



**The Zen of Indoor FF:  
A Modeler's Take**  
by Sam Brauer, Ph.D.

This article is written for folks who have flown RC airplanes for a few years and are interested in trying their hand at indoor rubber powered models. Tom Nallen, who is quite the wiz at flying rubber powered models asked me to take a crack at this article because I fly both FF and RC. I started flying outdoor FF when I was a kid some 50 years ago, went to RC in my teens, got interested in indoor FF in my 20s and continue to happily build and fly both RC and FF (both indoor and outdoor)- hence I call myself a modeler and try not to get into arguments with the purists. Odds are if you're reading this though, you've got some experience with RC aircraft and are tired of freezing various body parts trying to fly RC when there's white stuff on the ground, so the allure of being inside in the winter months to fly airplanes is pretty powerful. You may have discovered that the crowd that flies indoor FF is a different bunch of people than fly RC indoors- you'll catch that vibe very quickly, which is why they typically don't mix.

If you haven't tried your hand at flying a rubber powered airplane, there are many worse ways to start than with an AMA Alpha. This airplane has inherited the mantle of the old North Pacific Sleek Streak, and they do fly well out of the box. Hopefully you've been bitten by the bug of watching an airplane fly in circles with no input from the pilot- if you haven't, well, you have my sympathy and go play on your phone or something. There are two paths to go in indoor FF: 1) pure duration which involves airplanes with a stick fuselage, or 2) scale, which involves full fuselage airplanes. I really only fly full fuselage airplanes, so that's focus of this article.

The key goal in successfully flying indoors? A repeatable, reliable, power pattern! When the prop stops turning, the airplane is down- or will be very shortly. If the airplane whacks into walls or ceiling, it's not going to be repeatable. An ideal indoor pattern are circles that use up ~ 1/2 to 3/4ths of the space available and the airplane should fly in a flat, skidding turn, i.e. wings pretty level. We want ZERO trim changes during flight. This means that the cg

must have a broad enough range so that if the motor unwinds a bit unevenly, there's still enough stability to prevent a major stall/spin. An airplane that tucks will not last long- even indoors there are air currents that will cause an airplane to stall, so the recovery from the stall must be rapid and stalls must be gentle.

How do we minimize trim changes? Trim changes are a function of speed, i.e. an airplane trimmed to fly level at one speed will often climb if the speed is increased and descend if the speed is decreased. (Aerobatic aircraft are NOT trimmed this way.) Imagine you're flying an RC airplane- and you can't touch the elevator! You get to control the airplane using throttle and rudder- and there were control setups that did exactly that back in the early days of RC. Well, flying indoor FF is a similar challenge- except of course that your throttle is set from when you launch and your rudder servo doesn't work in the air. So for indoor FF you want an airplane that flies at pretty much one speed- say ~ 1 meter/sec. You want it to climb at 1.05 m/sec, and you want it to descend at 0.95 m/sec. To do this, you need a high lift/high drag airplane. Super slippery airplanes are not friendly indoors! You do need light weight- which helps in two ways:

- 1) It makes the airplane easier to trim.
- 2) A slower airplane doesn't get as damaged when it runs into things. The way you build an airplane that can survive an incident with a wall is not to beef up the structure-the wall will ALWAYS win- but to make it as light as possible! Dave Aronstein, one of the indoor gurus (who's gotten a rubber powered EDF to fly!) made the observation: Zero mass needs zero strength. What we're really looking for are really good strength/weight ratios.

There's another part of building for indoors that's going to sound like heresy: straight isn't that important. (Yes, I know straight is critical for most RC airplanes- but that's a different animal.) We want the airplanes to fly in a circle- not in a straight line. It turns out that asymmetries often can work to your advantage- we used to build the port wing a bit larger on an airplane intended to turn left because on the inside of the circle, the inboard wing is moving a touch slower and hence needs more lift than the outboard wing. (No longer legal in FAC events.) These days we use washin and washout along with drag tabs. Often the left wing on my airplanes looks like a "smile" when viewed from behind, while the right wing has a straight line from root to tip, although I generally use some washout- both tips. Washout is important to make sure you've got a gentle stall. Slow flying airplanes tolerate large control surface deflections- enough rudder to induce a rapid roll in an RC ship may not be enough to get an indoor model to turn quickly enough. Some airplanes will turn left happily, other airplanes stall/spin when turning left and do far better turning right. Doesn't seem to be all that predictable to me, although most folks try to turn left.

