Electrics Made Easy

Selecting a Suitable Motor

As I have no experience with ducted fans this article will concentrate on the selection of a suitable brushless outrunner for propeller driven aircraft.

Just as in an ic aircraft the first thing you need to determine is the power you need for your personal type of flying. In the ic world power is usually expressed as brake horse power (Bhp). A typical 60 two stroke will produce about 2 Bhp and a 60 four stroke about 1 Bhp.

Electric power is measured in watts. Bhp can be compared to watts using the following simple conversion:-

1 Bhp equals 750 watts

The first thing I do when deciding on a motor is to estimate the All Up Weight (AUW) of my model. If the model is built I use some electronic fishing scales. If it is a kit or plan I use the guide AUW given. I find that electric systems including their batteries are of similar weight to the ic equivalent with a full fuel tank. Do not worry too much about the accuracy of this weight estimate.

Next thing I do is to put my model into a type category and using this in conjunction with the estimated weight I can decide how much power (watts) the model needs :-

1. Sport / scale glider 40 to 80 watts per pound
2. Scale 60 to 120 watts per pound
3. Sport / aerobatic 100 to 200+ watts per pound

Taking the example of a kit built Wot 4 with an AUW of 5 pounds the guide lines above tell us that this sports model model needs a motor that has a minimum power of 5 pounds multiplied by 100 watts…..ie a 500 watt motor.

In all the 3 categories you have to use your common sense. Both of the Sport categories will give adequate performance at the lower end

power but if you require sustained vertical climb etc. you need the higher end power. In the scale category an auster or cub will fly in a scale manner at 60 watts per pound but a spitfire may require nearer 120 watts per pound.

Even at the lower end of the above guidelines you will find that you have sufficient power to take off from grass and throttle back once flying. However if you are worried about the available power go for a more powerful motor just as you would when choosing an ic engine. If the motor is too powerful you can fly with reduced throttle as long as the speed controller has some cooling air around it or alternately use a smaller propeller. (I will discuss propellers in a later article)

We now have an estimated engine power in watts. However before we choose the actual engine you will need to know one simple calculation:-

AMPS (current) multiplied by VOLTS equals WATTS (power)

If we know any two of the above we can always work out what the remaining number is by rearranging the calculation:-

AMPS equals WATTS divided by VOLTS

VOLTS equals WATTS divided by AMPS

For example in the Wot 4 above we have calculated it needs a minimum of a 500 watt motor. Therefore if we plan to run using a three cell LiPo which will deliver approximately 11 volts when under load then the current drawn will be 500watts divided by 11 volts which is 45amps.

If we plan to use a four cell LiPo delivering 15 volts under load the current drawn will be 500 divided by 15 which is 33amps.

I have a personal rule not to fly my models at more than 60 amps. If the calculation indicates a max current of more than 60 amps I will choose a battery pack with more cells (higher voltage) to bring the current below this figure. I will talk about battery choice in a later article.

From above we have now fixed the power of the motor and the equations show how you can control the amps and volts so we can now choose our motor:-

1. Buy from a specialist dealer where you can see a full specification. I have used Giantshark, BRC Hobbies and Overlander and all have excellent detailed websites. There are many other good sources and this article is not intended to promote any particular supplier.

2. Manufacturers give motors a name eg. E max BL 2820-07. Apart from using it on an order form IGNORE this code. It will only confuse you as there is no consistency among manufacturers as to its meaning.

3. From the specifications you need to identify the max power of the motor you wish to purchase. This has to be at least 500 watts for our Wot 4. Most suppliers quote max continuous power.

4. If max power is not quoted then find the maximum constant current (amps) and the maximum voltage the motor will handle from the spec sheet. Multiply these two figures and you will have the maximum motor power.

5. If you cannot find the data stated in 3 or calculate it as in 4 use another supply source.

6. If you are using a specialist supplier you will by now have identified several motors that might suit your needs. With our Wot 4 example we would be looking between 500 watts and 1000 watts depending on how you want to fly it. My own Wot 4 has a motor capable of 800 watts continuous power.

7. There is now only one more important figure you need to find on the spec sheet to identify the best motor from the group in the right power range. This is the number of revolutions per minute the unloaded motor will turn per volt applied to it. This figure is called Kv and all good suppliers quote it. If you multiply the Kv by the battery voltage you will get the unloaded rpm of the motor eg Kv 1000 using 3 cell 11volt LiPo gives 11,000 rpm.

8. The Kv you choose will depend on the volts (number of cells) of your battery pack. I always aim to end up with a unloaded rpm

similar to the max rpm of your average ic motor. Use the following for a guide:-

3 cell (11 volts)	Kv 800 to Kv 1400
4 cell (14.6 volts)	Kv 600 to Kv 1000
5 cell (18.3 volts)	Kv 400 to Kv 750
6 cell (22 volts)	Kv 250 to Kv 500

9. If the size of the motor is important you should find the dimensions in the spec sheet. Electric motors are a lot smaller than their ic equivalents and fit easily into most models.

10. What you pay for the motor is your own choice. If you are a serious competition flyer then the more expensive European motors are worth considering as they generally have better bearings, magnets and balancing so will be more efficient. However for general sport flying I have had very little problem with Chinese motors. It is worth shopping around because I believe that most motors come from just a couple of manufacturers and individual retailers try to personalise them by having them painted in their own colour. Their prices vary considerably for what is basically the same motor. You can buy Chinese motors of 500 to 1000watts for £20 to £30 from the cheapest UK suppliers.

Micks electric Wot 4 which used to be powered by Saito 56 four stroke.

This model is now powered by an 800watt motor of 710Kv.

It performs well on a 4 cell battery pulling 44amps giving 640 watts power. (if I needed more power I would increase the prop size till I reach the 800 watt max. This would also increase my maximum current draw to 55 amps……work it out from the equasions!!)

Next time I will move onto speed controllers.

Mick