



C.G. MACHINE™

ASSEMBLY INSTRUCTIONS

Not designed for use with planes under 2 lbs flying weight.



Thank you for purchasing the Great Planes® C.G. Machine. We are glad you realize the importance of properly balancing your model and the effects the C.G. location has on the way it flies. Although checking the C.G. is often one of those last minute "oh, I'd better do that before I get to the flying field" procedures, the C.G. location can have a profound effect on the way all models handle and respond to control inputs. Therefore, determining and shifting your model's C.G. is an operation that you should perform with care and accuracy. That's where the Great Planes C.G. Machine comes into play. With the Great Planes C.G. Machine, you can accurately and easily balance your model according to the manufacturer's recommendations, and then make incremental changes to the C.G. location to alter your model's flight characteristics according to your flight skills and preferences.

Great Planes Model Manufacturing

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Undoubtedly, you have an airplane on which you are anxious to test your C.G. Machine, so let's get started!

TOOLS AND SUPPLIES REQUIRED FOR ASSEMBLY:

- Thick or medium CA
- Hobby knife
- Phillips screwdriver
- Small metal file
- Thread locking compound
- 600 & 220-grit sandpaper
- Small 90° triangle
- Tissue or paper towel
- Rubbing alcohol or glass cleaner

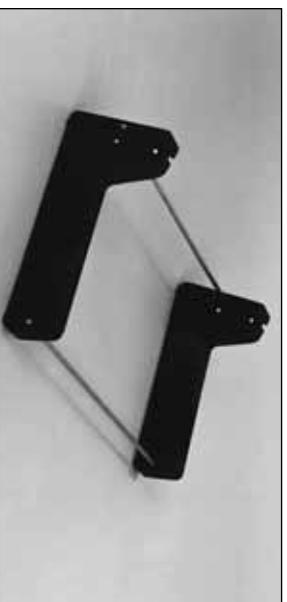
C.G. MACHINE PARTS



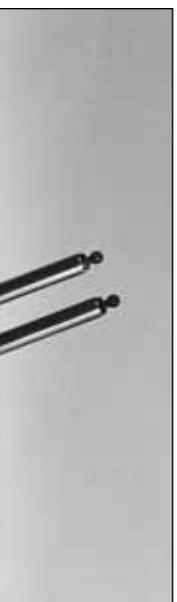
- ❑ 1. Examine all molded plastic parts, and trim off any mold flashing with a sharp hobby knife. Examine the ends of the metal rods for burrs, and carefully remove them with a metal file or emery cloth.

ASSEMBLY SEQUENCE

- ❑ 2. Insert the two 3/16" x 12" steel base joiner rods into the holes in one of the molded plastic bases. Both of the bases are the same so there is not a right or a left. The joiner rods should fit snug, but if they are too tight, lightly lubricate them with bar soap. If the rods are still too tight, carefully enlarge the holes in the base with a 3/16" drill bit or a round file.

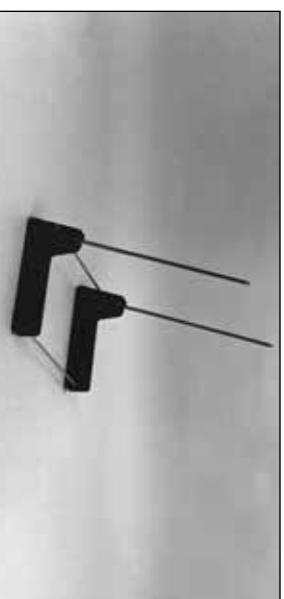


- ❑ 3. Join the other base to the joiner rods the same way.



- ❑ 4. Thread the two 2-56 threaded steel pivot balls into the ends of the 1/4" steel upright rods with a drop of thread locking compound.

Carefully remove any burrs on the pivot balls with a small file. Clean the pivot balls with a tissue.

