travel
B = Trim Tab up limit
C = Trim Tab down limit
D = Elevator up limit
E = Elevator down limit

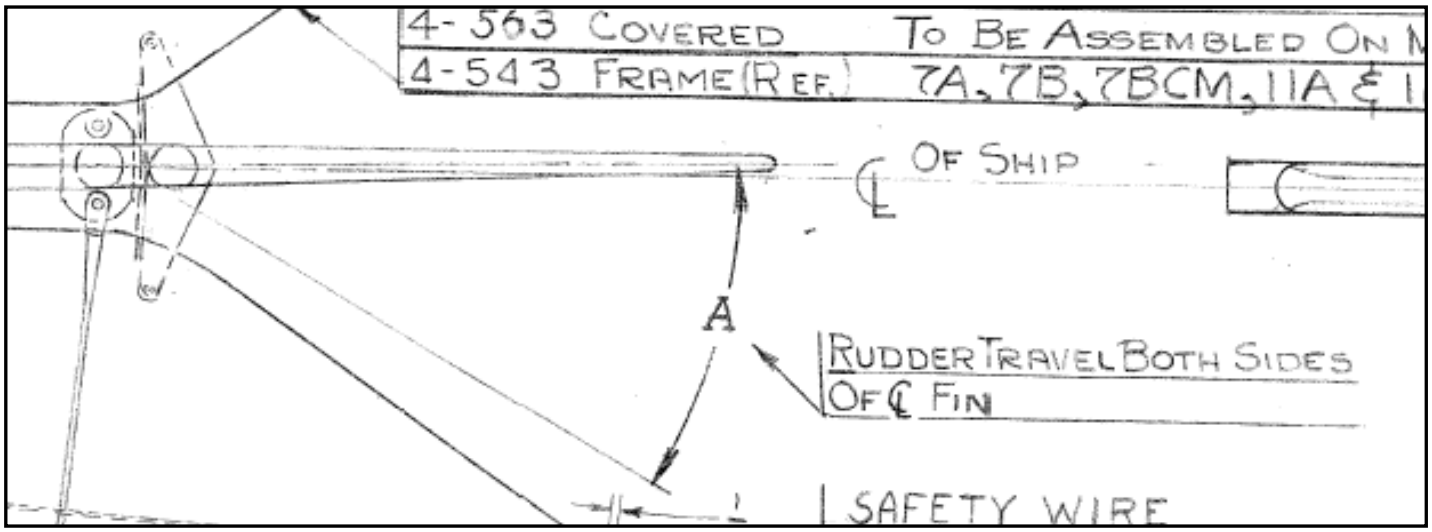
Section AA from drawing 7-437 shown below displays the elevator trim tab up limit “B” and the down limit “C”



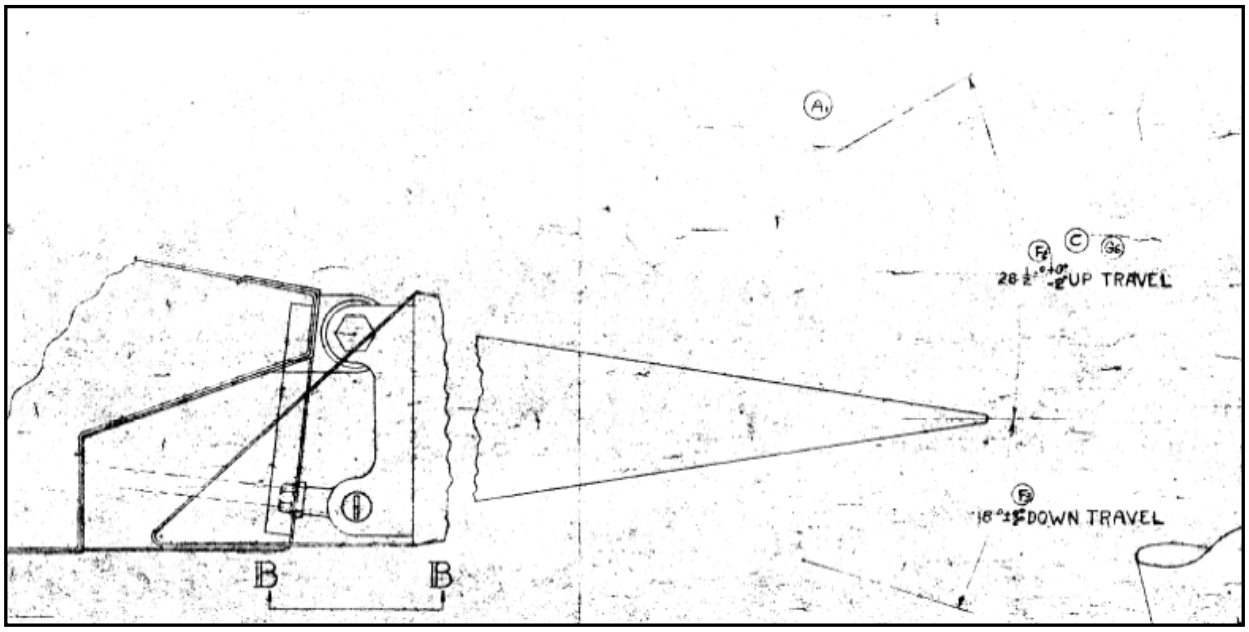
The next section from drawing 7-437 displays the up limit “D” and the down limit “E” of the elevator



