

# Aircraft Weight & Balance Tool

Aircraft CG Limits

Minimum CG

15

inches

Maximum CG

20

inches

Your Airplane Measurements Inches from Datum

Wing LE

14.5

inches

Main Axle Center

16

inches

Passenger Center

35

inches

Pilot Center

65

inches

Fuel Tank Center

9

inches

Baggage Center

68

inches

Nose/Tail Wheel Center

180

inches

What If? Move Single item

Remove From

0

inches

Move to

0

inches

Item Weight

0

pounds

Empty Weight CG

	Weight (Pounds)	Arm (inches)	Moment (inch/pounds)
Main Wheels	700	1.5	1050.0
Nose/Tail Wheel	30	165.5	4965.0
Remove	0	-14.5	0.0
Add	0	-14.5	0.0

EWCG = 8.24 =

Empty Weight Total Moment = 6,015 inch/pounds

Empty Weight = 730 pounds

Maximum Pilot Weight = 281.5 pounds. Minimum Pilot Weight = 139.0 pounds

Flight Weight CG

	Weight (Pounds)	Arm (inches)	Moment (inch/pounds)
Fuel Tank	0	-5.5	0.0
0 Gallons			
Passenger Weight	185	20.5	3792.5
Pilot Weight	185	50.5	9342.5
Baggage Weight	0	53.5	0.0

CG = 17.41 inches =

Total Moment = 19,150 inch/pounds

Gross Weight = 1,100 pounds

**WARNING!**

**Garbage in = Garbage out**

**You must enter accurate data to get accurate information!**

**(Please don't make me add a disclaimer here)**

Important!

Please read and refer to The FAA publication

FAA H-8083-1A

“Aircraft Weight and Balance Handbook”

This tool can be used for any GA or experimental aircraft;  
however, the author has targeted the Pietenpol Aircamper  
throughout this document

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## 1. Aircraft CG Limits

This should be self-explanatory for any pilot, but if you are new to Aircraft Weight & Balance, every aircraft design (Pietenpol, Cessna 150, Boeing 747-800) has a specific minimum and maximum CG Range.

Example: The Pietenpol Aircamper minimum CG is 15 inches aft the wing leading edge and the maximum CG is 20 inches aft the wing leading edge (as shown below).

Aircraft CG Limits		
Minimum CG	<input type="text" value="15"/>	inches
Maximum CG	<input type="text" value="20"/>	inches

## 2. Entering your aircrafts Measurements

Handmade, plans built aircraft like the Pietenpol Aircamper all seem to have slight variations in physical dimensions. It is very important to enter YOUR aircrafts locations of fuel tank (center) , passenger (center), pilot (center), baggage(center) and the location of the main wheels (center) and the tail or nose wheel (center). **Garbage in = garbage out!**

**IMPORTANT:** This Weight & balance calculator recognizes a datum that is NOT the Wing LE. It is suggested you use the firewall (tail wheel) or tip of the propeller/spinner (tricycle) as your Datum. This allows you to play “what if” scenarios with the Wing LE position without having to change all the reference locations. The Pietenpol is one of the few aircraft designed to allow the wing to be moved after construction to improve the CG.

Using the spinner tip on tricycle airplanes allows positive measurements to be used entirely.

**TIP:** Pilot CG often uses the “belly button” location as the station location. In this Aircamper example, I used a measurement 10” forward of the top of the seat back (i.e. subtract 10 from the measured physical location). You can subtract less than 10 inches to be “conservative”. Same applies to passenger center.

Here are the measurements for our sample Pietenpol using the firewall as Datum.


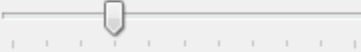
Your Airplane Measurements Inches from Datum		
Wing LE	<input type="text" value="14.5"/>	inches
Main Axle Center	<input type="text" value="16"/>	inches
Passenger Center	<input type="text" value="35"/>	inches
Pilot Center	<input type="text" value="65"/>	inches
Fuel Tank Center	<input type="text" value="9"/>	inches
Baggage Center	<input type="text" value="78"/>	inches
Nose/Tail Wheel Center	<input type="text" value="180"/>	inches

### 3. Aircraft Empty Weight CG

Once all the required fields are entered, (CG limits, Measurements, Empty Weight), you will have an accurate EWCG (8.24 inches in this example).

**TIP:** If you are still building, use your “targeted” weights or the actual weights of an aircraft you are emulating.

Empty Weight CG

	Weight (Pounds)	Arm (inches)		Moment (inch/pounds)
Main Wheels	<input type="text" value="700"/>	1.5		1050.0
Nose/Tail Wheel	<input type="text" value="30"/>	165.5		4965.0
Remove	<input type="text" value="0"/>	-14.5		0.0
Add	<input type="text" value="0"/>	-14.5		0.0

Empty Weight Total Moment = 6,015 inch/pounds

EWCG = 8.24 =  $\frac{\text{Empty Weight Total Moment}}{\text{Empty Weight}}$

Empty Weight = 730 pounds

Maximum Pilot Weight = 281.5 pounds. Minimum Pilot Weight = 139.0 pounds

**TIP:** The slider bars are an excellent way to make “sliding” adjustments to a weight data item and see the effect on EWCG, min and max pilot weights, etc.