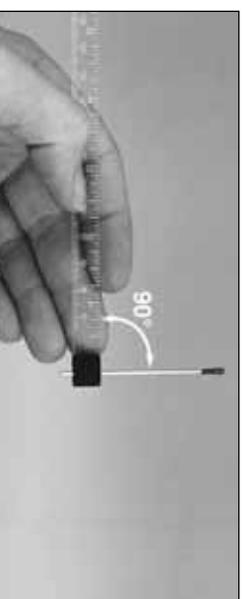


- ❑ 5. Push the 1/4" steel upright rods all the way into the bases. If there is much resistance, carefully enlarge the holes with a 1/4" drill bit or a round file.



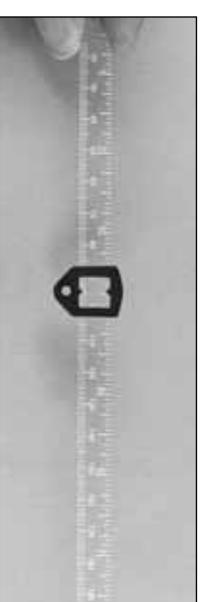
- ❑ 6. The plastic ruler set consists of two rulers, connected by three tabs. Use a hobby knife to cut part-way through each tab on both sides of the rulers, then carefully flex and snap the rulers apart. Trim the remaining tabs flush with the edge of the rulers, then finish with a flat sanding block and 220-grit or finer sandpaper.

- ❑ 7. Insert the .074" x 2-1/2" wire pointers into the plastic ruler end caps. This should be a secure friction fit.



- ❑ 8. Slide the ruler end caps onto the rulers. When the ruler end caps are fully seated, the pointers should be perpendicular to the ruler – you can use a small 90° triangle to check. If it is necessary to adjust the fit, sand the end of the ruler slightly or trim the slot in the ruler end cap.

- ❑ 9. Apply a drop of thick or medium CA to both sides of the ruler at the "zero" end, insert the ruler fully into the slot in the end cap, then immediately confirm that the pointer wire is vertical. Attach a ruler end cap to each of the rulers.



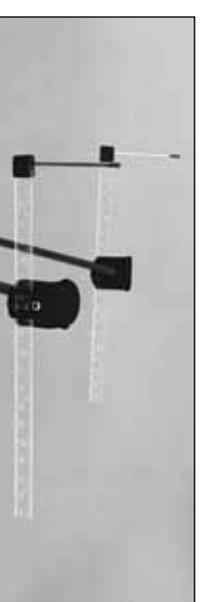
- ❑ 10. Check the fit of the rulers in the molded plastic ruler holders. The rulers should slide freely in the ruler holders. If they do not, carefully sand the edges of the rulers with a sanding block and fine sandpaper until the rulers slide freely.



- ❑ 11. Loosely attach the ruler holder to the molded plastic socket cap with a #4 x 3/8" screw.

- ❑ 12. Insert the ruler through the ruler holder, then tighten the screw only enough to provide friction. Do not overtighten the screw, as this may deform the plastic.

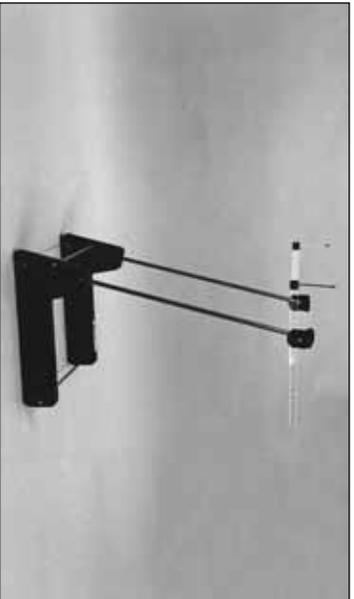
- ❑ 13. Clean the top of the socket caps with a tissue or paper towel dampened with rubbing alcohol or glass cleaner. Peel off the backing from the foam rubber pads, then apply the pads to the tops of the socket caps.



- ❑ 14. Snap the socket caps onto the steel balls on the upright rods. There is not a front or a rear to the C.G. Machine so at this time it does not matter onto which upright rod you install the socket caps.

- ❑ 15. Pivot the socket caps throughout their range of motion to check for free movement. If there is a significant amount of friction between the cap and the ball, remove the cap and snap it on again, moving and spinning it around. If there is still too much friction, polish the steel ball with 600-grit sandpaper and coat it with a thin film of bar soap.

