Instructions and Cautions for your Speed 400 Propulsion System.

For New To Electrics ~ Special Instructions/Cautions

1. **Always turn on your transmitter before plugging-in the battery**
2. **Always make sure the throttle is closed**
3. **The first time you try the system do so without the propeller.**
4. **On every landing make SURE you close the throttle***
5. **On a crash landing ALWAYS CLOSE the throttle***
6. **After every flight always unplug the battery****

* If you stall the motor by catching the propeller on the ground, the system will "see" very high current ~ high enough to melt something; ESC or Motor

** LiPoly batteries MUST NOT be discharged below about 3 volts per cell. For the two-cell battery this is 6 volts. If you leave it plugged in to the ESC it will drain to below this voltage and ruin the battery even if the transmitter is not turned on.

About Electric Motors and their Limits

Most motors we use in model airplanes have permanent magnets and copper wire wound armatures. The brushed motors use carbon brushes rubbing on a commutator to switch the voltage to alternating electro magnets. The brushless motors accomplish the same switching by electronic means.

However, all such motors have limits and as we are seeking the most power for the weight of the motor we push them towards these limits. There are three limits that concern us with the Speed 400 (Mabuchi) motor*. They are;

1. Temperature in the copper windings (the bare copper is insulated with a varnish like substance)
2. Temperature in the permanent magnet; beyond a certain temperature the magnetic properties are permanently diminished.
3. Speed of the armature; windings can separate due to centrifugal force.

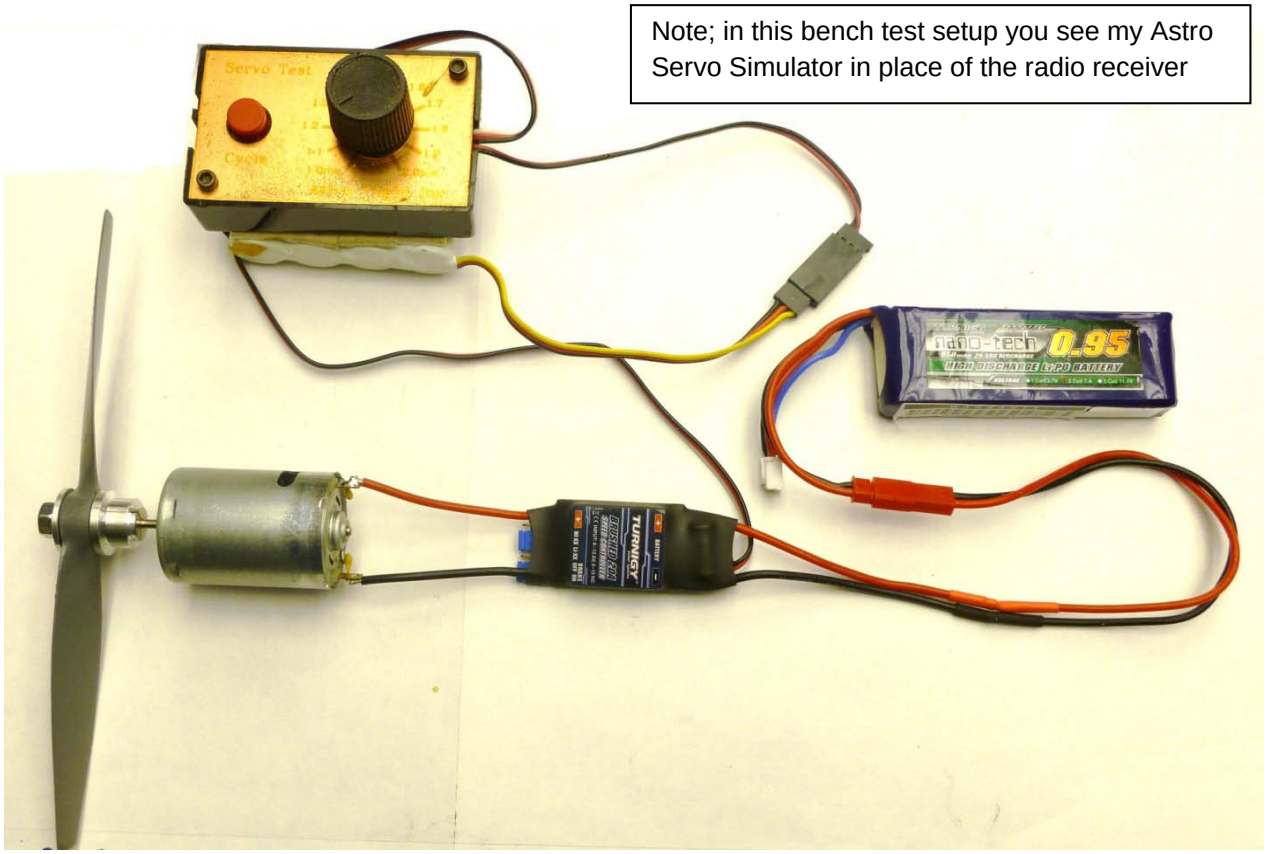
So long as we use a two-cell battery we don't worry about #3. But the first two are a real concern.