Weight (Pounds)	Arm (inches)		Moment (inch/pounds)
<input type="text" value="700"/>	1.5		1050.0

#### 4. Maximum/Minimum Pilot Weight

Using the empty weight Moment, empty weight (pounds), the Pilot arm (inches), and the aircraft CG limits, the maximum and minimum pilot weight can be calculated for a given airplane.

$$\text{EWCG} = 8.24 = \frac{\text{Empty Weight Total Moment} = 6,015 \text{ inch/pounds}}{\text{Empty Weight} = 730 \text{ pounds}}$$

Maximum Pilot Weight = 281.5 pounds. Minimum Pilot Weight = 139.0 pounds

Here is the formula:  $((AY) + B) / (C + Y) = \text{CG Limit}$

Where:

A = Pilot Arm

Y = (Max/Min) Weight of Pilot

B = Empty Weight Moment

C = Empty Weight

Example:

A = Pilot Arm = 50.5"

B = Empty Weight Moment = 6015

C = Empty Weight = 730 pounds

Y = Unknown max weight (pounds)

CG Limit (aft) = 20 inches

Substitute values for variables:  $((50.5 * Y) + 6015) / (730 + Y) = 20 \text{ inches}$

And to solve for Y the algebraic equation becomes:

$Y = ((\text{CG Limit} * \text{Empty Weight}) - \text{Empty Weight Moment}) / (\text{Pilot Arm} - \text{CG limit})$

$Y = ((20 * 730) - 6015) / (50.5 - 20)$

Max pilot weight Y = 281.5 pounds

Tip: Substitute the Minimum CG for the minimum pilot weight.



## 5. Flight Weight CG and Gross Weight

This is especially useful to play “what if” scenarios. For example, set your pilot weight to your own weight, then start filling up the fuel (using the slider or entering values in the text field)s. Then look at your CG and gross weight values changing dynamically while sliding.

**Note:** Flight weight CG will equal EWCG when all the flight weights are set to 0.

In this example we set the pilots weight, the passenger weight, and no fuel and notice how the plane is within its CG limits! You might want to know how much fuel you can add to keep within your aft CG limits, right?

Flight Weight CG		Weight (Pounds)	Arm (inches)		Moment (inch/pounds)
Fuel Tank	0	0	-5.5		0.0
0 Gallons					
Passenger Weight	185	185	20.5		3792.5
Pilot Weight	185	185	50.5		9342.5
Baggage Weight	0	0	53.5		0.0
CG = 17.41 inches =		Total Moment = 19,150 inch/pounds			
		Gross Weight = 1,100 pounds			

## 6. What if? Moving a single item

This feature was added for two purposes. The first is to show how little CG shift you obtain when a heavy item (225 pound engine) is shifted a short distance, as opposed to a relatively light object (16 pound battery) is move a long distance (from firewall to behind the pilot).

What if? Move Single item

Remove From

inches

Move to

inches

Item Weight

pounds

Our sample aircraft has a gross weight of 730 pounds and its EWCG is 8.24. This happens to be a fairly good balanced aircraft. However let's say you find out you are tail heavy and think moving the engine 4" forward is the answer.

What If? Move Single item

Remove From	<input type="text" value="-14"/>	inches
Move to	<input type="text" value="-18"/>	inches
Item Weight	<input type="text" value="225"/>	pounds

The change in C.G is only 1.23 inches (8.24 – 7.01)

Empty Weight CG

	Weight (Pounds)	Arm (inches)	Moment (inch/pounds)
Main Wheels	<input type="text" value="700"/>	1.5	1050.0
Nose/Tail Wheel	<input type="text" value="30"/>	165.5	4965.0
Remove	225	-28.5	6412.5
Add	225	-32.5	-7312.5

Empty Weight Total Moment = 5,115 inch/pounds

EWCG = 7.01 =  $\frac{5,115 \text{ inch/pounds}}{730 \text{ pounds}}$

Maximum Pilot Weight = 311.0 pounds. Minimum Pilot Weight = 164.4 pounds

Now let's move a 16 pound battery from the firewall to behind the pilot seat

What If? Move Single item

Remove From	<input type="text" value="-2"/>	inches
Move to	<input type="text" value="77"/>	inches
Item Weight	<input type="text" value="16"/>	pounds

The change in C.G is 1.73" (9.97 - 8.24)

Remove	16	-16.5	264.0
Add	16	62.5	1000.0
Empty Weight Total Moment = 7,279 inch/pounds			
EWCG = 9.97 = $\frac{7,279}{730}$			
Empty Weight = 730 pounds			

## **Saving your Data**

All data is automatically saved when the application is closed.

TIP: do not delete the WB.xml file – this is your data!