- ❑ 16. Apply the peel-and-stick decal to the top edge of one of the bases.



Your C.G. Machine is now ready to use.

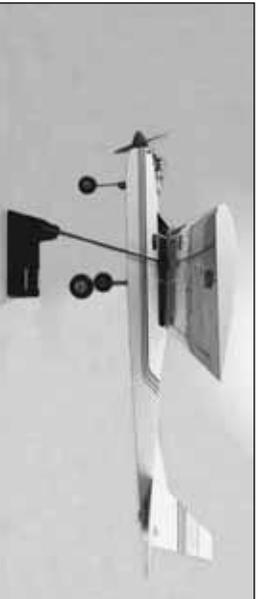
BALANCE YOUR MODEL

To balance your airplane at a predetermined location:

1. Adjust the width of the bases so the upright rods clear the sides of the fuselage and landing gear.
2. Determine the distance from the leading edge of the wing to the balance point, from your airplane's plans or instructions.

3. Slide the rulers to the distance determined in the previous step. View the measurement in the center of the ruler holder windows.

Note: For maximum stability, balance high-wing airplanes right side up and low-wing airplanes upside down.



4. Place your airplane in an approximately level attitude on the foam rubber pads. Pivot the rulers until they are horizontal. Hold your airplane as you move it forward until the leading edge of the wing contacts the pointers. This is the position at which your model should be balanced.



Note: In some cases, especially with high-wing tail draggers, the landing gear may interfere with the upright rods. If that is the case, turn the C.G. Machine 180° and switch the socket cap and ruler assemblies. If this does not work, raise the front or back of the bases to change the angle of the upright rods in relation to your airplane, but not enough to make the bases unstable.

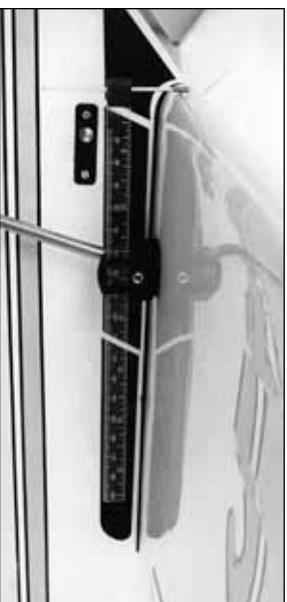
Note: If, for some reason, you need to spread the bases more than 12" apart, you may do so by substituting longer 3/16" base joiner rods.

5. Gently release the airplane. If the tail drops, the model is *tail heavy* and you must either add weight to the nose or move internal components (battery, servos, etc.) forward. If the nose drops, the model is *nose heavy* and you must either add weight to the tail or move internal components aft. See **General Balancing Tips**.

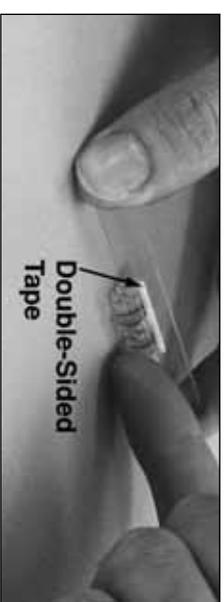
1. Slide the rulers out near the 7-inch line.
2. Position your airplane on the foam pads so it rests level.

To measure where your airplane currently balances:

3. Pivot the rulers so they are horizontal, then adjust the rulers until the pointers touch the leading edge of the wing.
4. Read the distance in both ruler holder windows. **Note:** If the two distances differ slightly, it is sufficiently accurate to use the *average* of the two values.



HOW TO USE THE LEVEL



To assist you in accurately balancing your airplanes, we have included a small, lightweight level vial. You can use this in various ways to help determine when your airplane is truly level, rather than relying on estimation. Although the level vial may be used alone, you may attach it to the 1/2" x 3" plastic strip, with a small piece of double-sided tape (cut from the included 1" square), carefully aligning the vial with one edge of the strip. Attaching the vial to the plastic strip will allow it to be taped to the side of the fuselage along a reference line. You can also place the assembled level on the stabilizer.

