Building an Electric Powered System

The first thing you need to know is approximately what the finished aircraft will weigh. If it is an ARF or kit it will say somewhere on the box or in the paper work with the plane.

Let's assume we have a P47 Thunderbolt ARF originally designed to fly on a .40 internal combustion engine. The recommended engine is .40 - .46 cu in 2-stroke and the finished weight is 4.5 to 5.5 Lbs.

The next thing you need to know is how you plan to fly this plane, scale like, as a trainer, mild aerobatic or 3-D aerobatic. Now you can use some general guidelines from the chart below to see what you will need for power.

Trainer/Scale like	60 to 90 watts per pound
Mild aerobatics	90 to 120 watts per pound
3-D Aerobatics	150 to 180 watts per pound

So far we have a 5lb plane and let's say we want the mild aerobatic range. Our power system will need to be between 500 and 600 Watts because War Birds tend to have more drag than cleaner aerobatic models.

We now need to know a few basics like, do we have limited ground clearance where prop diameter may be limited and do we want to keep the current low to avoid a more expensive Electronic Speed Control (ESC) or higher torque and larger prop for a more scale appearance say for a War Bird?

Having a War Bird that has a large radial engine it would look better with a large diameter prop so we will look for a motor that has a lower RPM/Volt rating (Kv) capable of at least 600 watts sustained 1000 Watts Max (figure on the high end to alleviate possible overheating.) I found the following motor on Hobby kings web site USA warehouse.

Motor info:
Battery: **5~7 Cell /18.5~25.9V**
RPM: **300kv**
Max current: **60A**
No load current: **11V/1.2A**
Current capacity: **60A/15sec**
Internal resistance: **0.04 ohm**
Max power: **1425 Watts**
Weight: **360g (not including connectors)**
Diameter of shaft: **6mm**
Dimensions: **81x50mm**

Test Data:
18.5v - 14x10 prop - 17A - 1600g Thrust
18.5v - 15x8 prop - 17A - 1950g Thrust
22.2v - 13x8 prop - 16A - 1650g Thrust

PRODUCT ID: G60-300

Next we need an Electronic Speed Control or ESC and battery. If we keep the cell count higher we will be able to hold the current lower. A note of caution here it is **NOT** true that on a functioning system just increasing cell count will lower the current. The opposite is usually true. Changing a battery cell count in a system requires the whole process of reselecting an appropriate prop which is the determining factor for current draw. Let's shoot for a 30 amp current draw and pick an ESC in the 50-70 amp range. We'll start with a 6 cell LiPo which will give us about 24 Volts fully charged. Using the power formula P=EI we see that 30 Amps times 24 Volts = 720 Watts but at near battery depletion the battery voltage drops to near 18 Volts and 30A times 18V = 540 Watts which is in our target 500-600 Watts.

Here's where the magic comes in, we need a prop that will get us in the ball park for our power requirements. The motor has a 300 Kv rating (Kv means RPM per Volt and has nothing to do with power or voltage limits) and we are designing around a 6 cell LiPo therefore we can assume a no load RPM of 24V x 300Kv = 7200 RPM. This motor listed some starting guidelines for prop selection, not all do and you will need to rely on experience using the RPM rating of the motor to select a prop. Using the guidelines given with the motor a 13x10 or 14x10 should get us close to our target. Some experimentation will be necessary to get the final size right, but for the purpose of this exercise let's assume we are drawing 32 amps.

We need to determine battery capacity now. We decided on a 6 cell LiPo in the beginning but now we must determine the Amp Hour (Ah or Mah) rating. We want to fly for 9 minutes minimum so knowing our power consumption from the prop selection we can now determine the necessary battery capacity. 9 minutes is .15 hours (9/60) so to fly .15 hours at 32 amps we need to compute (AHr = Amps x Hrs) or 32A x .15Hr = 4.8 Amp Hours or 4800 Mah battery pack. The battery can be two 3cell packs in series or one 6 cell pack. Personally I prefer two 3 cell pack in series for versatility because I can use them separately in other planes. A 3200 Mah pack will give you 3.2Ah/32A= .1 Hours or 6 minutes. It is unlikely that you will fly the entire flight at full power and presumably flight times will be extended accordingly.

Keep in mind many variables will alter performance but these guidelines will be close.

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