The temperature is dependent on the internal losses in the motor, cooling and run time. The losses are a function of the operating current, which in turn depends on the propeller used. For the Speed 400 SAM competitions I use the GWS DD 6x3 prop. It pulls about 8 amps and will take an aerodynamically clean 16 ounce model almost out of sight in the three minute run. If properly cooled the motor will survive just fine. Some use a bigger prop such as the APC 6 x 4 or even larger; do so at your own risk. But know that the magnet damage is not apparent until you fly and find the performance is way down.

I always include cooling in my Speed 400 airplanes. I usually mount the motor to a forward bulkhead where I cut cooling holes to match the front face of the motor. I have included a pattern for you to do the same if you mount your motor this way. In addition to these cooling holes I also arrange for the motor compartment to have cooling air via a small intake and exhaust. It is also a good idea to have some cooling flow over the ESC too.

**Note on Limits; High quality motors use high temperature insulation on the armature wires, neodymium or other rare materials in the magnets to increase the critical "Currie Point" temperature and armatures are nowadays wound with Kevlar thread to vastly increase the limiting armature speed.*

System description



Note; in this bench test setup you see my Astro Servo Simulator in place of the radio receiver

Maxx Products ACC341 motor http://www.maxxprod.com/mpi/mpi-10.html

Turnigy TGY-20A/33300 20A BRUSHED ESC
Turnigy nano-tech 950mah 2S 25~50C Lipo Pack
Hobby King USA warehouse; http://www.hobbyking.com/hobbyking/store/index.asp

Prop adaptor 2.3 mm shaft, and GWS DD 6x3 prop and JST Male connector and wire pigtail ~ many vendors

Motor mounting screws ~ 2.3 mm x 8 mm Search eBay as these are used in several model helicopters.

ESC instructions

Included.

Battery charging

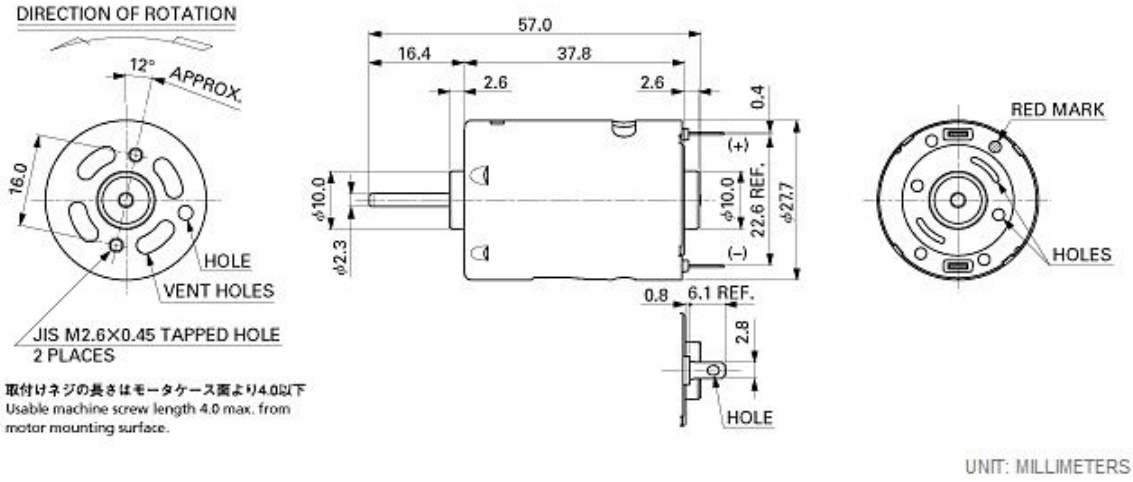
You MUST use a LiPo battery charger, and it is wise to hold the battery in a paint can, ammo box, cement block or other fire proof container while charging. This is probably over the top, but even the 1% problems can grow to be disasters. It is not necessary to balance charge the battery every time but check it once in a while.