You need to start construction from the onset with the goal of building light- that's part of the "zen" of indoor FF. I can't emphasize enough that one of worst mistakes that people make starting out is that they think they can get away with an airplane that's too heavy- they'll just use less rubber or get less duration. Well, the biggest problem with an airplane that's too heavy is that its really hard to trim! See below for materials that you should use.

The serious competitors will go to the extreme of sanding tissue to reduce weight, but for most of us, it's possible to build light enough for indoor without such extremes- even without a scale that measures hundredths of a gram. The scale I use measures only grams, and for most of what I do- that's good enough. It lets me know the airplanes finished weight and to get sort of close when I need 15% rubber for outdoors.

What are the essential tools/materials for building indoors? Not that much- I often build in hotel rooms on a business trip with all my supplies in a conference bag.

Adhesives: I like using Siment these days for most construction- it's the lightest adhesive out there and has a couple of other advantages- it's sandable- really important for when you do a sheet infill, and if you make a mistake, add a little more glue if you're lazy or get some acetone and dissolve the glue in the joint and try again. A couple of cautions (aside from the smell)- cyanoacrylates will not bond to a Siment joint! But if you've got a cyano joint that just refuses to hold- well, often Siment works where nothing else will. It's also a lot more flexible than cyano- takes a hit better. Another caution- a lot of kit manufacturers must never have tried building their airplanes using their instructions, because one of the worse things you can ever do is use wax paper to protect a plan if you're building with Siment. The solvents in the glue dissolve the wax which travels into the joint- and makes it heavy and weak. Best stuff to use- Monokote backing if you can still find some.

Titebond II has better gap filling- takes a little longer to set up than Siment though. Not easy to sand and if you make a fumble with a joint, you better be good with a knife.

RC 56- aka canopy glue. Works well on canopies- but also aluminum tubing and wire.

Elmer's glue- I thin this with water to adhere tissue to a framework. Other folks use permanent glue stick. Use whichever one you like, fine aircraft can be built either way.

I don't use much cyano these days. You also don't use dope on an indoor model.

Building board- well, if I'm traveling- a piece of sheet rock-otherwise I have some Guillow's balsa building boards that are very nice.

Pins- Midwest sells "Grip Pins" which work better than "Tee" pins- they're sharp and skinny which means that if you need to pin through wood- they do less damage. They're also easier to position more accurately.

Sanding blocks- you won't need anything coarser than 150 grit, but I rarely use anything much finer than 220. I like small T-bars, but other folks just use sandpaper glued to a wooden block. You have to be careful sanding these frameworks- you don't need to do much.

Jewelers files or reamers. One thing you'll need to do is "scallop" between stringer on a fuselage where you don't want covering to adhere- so some type of file or reamer helps- although you can just use small pieces of sandpaper if you're desperate.

Knives. I find that X-actos are not sharp enough for building indoors- the blades crush the fibers of the wood rather than cut them. I really like these blades: <https://grifhold.com/product/no-7e-straight-blades/>- plan on going through 2-3 per airplane. Nice handles too.

Materials: The reality is that there really aren't any indoor FF walnut scale (max wingspan of 17.5") kits being sold any more. If you're lucky enough to find an old Micro-X kit labeled for indoor (same designs as their outdoor kits, just lighter wood)- that's a great way to get started. If not, well, you're going to have to assemble your own kit. First- do NOT raid your RC scrap box! Indoor wood tends to be much lighter than what's used for most RC aircraft. Dave N. of Easy Built will sell you 4-6 lb balsa in both sticks and sheet. Japanese tissue is available from a number of sources- and do use Esaki Japanese tissue! Domestic tissue is heavier and harder to handle. Chuck I. of Wind it Up (nee Peck Polymers) has prop hooks, washers, and thrust bearings- you won't need anything larger than 1/32" stuff. For rubber, 3/32", 1/8" and 5/32" (if you can find it) is all you'll need. For a winder- the AMA Alpha kit for \$20 has a nice little 20:1 winder, but Wind it Up has an electronic counter for some of the K+P winders which makes life lots easier.