The next section from drawing 7-437 displays the rudder travel limits. The limit is the same on both sides of the centerline of the fin (except when noted otherwise in the table or Type Certificate.

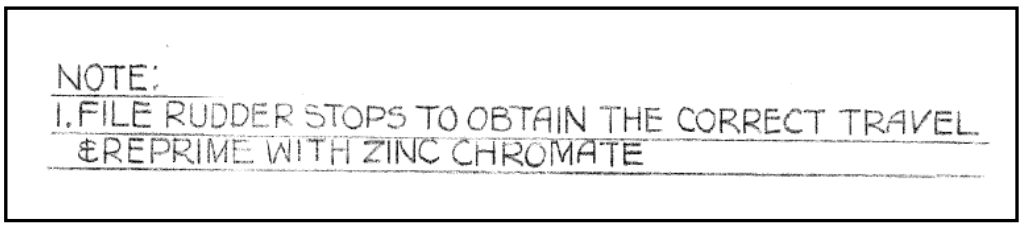


Drawing 7-438 titled “Installation Wings and Struts” displays the up and down limits of travel for the ailerons on 7A, 7B, and 7BCM aircraft. Drawing 7-505 also titled “installation Wings and Struts displays the limits of travel for ailerons on 11-A and 11-B aircraft.



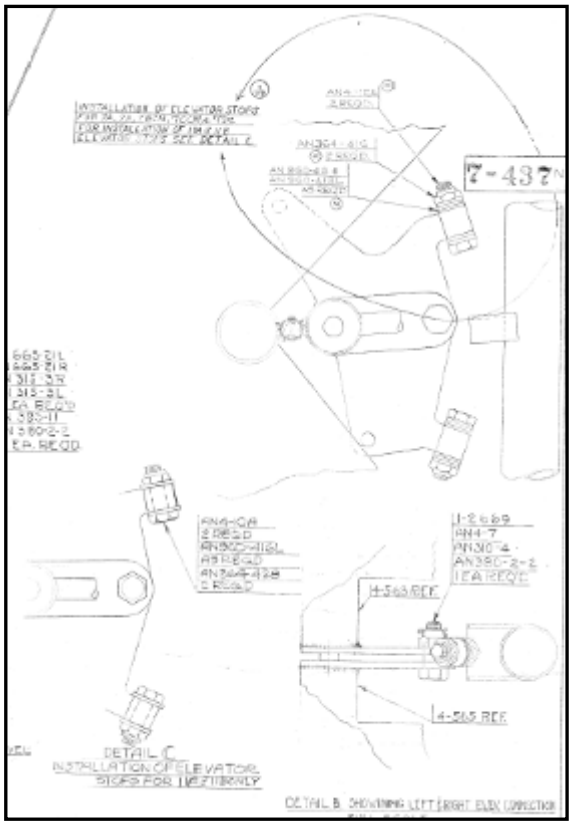
The drawings mentioned in this article displays numeric limits for the various control surfaces. The most current aircraft Type Certificate should always be checked to confirm the latest control surface limits. If there should be any deviation between the Type Certificate and any other document, the values shown on the Type Certificate always take precedent.

The following note on drawing 7-437 indicates that the rudder travel is adjusted by filing the rudder stops for the correct travel. Obviously this method only works if the travel must be increased. To reduce the rudder travel the rudder stop must be built up with welding or other comparable methods. It is very important to check the rudder travel. With time and abuse from wind, the rudder stops may become damaged, permitting excessive rudder travel. This in turn can result in the rudder coming into contact with the elevator. Routine aircraft inspection should include confirmation that clearance exists between the rudder and the elevators. As a visual reference, the angle between the neutral rudder and the angled elevator edges is 35º. Since the specified travel of the rudder on Champs and Chiefs is typically between 25º and 28º, when the rudder is rotated to the stop, it should be less than parallel with the angled edge of the elevators. This is a quick and easy check of the rudder travel on Chiefs and Champs.



