

This is a long one, but had to be.

First, regarding Mr. Spencer's concerns - I don't know why he would come back from Jamaica.

I think the Eagle Planes, LEU, LEXL and DE are nice designs, easy to build, fun, overall great little planes. We had fun with our LEU, and are having a blast with our DE. In all my posts I never suggest otherwise. I tried to only state the facts related to our DE. If our facts can help other DE builders evaluate their particular DE, noting that those particular DEs may not be exactly like the prototype, then this info is good to know.

I'll admit our DE Stubby is a bastard, as compared to the prototype. And, I'll bet that many, if not most of the DEs built, are also bastards, as compared to the prototype. That's the nature of amateur building. Stubby has a full feature 2180 Great Planes engine (202 lbs, incl prop and all accessories), relatively heavy panel, ELT, heavier gear/wheels, all different from the prototype. If you are building a bastard DE, then it would be prudent to think about the resulting cg earlier in the build, rather than later, as we did, and certainly before flight testing. Especially the flying cg, which may not automatically be in the right spot if you simply have the empty cg near the front spar, as per the plans. My main concern is to make builders aware of this and that if flying cg is not too far forward (or aft), the airplane will fly well in all phases of flight.

Second, I am only too happy to answer questions related to our DE. So, to answer John's (DE C-11) request, I am including our W&B info, but first, some background.

This note is intended to clarify cg definition and determination of it for our DE Stubby, which is a non-prototype DE aircraft. How we finally achieved our desired flying cg is secondary, and should not be construed that the DE as designed is faulty.

I've stated this before, but here it is again.

My DE plans, #C-51 provide the following information regarding CG:

- In the overall instructions, p 11, talking about the actual weights of the prototype, "Total moment arm (22734.6) divided by total empty weight (389.2) equals 58.4 inches, which is very close to the front wing mount." This suggests that the empty CG should be very close to the front wing mount, which, per the plans is at the front wing spar, which is about 6.6" back from the leading edge of the wing.

- On plans drawing #57, there is a table for CG calculations. Below the table is a statement, "Gross Wt. should fall in first 14 inches. No weight rear of seats". After talking with Leonard on the phone, I took this to mean that the gross wt should fall in the first 14" aft of the wing leading edge (note- you may find other interpretations in the EaglesNest posts that I made, but this is how I now interpret it). Also, I believe gross wt to mean, essentially, the flying wt. So, boiling this down, the flying cg should fall between the leading edge and 14" aft of wing LE. Converting this to wing cord percentages, this is 0" divided by 55" times 100 equals 0% for the forward cg. The aft cg would be 14" divided by 55" times 100 equals 25.4%. Restated, this page of the plans says that the flying cg should be between 0% and 25.4% of the wing cord.

- I also found in the "Canted Main Landing Gear Design for Double Eagle", by Ed and Doug DeLoach, 11/14/07, which is available in the Files on this forum. I believe these plans have been OK'd by Leonard, based on various postings, so I consider them a valid source of information. These plans show a side view drawing with a side view of the seated pilot. At the top of the wing is a dimension, 14" back from the wing LE, with a note "Aft cg at max gross weight". In terms of wing cord percentage, max aft cg would then be  $14" / 55" \times 100$  equals 25.4 % of wing cord.

I have never heard from anyone saying that the above interpretations are not true, or are wrong for any reason. And, if I am interpreting correctly, the information is potentially misleading to builders, especially as pertains to correct flying cg location in non-prototype DE airplanes.

We have not tested a flying cg near 0%. We have tested flying cgs as low as 18%. We found that a flying CG that is between 18 to 20% will allow the airplane to fly, but adds some special requirements to land safely, including keeping some power on, and/or keeping flying speed well above stall speed. I found that trying to land with power off with speed only slightly above stall speed, the airplane would not flare, and a nose-down landing resulted. I have had discussions with other DE builders that flew with CG under 20% that have had similar experiences, including one who damaged his main gear.

We have discussed this topic at length on this forum. I have written updates as we made tests and progress to getting our flying cg correct. If interested go the forum search page and search for the following topics (without the parenthesis): (DE CG, more tests), (DE "Stubby" CG tests), and (DE weight). You can see how our testing developed, what we learned, mistakes we made, and how we ended up where we are.

We tested flying cg positions carefully, step-by-step, primarily by adding temporary weights to the tail. We found that a bunch of weight (12# battery and 20# ballast near the tail) would be required to allow the airplane to land power-off and flare at speeds just over stall. We decided that this was not desired, so our solution was to move the firewall and engine back by 7", which is where we are now. In addition, as one of the steps to achieve landing flare, we increased up elevator travel from the original of about 30 deg to 40 deg. This also helped to improve low speed pitch up control.