Design Considerations: Here's what to look for in for your first indoor ship.

- 1) Low aspect ratio, "Hershey bar" wing. Tapered wings are harder to trim- straight wings are easier. Area trumps aspect ratio below 6' - and you should be looking for a wingspan in the 16-18" range. Peanuts (13" max wingspan) are much harder to trim.
- 2) Ideally, a weight without rubber of 15-17 grams, will fly on a loop of 1/8" rubber with a 6" prop.

3) Simple, squarish fuselage. A lot of designs use a simple balsa box with some formers added to dress it up- it's lightweight and easy to build. Avoid keel and former designs until you know what you're doing.

4) Adequate tail surfaces- or be prepared to enlarge the stab.

5) A lot of people think high wing airplanes are easier to trim- they're probably right, but one of my favorite embryos is the Skiptown Cadet by Tom Nallen Sr.- it's a low winger, but has proved to be easy to get to fly.

I'm going to toss out a bunch of ideas for airplanes- all of which have proven to fly and have been successfully built and flown by newbies. It's not an exhaustive list by any means.

Non scale:

Wind it Up: The Golden Age Reproduction 20" Pacific Ace (<https://www.wind-it-up.com/collections/kits-by-golden-age-reproductions/products/gar-33>) is a good first airplane and the kits have decent wood. Some judicious substitution can lighten the airplane, but it is flyable even stock. The aforementioned Skiptown Cadet (<https://www.wind-it-up.com/collections/sport-model-kits/products/pp-47>) works well too.

Volare ([https://volareproducts.com/index.php?main\\_page=index&cPath=2\\_18](https://volareproducts.com/index.php?main_page=index&cPath=2_18)): George B. Volare sells a lot of short kits and if you ask George nicely, will likely cut you one using indoor wood. However, most of his kits need some more advanced building/trimming skills. He does have a short kit of a Blue Ridge Special- and that's a great little airplane, but it's a stick fuselage. If you're OK with that- this one would get my vote to as a first FF airplane to build.

Easy Built ([www.easybuiltmodels.com](http://www.easybuiltmodels.com)): Dave N. Ask Dave for his suggestions for indoors. I buy a lot of my strip and some sheet from him- he does have 4-6 lb wood which he thinks is too light for outdoors.

Scale: As I mentioned earlier-there really aren't any walnut scale or a bit larger indoor kits on the market. What I do is substitute strip stock, cut lots of lightening holes or sand down the kit parts- and that's for a good design. On a lot of airplanes, I'm changing airfoils, wing incidence, spar locations (a spar on top of the wing aft of the high point is a no/no.) and occasionally adding beef in spars- a lot of the old Comet designs are wildly inadequate in terms of spars. However, this is not what you should need to do for your first airplane or two!

Possible options: Herr- probably the Aeronca. (<https://sigmfg.com/products/herr-aeronca-champ>) I've built the Cessna 180- and it's a nice flyer outdoors using the included domestic tissue and doping it. With no dope and better tissue, it might work indoors, but I'd bet the Aeronca would be better based on the wing

planform. Might try the Tri Pacer too, but I'm guessing here. Nevertheless, the kits had good wood and a light, simple design.

Wind it Up: Of the Golden Age Repro (GAR) airplanes- my vote would probably be the Spartan Cabin. <https://www.wind-it-up.com/collections/kits-by-golden-age-reproductions/products/gar-5> It's a bit complicated struttery, but I think I used the kit wood and had an airplane that won a few mass launches indoors. Note-if the wingspan at 25" is correct, might not be legal in indoor events which often have a 24" limit. I build a lot of the GAR kits- the wood is very good but I often "tweak" the designs so I'm hesitant to recommend them for newbies. Chuck's peanut scale kits are very nice, but as noted earlier, not for a beginner.