GENERAL BALANCING TIPS

- A. Always balance your airplane in a ready-to-fly condition with an empty fuel tank (unless the fuel tank is behind the C.G.). Check your airplane's instruction manual for specific balancing instructions.
- B. On models where the leading edge of the wing sweeps rearward, the distance between the leading edge and the C.G. decreases along the span. In other words, the leading edge of the wing gets closer to the C.G. toward the wing tip. The C.G. shown on most plans is where the wing meets the fuselage. This means the distance between the leading edge of the wing and the C.G. is valid **only** next to the fuselage; so, for tapered wings, you should position the upright rods and the foam pads as close to the fuselage as possible.

- C. Before you add weight to balance your model, if possible, rearrange the internal components. Add weight only if you must.

- D. If you must add nose weight, start with a Great Planes 1 oz. or 2 oz. spinner weight (a weight that fits inside your spinner, and takes the place of the prop washer), as this places the weight far forward where it has the most effect. If your plane does not have a spinner, then use a Great Planes heavy brass prop nut. If this does not provide enough weight to balance, add Great Planes stick-on lead weight to the front of the model on the front or back of the firewall or another location that will not interfere with other systems. Never mount weights to the cowl of your model because it is not meant to support additional weight.

- E. Stick-on lead weight works well for tail weight too. You can stick the weights directly to the covering, or cut an access hatch in the fuselage and install the weights inside, then reinstall the hatch. Before you cut the model open to install weights inside, you should first confirm the amount of tail weight you require by test flying your model with the weight stuck to the outside. Before you permanently stick weights to the covering, remove all residual exhaust or other oil. Poke a few pinholes through the covering in the area where you will place the weight and apply a drop of thin CA to each pinhole to make sure the covering is securely bonded to the structure (and the weight securely bonded to the model). Attach the stick-on lead weight to the bottom of the stab or fuse.

- F. For the first flights it is common to balance the airplane at or **slightly** forward of the **center** of the recommended balance range. For first flights it is desirable to have a model that is stable.

- G. In addition to checking the C.G., you should also balance your model *laterally* (from side to side). Lift your model several times by the propeller and the vertical fin. This may require a helper if you have a large model. Add weight to the wing tip opposite the heavy side of the model until it balances.

TROUBLESHOOTING C.G. PROBLEMS

Your model may be nose heavy if:

You cannot lift the nose on final approach and it seems to overshoot landings, or landing speeds are too high, or the model requires lots of forward stick (down elevator) to hold it level while inverted, or your aerobatic model will not snap roll or generally seems to be too stable.

Your model may be tail heavy if:

It seems unstable or overreacts to control inputs, or the tail drops while in a high banked turn, or no forward stick (down elevator) is required to maintain level flight while the model is inverted (*although neutrally stable models such as contemporary pattern planes require virtually no down elevator to maintain inverted flight!*), or if upon landing approach your model flares without adding any up elevator, or upon landing down elevator is required to prevent a stall.

ACCESSORIES

Here are some order numbers for Great Planes Accessories:

- Great Planes Stick-on Lead Weight (GPMQ4485)
- Great Planes 1/4-28 Brass Spinner Nut 2.5 oz. (GPMQ4640)
- Great Planes 1 oz. Spinner Weight (GPMQ4645)
- Great Planes 2 oz. Spinner Weight (GPMQ4646)

We hope you enjoy your Great Planes C.G. Machine and have an easier time of balancing your next model and can improve the flight characteristics of your current models.

PARTS LIST

Part#	Qty.	Description
NYLON141	2	Base
NYLON138	2	Socket Cap
NYLON139	2	Rule Holder
NYLON140	2	Rule End Cap
LEVEL01	1	Level Vial
LEVEL02	1	1/2" x 3" Plastic Strip
WBNT282	2	Leading Edge Pointer
SCRW072	2	2-56 Threaded Ball Link
FTAP001	1	1" x 1" Double-Sided Tape
FOAM002	2	Self-Stick Foam Rubber Pad
SCRW043	2	#4 x 3/8" Sheet Metal Screw
NYLON142	1	Rule Set (L&R)
ROD003	2	1/4" x 16" Upright Rod
W/RES07	2	3/16" x 12" Base Rod
STKER46	1	C.G. Machine Sticker