So You Want To Fly Speed 400?

by Mike Myers

A free flight friend of mine saw me flying one of my Speed 400 models. He asked for advice about setting up his first Speed 400 model, i.e. what motor, what model, how do I wire it up, etc.

The short answer is that you take a specific model brushed 6-volt Speed 400 motor, use a 2 cell LiPo battery and a 6 x 3 or 6 x 4 propeller, and put it all in a legal old timer air frame that weighs 16 ounces or more. There is, of course, a longer answer.

The Rule — It's set forth on the SAM website and in the SAM 2015 Rulebook. You fly a 3 minute motor run, with a 15 minute max flight time. You can hand launch or ROG. You can use a folding prop, so long as it is restrained from folding in flight.

At two recent SAM Champs, the contest directors have modified the flight times to a 2 minute motor run and a ten minute max. You cannot run the motor after the initial time period. There is no wing loading rule — If the ready to fly airplane weighs at least 16 ounces, it's "legal".

The Motor — The Speed 400 event was introduced at the 2007 SAM Champs. European SAM modelers had been flying something called "Electric Texaco" requiring the use of a Graupner 3321 6V Speed 400 motor. So, our original Speed 400 rules also specified the Graupner 3321.

Graupner has now stopped selling the 3321 motor. So unless you have one already, you've got a problem. If you can't find a Graupner 3321, you can use the Maxx Products International ("MPI") 6V ACC 341 motor—which sells for $8.95.

You can order from the MPI website, or get one at your local hobby shop. Since MPI charged me $7.95 to ship one motor to me, you might want to buy at your local shop.

Oddly enough MPI doesn't put a label on the motor case, so the contest director is going to have to take your word for it that your 6V motor is a "legal" MPI ACC 341.

All of this motor kerfuffle may not make much difference. The rules allow you to modify the timing of your Speed 400 motor. You do this by loosening the end cap and rotating the cap about 3/16th inch against the direction of rotation.

That timing adjustment does two things. It makes your Speed 400 motor run faster, and it also makes it run hotter, shortening motor life. You can retime, but most modelers will find that a stock unmodified Speed 400 motor can take a Speed 400 model almost OOS in 3 minutes.

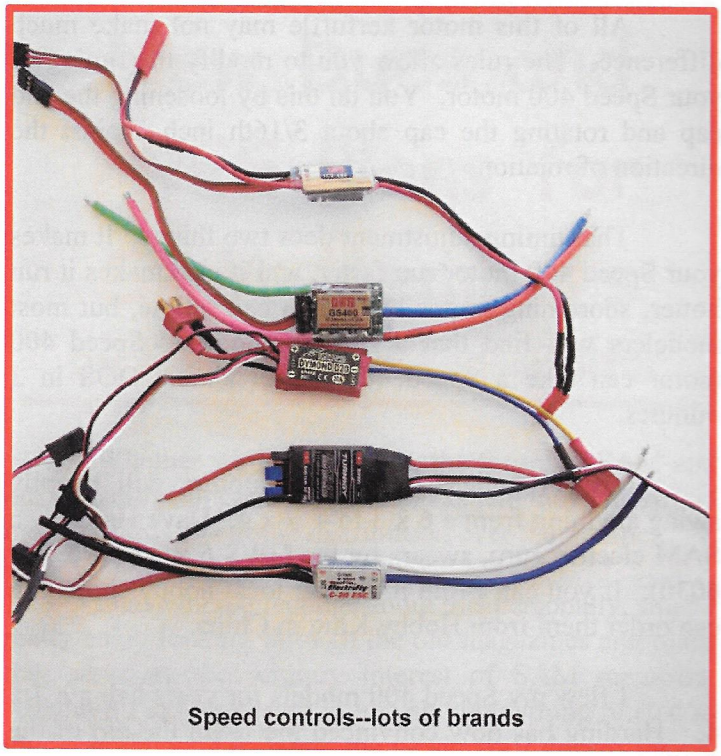
The Propeller—Speed 400 motors will happily swing anything from a 6 x 3 to a 7 x 4. Dave Harding, a SAM electric guru, swears by the GWS 6 x 3 (GWS DD 6030). If you can't find it in your local hobby shop, you can order them from Hobby King in China.