Where are we now? Our DE Stubby has almost 50 hours on it, over 40 flying. With one person (haven't tested w/ passenger), approx 840# gross wt, CG about 25.5%, it takes off quickly, climbs at 60 mph, getting 600 fpm. Cruises 70 mph at 2900-3000 rpm. Top speed, full power about 80 mph. Stalls gently at about 45 mph, can hold wings level w/ rudder, and recovers quickly with releasing pressure on the stick. Approach at 60 mph yields about 750 fpm descent. To land, with power off, hold 60 mph until close to ground, pull stick back slowly, aircraft starts flare, then as ground contact approaches, continue pulling stick to full back. Result is, if timing is right, a smooth landing. Tests and flying were done by four persons: 30,000 hour retired Delta 777 pilot, few thousand hour private pilot who previously owned an airport, a couple thousand hour pilot with a wide variety of experience, and me, around 400 hrs. We all agree, it is now a sweet flying airplane.

25 - 26% is the most-aft cg that we have experience with. We will use care as we test towards the 27.8% limit in the W&B table, since we are aware that too far aft cg can be dangerous.

Here are tables showing dimensions and W&B at various loadings:

| AIRCRAFT WEIGHT AND BALANCE |  |         |
|-----------------------------|--|---------|
| Date:                       | 9/17/12  |         |
| Model:                      | Double Eagle   |         |
| Registration:               | N110EP   |         |
| S/N:                        | C-51   |         |
| Builder:                    | Double Eagle Flyers, LLC   |         |
| Gross Wt:                   | 1100 lbs.  |         |
| CG Range:                   | 12.7" to 15.3" aft of wing Leading Edge<br>(23.2% to 27.8% of cord(55")) |         |
| Datum:                      | Leading Edge of Wing   |         |
| Arms:                       |  |         |
| front face prop             |  | -46.0 " |
| engine                      |  | -31.0 " |
| firewall                    |  | -16.3 " |
| main wheels axles           |  | 0.9 "   |
| wing LE                     |  | 0.0 "   |
| center front spar           |  | 6.6 "   |
| pilots                      |  | 20.2 "  |
| fuel                        |  | 20.7 "  |
| battery                     |  | 109.8 " |
| tailwheel                   |  | 156.9 " |

| CG, empty, batt aft: |                       |       |        |
|----------------------|-----------------------|-------|--------|
|                      | wgt                   | arm   | moment |
| Left main            | 270                   | 0.9   | 243.0  |
| Rgt main             | 264                   | 0.9   | 237.6  |
| tailwheel            | 34                    | 156.9 | 5334.6 |
| pilots               | 0                     | 20.2  | 0.0    |
| fuel                 |                       | 20.7  | 0.0    |
| add spring           | 1.5                   | 146.8 | 220.2  |
| ballast              | 0                     | 0.0   | 0.0    |
|                      | 569.5                 |       | 6035.4 |
| CG=                  | 10.60" aft of wing LE |       |        |
|                      | 19.27% of cord        |       |        |

| CG, w/ Light Pilot and 2 gal (12#) fuel: |                       |       |        |
|--|-----------------------|-------|--------|
|  | wgt                   | arm   | moment |
| Left main                                | 270                   | 0.9   | 243.0  |
| Rgt main                                 | 264                   | 0.9   | 237.6  |
| tailwheel                                | 34                    | 156.9 | 5334.6 |
| pilots                                   | 150                   | 20.2  | 3030.0 |
| fuel                                     | 12                    | 20.7  | 248.4  |
| add spring                               | 1.5                   | 146.8 | 220.2  |
| ballast                                  | 0                     | 0.0   | 0.0    |
|  | 731.5                 |       | 9313.8 |
| CG=                                      | 12.73" aft of wing LE |       |        |
|  | 23.15% of cord        |       |        |

CG, w/ max fuel, 14 gal (84#) and pilots to make full gross wt (1100#):

|            | wgt                   | arm   | moment  |
|------------|-----------------------|-------|---------|
| Left main  | 270                   | 0.9   | 243.0   |
| Rgt main   | 264                   | 0.9   | 237.6   |
| tailwheel  | 34                    | 156.9 | 5334.6  |
| pilots     | 446.5                 | 20.2  | 9019.3  |
| fuel       | 84                    | 20.7  | 1738.8  |
| add spring | 1.5                   | 146.8 | 220.2   |
| ballast    | 0                     | 0.0   | 0.0     |
|            | 1100                  |       | 16793.5 |
| CG=        | 15.27" aft of wing LE |       |         |
|            | 27.76% of cord        |       |         |

Again, hope this is taken as constructive information, and helps DE builders with their flight testing.

Tom H  
DE Stubby  
LEU Treehugger