While the ailerons have up and down limits, there are no adjustable stops for setting the aileron limits. The bellcrank mechanism located in each wing has a non-adjustable tab to limit the rotation of the bellcrank but it is not involved in the adjustment or operation of the aileron. To adjust the travel of the ailerons, the aileron pushrod assembly shown on drawing 1-2341 is first set at exactly 5 1/4". The three turnbuckles in the four aileron control cables are then adjusted to align the ailerons. Bill suggests that with the control stick in the vertical (neutral) position, the cables be adjusted to provide 1/8" droop at each aileron, i.e. the trailing edge of the aileron is positioned 1/8" below the trailing edge of the wing with the control in the vertical position). Normally the length of the aileron pushrod is not changed when setting the ailerons. However, Bill says that on a few rare occasions where a turnbuckle has reached a limit or where an aileron may just need a very slight tweaking, the pushrod length has been altered by a turn or two to align the aileron. However, caution must be exercised here as a significant change in the length of the pushrod will alter the nonlinear travel of the pushrod with respect to the rotation of the bellcrank.

The following section from drawing 7-437 displays the two adjustment stops for the elevator.



There is considerable conflicting information related to the elevator stops. The extract shows what is probably the most often used method for installing and adjusting the elevator stops. This involves using standard AN bolts, washers, and elastic stop nuts. Washers are added as needed to set the limits of travel. The conflict mentioned above is associated with a special stop bolt 1-2540 (shown on the drawing 1-2540). This bolt is essentially a standard AN bolt in which the threads have been chased the entire length, permitting two jam nuts, rather than washers for setting the travel. The revision table on drawing 1-2540 indicates that the reference to 7 model aircraft was removed leaving the 1-2540 bolt referenced only to 11 model aircraft. However, the only actual reference to the use of the 1-2540 bolt is in the Champion and Chief "Service Manuals". While the reference to model 7 aircraft was removed from drawing 1-2540, the Champ service manual shows using the 1-2540 bolt. The Chief service manual, on the other hand, references using a standard AN bolt and washers. To add additional confusion, the July 1,1947 Aeronca Master Parts Price List covering current and prewar Aeronca Airplanes indicates that two 1-2540 bolts are needed for Champs, but none are needed for Chiefs.

Some Aeronca owners have indicated that their aircraft is rigged with one of the elevator stop bolts missing. Bill commented that over the years some aircraft have been repaired resulting in the elevator fixed stop tab being positioned higher or lower than specified resulting in the need for one of the limit bolts not being needed.

Bill also commented that the most common and accepted method for setting the elevator stop on all Champs and Chiefs is the use of the standard AN bolt and washers as shown on drawing 7-437.

When setting elevator limits, Aeronca Service Helps and Hints # 24 should be reviewed to assure that there is adequate clearance between the upper elevator cable and the mounting bolt for the elevator trim tab cables located just forward of the elevator cable attachments.

There are a number of different tools that can be used to measure the angular travel of the control surfaces. Basically any type of protractor device, calibrated in degrees can be used. There are levels and protractors with built in bubble and gravity levels available from places such as Harbor Freight or Sears. Some of the newer electronic levels also have the ability to display angular deviation from level or a preset reference. Any of these type devices should have the necessary accuracy needed to set the limits.

A reference from Aeronca Service Letter 15, section 5 (a), provides the technical definition of angular control surface measurement:

> "Angular travel is shown in degrees, for all surfaces, and is the angle that the chord line of the control surface makes with the chord line of the particular fixed surface to which the control surface is attached."

It is important to remember that all inspection, maintenance, alterations, and documentation should be done in accordance with Part 43 of the Federal Aviation Regulations (FAR).

Below are photos of various tools that might be used to measure control surface travel. All of these tools are available from Harbor Freight.

Measuring Control Surface Travel - A Case Study

The following readings were measured on a 7AC Champ that had been converted to a 7DC.

The readings were taken using a dial gauge angle finder, purchased at Harbor Freight for about $5. All readings were taken with the aircraft in its normal 3 point stance on a level floor. The aircraft tail does not have to be raised to a level position because only the relative angle between the neutral and limits is desired.