I flew my Speed 400 models for years using a 7 x 4. Harding has now convinced me (with the aid of the Motocalc performance predictive program) that something like the 6 x 3 is the better way to go. The model climbs the same on both propellers (albeit at a lower rpm for the 7 x 4) but the extra energy used by the 7 x 4 is simply turned into motor heat—not climb performance. I've never burned up a stock Speed 400 motor using the 7 x 4 prop.

There are two ways that excess motor heating can damage a motor. The magnets can come loose, resulting in total motor failure, or the magnets can lose strength through overheating, resulting in decreased motor performance. APC makes a 6 x 4E propeller specifically designed for Speed 400 motors. Since the airplane reaches the same height using either a six inch or a seven inch propeller, I'll listen to Harding's advice and stick with the 6 inchers from now on.

The Speed Controller—When we started to fly Speed 400 ten years ago brushed motor ESC's (electric speed controllers) were easy to find in hobby shops. Now that brushless motors have taken over, it's a bit harder. You can find them on the websites at E Flite, or MPI, or Great Planes with their Electrifly ESCs, or Hobby King. The GWS people were big in the brushed ESC market at the time, and you can still find some of their ESCs on E Bay.

Recently I bought some 20-amp Hobby King brushed motor ESCs on Amazon for less than ten bucks apiece. You should look for a 15 to 20 amp ESC — since a Speed 400 motor will have an initial amp draw of 13 or



Speed controls--lots of brands

14 amps, rapidly settling down to 10 amps or so for most of the three minute motor run.

It would be nice if the ESC had a "brake" to prevent the propeller from freewheeling in flight, which causes excess drag during the glide. The Hobby King ESC has such a brake. You set the Hobby King brake using a jumper plug — and the LiPo low voltage cutoff using another jumper plug. That's stone simple, and both plugs come with the ESC. Some, but not all, of the GWS ESCs had a brake. A lot of the older brushed ESCs out there were set up with a low voltage cutoff for NiCads or NiMhs only. But see below as to why that shouldn't be a problem.

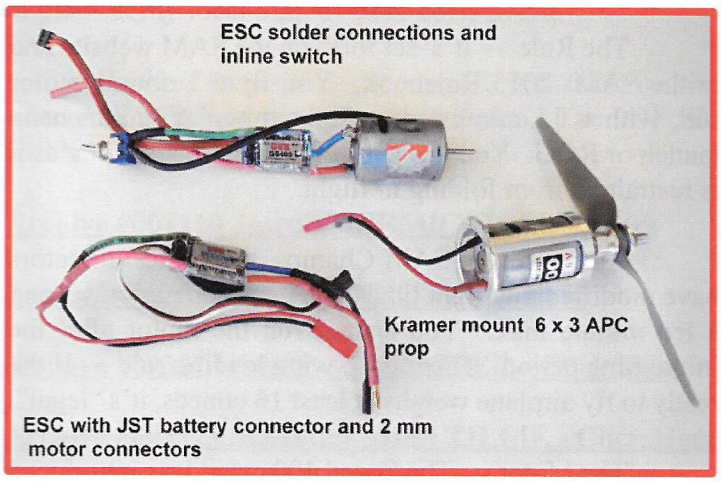
The Battery — The rule allows 2 cell LiPos or six cell NiCad or NiMh batteries. In practice, I've never seen any Speed 400 model that didn't use a 2 cell LiPo battery. I did some tests in 2007 using a Speed 400 motor, a 2 cell 1300 mah LiPo battery and a 7 x 4 propeller. Over a series of 10 three minute runs, the motor consumed between 530 and 550 mah of battery capacity on each run.

So, allowing some battery capacity to operate the radio during the glide phase of the flight, you should use at least a 750 mah capacity battery. I've flown Speed 400 models with battery packs ranging from 850 mah to 1300 mah. Since it's unlikely that you will use all of the LiPo's capacity in a single flight, the fact that you are using an ESC designed with a low voltage cutoff for a NiCad battery won't be an issue.

Once you have enough battery capacity for a single flight, you should consider the physical size and weight of your battery. Will it fit inside your airplane easily? If you have a CG problem, will the weight of a bigger battery help solve that? [My 850 mah LiPo weighs 47.8 grams; my 1300 mah LiPo weighs 83.5 grams).

