BASIC ELECTRICS

Reproduced from the December, 2002 Mid-Hudson Model Masters “Wing Tips.” Jesse Aronstein, Editor

Adapted from a set of articles that Rey McClusky wrote for Wingtips many years ago. Very timely today, considering the explosion of interest in electric power for Free Flight and R/C models.)

One of the many advantages of electric flight is that you can use smaller propellers. On small free-flight scale planes this can be a real plus. No need to have a 10" prop windmilling in front of your 24" wingspan model. You can even use a prop that will clear the scale length landing gear. Remember - I am interested in scale planes that fly in a scale like fashion, not models that move out like an F1C or even a P- 30.

Perhaps it is time to get around to a little "Lectricity", or the "Magic in the Wires", as my young niece used to say. In order to fly electric you will need to know a little about electricity and various components used for electric flight. I figure there are two ways of going about this; a simple explanation so you can go fly, or some erudite phantasmagorical treatise. I will leave the latter up to the technical crowd that uses Loran to find RC flying sites or the guys with the 40 ft. RVs. You know who you are.

OK- we are talking DC here, direct current; that means the little electrons just go one way in the wires. In order to fly electric you will need small DC electric motors, batteries, hookup wire, switches, jacks and plugs, a charger, maybe a cheap voltmeter, and some hand tools. A little knowledge of electricity will also help. Lets start with the little knowledge part. I=E/R is known as Ohm's Law. The current I is measured in Amperes, E is measured in Volts, and R is measured in Ohms. For you multiculturalists, a German, French, and Italian scientist contributed to this effort. Next you have to have sort of a handle an electrons. Think of Amps as the quantity of electrons. Volts as the pressure pushing the little devils along, and Ohms as resistance or friction.

A good but not perfect analogy would be water in a hose. A big hose can deliver a lot of water (electrons) under a lot of pressure (volts), with some loss due to friction (Ohms). If you decrease the size of your hose you can still keep the pressure (voltage) high, but the quantity of water (Amps) will be less. That is unless of course you really jack up the pressure to increase the flow rate. Ohm's Law is just a simple equation that shows you how these various factors are related in an electrical circuit.

The e's, or electrons, are the invisible particles that move through the wires and do the work. (At just about this time some quantum physicist among our club members will leap up and start to calculate the chance of an electron going right down the center of the wire in the wrong direction or perhaps in a helical path. Chill out and go sand some balsa) Perhaps you have even heard that electrons can behave either like a particle or a wave If you really understand that concept, the rest of this article will surely bore you to death.)

So what, if anything, does Ohm's Law have to do with our having fun with electric models? From it we can see that the quantity of electrons going through a circuit is related in a simple way to the Voltage and the Resistance. If we keep the resistance constant and increase the Volts, the Amps will increase. So what? Lets look at another simple equation P=EI, or the equation for Power (in watts). We can see that P (power, Watts) increases with I (current, Amps) and E (Voltage). We already know from Ohm's Law that I (Amps) will increase with E (Voltage), so if we want more Power, P, we just increase the voltage and away we go. This is more or less why you add more batteries if you want more power from your electric motor - up to a point.

If you keep adding volts, you will increase the power, until you blow the motor. It will fry! That is why, when you buy your motor, it is rated for a certain voltage limit. If the suggested voltage is two or three cells (at approx. 1.2 volts per cell) don't try more. It might work on more cells for a while, but it may start to cook or just burn out -- Zap' -- and It becomes useless!

The worst thing you can do is to keep adding more voltage and an even larger prop. You will load down the motor, increase the current, and overheat the works. I know it sounds backwards, but if you increase the voltage and your plane still doesn't have much zip try a smaller or lower pitch prop. Let the RPM increase instead of loading down the motor with a large prop. Try to think of it this way; as you increase the physical load on the motor, the motor acts as if you have reduced the resistance in the circuit and much more current is used. Don't stall the motor with the power on! That is a sure way to cook the motor and the batteries. A stalled motor is like a short circuit -- maximum amps, a lot of heat,and not movement.

As for batteries, high capacity (milliampere-hours) is nice for long-duration runs, such as you would want for Radio Control models, but the higher the capacity the heavier they are (for any given type of cell). How heavy can you make your electrical system? 50% of the finished model is an upper limit for the electric system weight. A 50-gram electric system in a 50-gram airframe. (28g = 1oz).

The wing loading of the model is also important. In general, a heavy plane with a small wing will have to fly faster than a light model with a larger wing. Here's an example of what works. A Hiline Mini-6 motor will, according to the supplier, fly a 75 to 150 square inch (wing area) model of 2-1/2 to 5 ounces. They give an ideal range of 120 square inches and 3-1/2 ounces. Hit the catalogs (such as Hobby Lobby) and the books (Don Ross's, for instance) for the data on different motor/battery/propeller combinations and the size model and wing loadings that work.

(For free flight endurance, with short timed motor runs, you can push the motors well beyond their rated current and voltage, since the mass of the motor serves as a heat sink. When a motor fries, or starts to lose power, you know you have gone too far Don't be shy about experimenting, especially if you are using readily available low-cost motors, such as the standard "Speed 400" types. ed.)