



## Electric Power Systems Workshop #2

*Electric motor selection by Steven DeMar*

NOTE: Due to decreasing cost and increasing availability, we will use only brushless motors and lithium-polymer batteries for this series of workshops.

### Two types of motors:

- Inrunner: Coils are attached to shaft and rotates. Outer case does not move. This type of motor is usually used in high-speed airplanes (such as ducted fans) or geared down for slower airplanes.
- Outrunner: As the name suggests, these motors have a rotating outer case (with magnets attached to it) that is connected to the shaft. The coils are fixed and connected to the mount.

### Some motor terms:

--KV: A motor constant measured in RPM's per volt. This determines how fast the motor will spin. For example, if you have a 1000-KV motor running on a 3-cell lithium polymer battery, you can expect to get around 10,000 RPM at the propeller. However, as the motor load increases, the speed will also decrease slightly. So, for practical purposes, you can expect the propeller to spin at closer to 9500 RPM.

--Watts: The input power a motor can handle.

--Efficiency: A percentage of the power out divided by the power coming into a motor. Most modern brushless motors have an efficiency rating in the 75-90% range. If the efficiency falls below 70%, then you are probably overloading the motor and creating excess heat.

*So where does one start when selecting a motor?*

--When selecting a motor, it is probably best to start from the amount of power (watts) required to fly your model the way you would like (see previous lecture notes).

\*A lot of companies will rate their motors by the equivalent old-technology brushed motor size (380, 400, ect..) or by their equivalent nitro or gas (power 40, power 60, ect..) However,

I find this to be rather misleading, as there are many more factors that go into a successful electric power system.

--Secondly, you want to figure out the pitch speed you want, and the maximum propeller size that your landing gear will allow. For example, a propeller spinning at 6000-RPM with 10-inch pitch will have a pitch speed of close to 60mph (10 inches multiplied by 6000-RPM divided by 1000)

--Finally, using the manufacturer KV rating, determine the number of lipo cells in series you need to get the RPM you want. Remember, if the situation allows, it is always better to have higher voltage and lower amperage (again see the previous workshop notes).