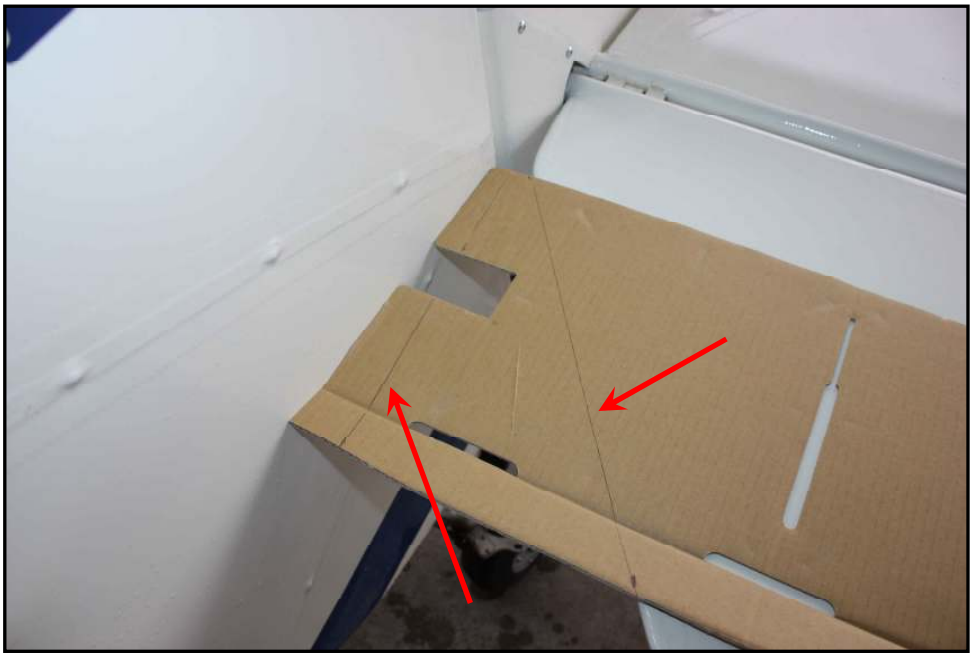
The table below shows the actual readings. Readings taken on one side of vertical zero are indicated as positive (+) while readings on the opposite side of vertical zero are indicated as negative (-).

Considering the fact that we are dealing with aircraft over 60 years old, it is not all that unusual to find some of the measured limits slightly outside the specified limits. Also, since except for the elevator, there are no stops for adjusting the other measurements, there is not too much that one can do to comply with the specs. All measurements should be reviewed with an I/A to verify that any deviations are not indications of possible hidden or potential problems.

Control Surface Measurements

	Measured °	**Angle °**	**Spec °**
Elevator up	-15 °	7.5 – (-15) = 22.5 °	24 ° +/-2
Stabilizer (neutral)	7.5 °		
Elevator down	31 °	31 – 7.5 = 23.5 °	24 ° +/-2
Aileron left			
Up	-5 °	27 – (-5) = 32 °	28.5 ° +0/-2
Neutral	27 °		
Down	43 °	43 – 27 = 16 °	18 ° +0/-2
Aileron right			
Up	-7 °	24 – (-7) = 31 °	28.5 ° +0/-2
Neutral	24 °		
Down	42 °	42 – 24 =18 °	18 ° +0/-2
Elevator Trim			
Up	-5 °	9.5 – (-5) = 14.5 °	17.5 ° +2/-0
Neutral	9.5 °		
Down	46 °	46 – 9.5 = 36.5 °	37.5 ° +2/-0
Rudder left	30 °	from cardboard	25 ° +0/-2
Rudder right	31.5 °	from cardboard	25 ° +0/-2

The angle finder shown in the photo cannot be used for measuring the throw of the rudder. The photo below shows a simple method used for measuring the rudder travel. A piece of cardboard is placed against the rudder in the neutral position and a line is drawn parallel to the angled surface of the elevator. The rudder is then moved to the stop and a second line is drawn parallel to the angled surface of the elevator. A protractor is then used to measure the angle between the two lines. This process is then repeated on the other side of the rudder.



Following the measurements for this case study, there was a concern that the total 55 º travel of the elevator trim tab could not be achieved. From stop to stop the total travel on this aircraft trim tab was limited to 48 º. Bill commented that it has been his experience that the trim tab swing in very few aircraft could actually be swung through 55 º. The mounting brackets for the trim tab mechanism set the limit of the trim control and it cannot be changed.