A bigger battery of say 1500 mah capacity might let you make two contest flights before you have to put a freshly charged battery in your model. While my batteries have discharge rates in the 25-40 C range, newer batteries are available with discharge rates of 65C or so. They will put out more "punch" than batteries with lower discharge rates.

How Do You Wire All This Up? — These days I use red JST connectors between the battery and the ESC. You're only pulling 10 amps or so, and the JSTs will handle that.



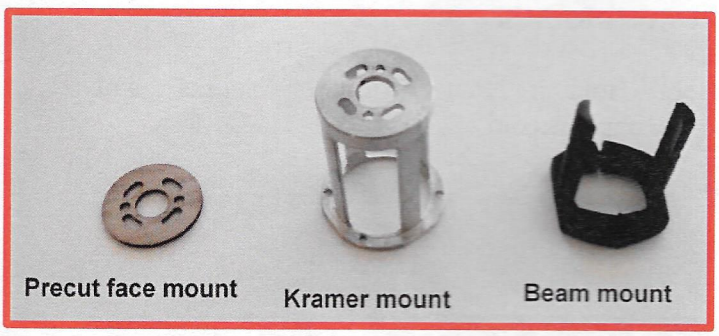
ESC with JST battery connector and 2 mm motor connectors

Some ESCs come with a small on off switch in one of the leads between the battery and the ESC. You can load your battery in your airplane, and then switch it on when you are ready to fly. If you are using a 1500 mah battery (good for two contest flights) then you can switch off between the flights, eliminating the slow drain of the ESC. If you are changing your battery after every flight, you can dispense with the switch — you shut things off by taking the battery out. I've done it both ways.

Sometimes I have soldered the motor output leads of the ESC directly to the motor contacts. But in most cases I've chosen to use 2 mm connectors in the leads between the ESC and the motor. If you have an "arrival" and need to remove your motor for repairs (usually a bent propeller shaft) the connectors make removal easy. If you're wiring things up, 16-gauge wire is fine. There will be markings on the ESC telling you which are the battery leads, and which are the motor leads.

How Do You Mount The Motor and Propeller? -- Speed 400 motors have two holes in the front case that take a 2.6 mm diameter x 6 mm long machine screw. You probably won't find the screws in your hobby shop, but you can find them on E Bay and Amazon. If you want to mount your motor inside your airplane, several people have made either wood or fiberglass mounting plates predrilled to fit the Speed 400. I show some made by Tim MacDonough. Bob Holman also cuts such plates. You can of course make your own plates, but the precut ones simplify the process.

Loren Kramer makes a sort of aluminum cage mount for Speed 400 motors. The back of it is predrilled with the same hole pattern as the back of a Cox reed valve .049 of the sort used for RC 1/2A Texaco. That makes it easy to mount on the firewall and "out in the breeze" with plenty of cooling.



The prop shaft of a Speed 400 motor is 2.3 mm in diameter. Prop adapters of that size are easy to find in hobby shops or in on line catalogs. The prop shaft itself is of soft metal. If you have an "arrival" that bends the prop shaft, you can straighten it. I use a #42 drill (.093 inches) to drill a hole that's just a bit bigger than 2.3 mm in an aluminum block. Put the prop shaft in the hole, grip the case of the motor and you can gently rebend and straighten the shaft.

What Airplane Should I Build? --- Here you are spoiled for choice. I've seen modelers fly Speed 400 models as small as 240 square inches, and as big as Jim Wiseman's Fubar 419 square inch model. There are any number of kits or plans out there for the RC 1/2A Texaco event. Most of them were scaled to 288 square inches.

Most of the OT models originally intended for the Ohlsson .19/.23 A/B class have wing areas between 300 and 320 square inches, and all of them would go up just fine on a Speed 400 motor. I've flown a Kerswap at 288 square inches, a Wedgy at 275 square inches and a Scientific Coronet and a Peerless Panther (both are 300 or 310 square inch models).

A wide range of designs have won the Speed 400 event at SAM Champs. They include the Comet Clipper, Tomboy, Lanzo Bomber, Lanzo Airborn, Stardust Special and a Cleveland Viking. If you have a favorite old time design, go for it!