If you damage the battery in a crash etc. discard it. Read the web to discover how.

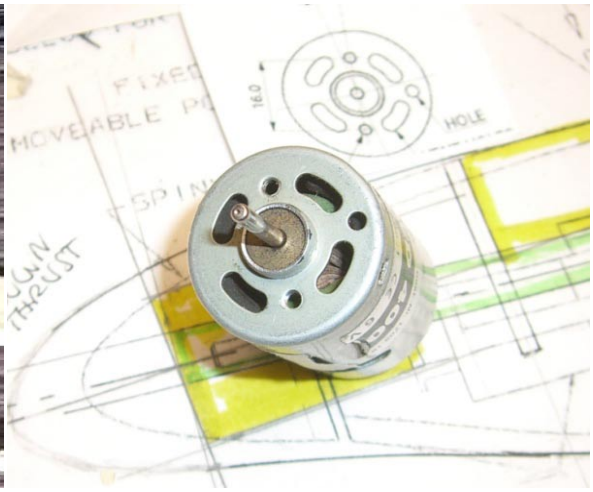
Your ESC will shut down the motor, but enable continued flight control when you have used up the juice to the 6 volt level. With the provided 950 mAh battery this will be about five minutes of full throttle running.

If you need more batteries make sure they are TWO cell ~ 7.4 volts nominal. If you can't solder then look for batteries with a JST connector that matches the one on the battery I have sent you.

Installation

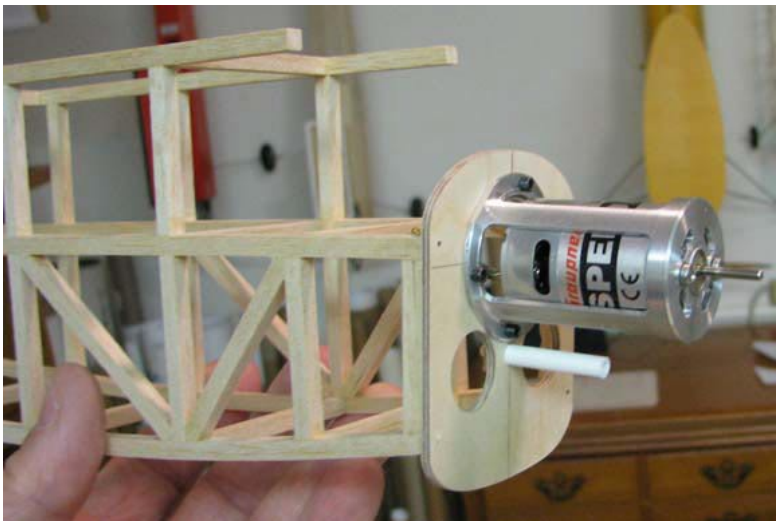


For models I design I find it simplest to mount the motor to the front former as shown here on my TU-ANT-25. The motor is fixed by two 2.3 mm screws. Make sure the screws are not bottoming on the motor as this will be into the windings. Test the length and use washers to ensure there is clearance.



If you are converting a 1/2 A Cox powered airplane you can buy mounts that will attach your Speed 400 to the Cox bulkhead. The prettiest of these mounts is made by Loren Kramer especially for this purpose. Here is one of his mounts used by Tandy Walker on one of his models. You can reach Loren at;

Loren Kramer; 707-763-9170



Another approach is to clamp the motor to longitudinal mount rails, like you might have used to attach a beam mounted glow motor. Here again heat is your enemy so aluminum clamps are recommended. You could buy them or simply make your own from aluminum flashing, a very useful material available inexpensively from Home Depot and other such stores.

Our friends in SAM 8 have a whole web page devoted to mounting Speed 400 motors although some of then involve gearboxes which are not allowed in this event. http://the-great-sam8.com/s400info.html

Operation

Be sure to test your installation for the first time without the propeller!

First hand launch should be with partial power. If you have insufficient downthrust you may climb into a loop with full power.

On landing watch the prop position. These GWS props are quite delicate and if the prop is up-and-down give the throttle a little bump until the prop blades are horizontal. Remember to shut the throttle landing.

If you do land with the prop vertical check the root of it after the flight. If a blade is somewhat swept back look at the root and see if there is any damage. If there is discard the prop. You don't want it to fail when turning fast; these guys will turn 15k.

Have FUN.

Oh, if you do fly in the Speed 400 event in a SAM meet let me know and I will send you $10 (one time only!) **Dave**