Because of the long motor run, Speed 400 models easily climb out of sight. Thus, people are starting to build larger ships — witness Jim Wiseman's 17 ounce 419 square inch Fubar. They are easier to see, and if you can hold the weight to at or just above 16 ounces, they'll float better.

There is a downside to going "too big". Jim's Fubar has a 5.86-ounce wing loading, and on a windy day, a ship built that light may have trouble penetrating to get home to the landing area. Now that the cutoff date for eligible designs has been moved to 1950, there are a lot of "pencil bomber" designs out there that merit a look. My next Speed 400 ship will be a Top Banana 200 (published in June 1950 so it's now " legal") which I will scale to around 350 square inches.

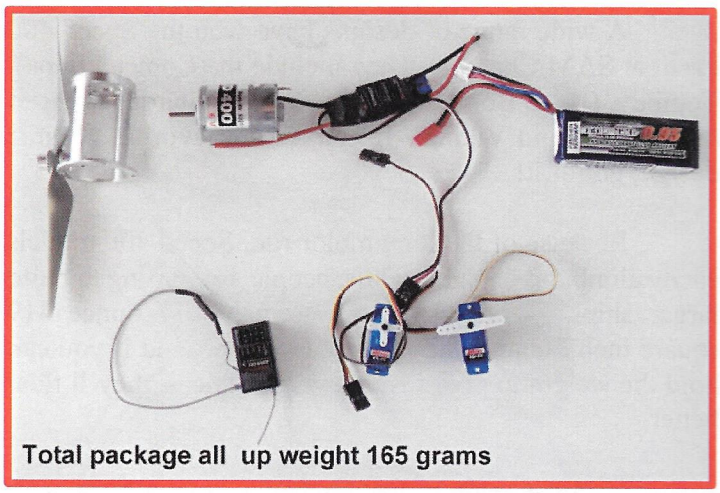
If you don't know which Speed 400 sized plane you'd like to build, you should go to Bob Holman's website and look at the plans and short kits available. If the model is anywhere between 250 and 350 square inches in wing area, it's a good candidate. Bob's short kits—which often feature Jim O'Reilly's plans -- are excellent value and give you a head start on building.

When you select a design, you should think about CG problems. I've included a photo of a typical Speed 400 power and radio set with a prop and Kramer mount, a motor, speed control, receiver, two HS 55 servos and a 950 mah battery. Taken together it has an all up weight of 165 grams.

An Ohlsson .19 with, plug, condenser, coil, two AA cells and a motor cutoff timer weighs 266 grams. Add in a tank of fuel and a propeller and we're talking 300 grams. More than half of that weight is in front of the firewall. What to do?

Well, try to select a design with a decent nose moment. Build the tail as light as possible. Consider using a pull pull control system. Or you can use the yellow inner Sullivan pushrods as a sleeve for a 1/32" music wire push rod. If you still need help (and you will) mount your battery as close to the back of the firewall as you can.

On a cabin design you may be able to mount the motor in the very nose of the airplane with the battery in front of the firewall. If you've got room and are still at or



Total package all up weight 165 grams

below the 16-ounce mark, install more battery capacity than you need. Better to add the extra weight of a larger battery than the weight of a loafing piece of lead in the nose.

A Cheap And Cheerful Old Timer Model -- Speed 400 models are cheap and cheerful. I fly a Spektrum Radio with a cheap Chinese receiver and two HS 55 servos. I've not had a range problem with the park flyer type receivers, although if you're worried about that Spektrum sells a 4 channel "full range" receiver with a longish antenna for less than $30.

Why Build a Speed 400 Ship? — If you like to compete, Speed 400 is a popular class, so you'll have people to fly against at nearby contests. If noise and the lack of a nearby airfield is a problem, Speed 400 models make excellent park flyers. Speed 400 models make no noise, don't get coated with grease, and cause no neighbor complaints. I practice on the Rose Bowl lawn six miles from my house. And boy, do I get comments, "Did you really build that?" from the foamie ARF crowd. So build a Speed 400 ship and join in the fun.

Sources:
Hobby King (ESCs and batteries) www.hobbyking.com

Maxx Products International (motor and ESCs) www.maxxprod.com

Loren Kramer (motor mount) LORENKRAMER@ATT.NET

Bob Holman Plans (motor mounts and kits) www.bhplans.com