How to Use the PropEngine

by Jim Kitt

Background Information You Should Know:

The PropEngine is an application that I developed to make power comparisons in electric RC systems easier. It is very important for the safety of our electric systems to be aware of the interrelationship between the electrical values, specifically the volts and Amps, and the mechanical component, specifically the motor, speed controller, and the propeller. If these components are not matched correctly, you could be creating a hazard to your aircraft and yourself.

The overview of this relationship is a simple one. With a specific amount of volts, the load you place on your motor will determine the Amps. Amps represent the current, and current is where heat and resistance comes from. Too much heat and resistance could damage any and all components.

This load can come in the form of the size, weight, and resistance of the spinning propeller, or the revolutions per minute that you are asking the motor to turn the propeller. The Kv and the volts will determine how fast the motor will try to spin the propeller.

- If you add a bigger prop to the same Kv with the same volts, the Amps will go up.
- If you add more volts to the same Kv with the same size prop, the Amps will go up.

Exchanging a smaller propeller with a bigger propeller on the same battery, speed controller, and motor, will increase the load on the motor and increase the Amps. The reason for this is that you are asking the motor to do more work as it tries to turn the bigger propeller to the same number of RPMs. If it tries to do more work, it will ask for more power (Amps x volts) to perform the required task.

Exchanging a battery with a lower number of cells with a battery with a higher number of cells on the same motor, speed controller, and propeller, will increase the load on the motor and increase the Amps. The reason for this is that you are asking the motor to do more work as it tries to turn the same propeller, faster. If it tries to do more work, it will again ask for more power to perform the required task.

Adding a battery to the system with a higher cell count will mean more volts to the system. The more volts added to the system, the faster the motor will try to turn. As we load the motor with bigger or heavier propellers, and add more cells to the system, the motor will still try to spin the bigger propeller faster, but ultimately, as we ask the motor to spin bigger props, and spin it faster, the system will bog down, heat up, and fail.

The idea, therefore, is to use the properties and formulas we have been given by some very smart people in the past, to make sure we are not being foolish, and burning up our hard earned money as a result.

In this application, the math is done for you. All you have to do is feed this PropEngine with the correct information, and it can help us get the most out of our power system and aircraft, and avoid a system failure.

Getting Started:

PropEngine

All up weight is the only field that is not required, and if not included, then **Adj Flight Time** cannot be calculated and will remain blank.
Use a Prop Pitch of 9 for Vess A and 11 for Vess B.

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Propeller diameter in inches:	24.0
Propeller pitch in inches:	10.0
Motor Kv:	215
Number of LiPo battery cells:	10
Volts per Cell:	3.70
LiPo Battery mAh:	5,000
All-Up Weight in pounds:	17.00
Air Temperature:	F=86 and up & C=30 and up
Average Throttle Setting %:	40
Kv Efficiency(Usually 75 to 85):	80.00
Prop K (Composite=0.9, Carbon=1.05, Vess Wood=1.04, Xoar PJN=1.08, Other Beechwoods=1.15, Laminated Wood=1.30):	1.08
Volts:	37.00
Amps:	120.37
Watts	4453.84
Watts-out:	3711.53
Amps-out:	100.31
RPMs	6364.00
Est Flight Time in Minutes	6.23
Horsepower	4.98
Torque in ft-lbs	4.11
MPH	60.27
Thrust in kg	14.25
Thrust in lbs	31.36
Static Thrust in kg	17.34
Static Thrust in lbs	38.14
Thrust-to-Wt in lbs	1.84
Discharge C Rating	24.07
mAh per minute used	601.87
Watts per Pound	261.99

Disclaimer: This application is only as good as the data that goes into it, and it is displayed only for the purposes of estimating values, and for intellectual curiosity. We take no responsibility for injury or loss as a result of information obtained here.

The PropEngine will ask for things you should already know about your system. This information should be easy to find.

[1] Fill the first data field with the propeller diameter, in inches.

The first thing the PropEngine will ask for is the propeller diameter. This is the full length of your propeller, and you probably bought the propeller because of this variable. If not, this value can usually be found on the propeller.

[2] Fill the second data field with the propeller pitch, in inches.

The second thing the PropEngine will ask for is the propeller pitch. This value can usually be found on the propeller too.

[3] Fill the third data field with the motor Kv.

The Motor Kv is a value that all motors have and one of the main reasons, along with size and weight, you consider buying a motor for your airplane. It may be printed on the motor, or you can reference the manufacturer's specifications. In most instances, the motor ads will include this value since it is that important.

The Motor Kv refers to the amount of RPMs the motor will turn, unloaded, per volt from your battery. So if you have a four cell Lipo battery, the minimum volts delivered to the system by your battery will be 3.7 volts per cell, times four cells, or 14.8 volts. You can multiply this value times the Kv to see how many RPMs the motor will turn without a propeller.

[4] Fill the third data field with the number of cells in your battery or batteries.

This is also something easy to find out and if you are using two batteries in series, it is important to include the total number of cells combined.

[5] Fill the fifth data field by selecting a value from the Volts per Cell menu.

This value represents the approximate volts per cell your battery is capable of delivering under load. Most Lipo batteries will list 3.7 volts as a typical volt reading, but a Lipo is basically spent at 3.7 volts per cell. Fully charged, the battery will generally register 4.2 volts per cell. Under load, a battery can generally register anything from about 3.65 to 3.90 volts per cell. If you are not sure about this, leave the value at the default setting of 3.80.

[6] Fill the sixth data field with the mAh capacity listed on your battery.

This milliamp-hour value (mAh) is easy to find, but it may sometimes be listed as Amp-hour (Ah) instead. This value is only needed to estimate the flying time of the system, so it is not critical unless this estimation is important to you.

[7] Fill the seventh data field with total weight of your airplane, will all items in it, ready to fly.

Again, this value is only needed to estimate the flying time of the system, so it is not critical unless this estimation is important to you.

[8] Fill the eighth data field by selecting the air temperature range in which you fly.

This menu has both Fahrenheit and Celsius temperature values so select one that fits your current weather. This value is used to determine Static Thrust since this formula utilizes air density, which is a function of air temperature.

[9] The Average Throttle Setting is a highly subjective variable. It will change from pilot to pilot, and can be different for the same pilot when flying different airplanes. The idea is that people flying for speed, or flying with underpowered motors, may be heavier on the throttle than others. Each pilot will, though, have a feel for their average throttle setting, such as half, two-thirds, or three-quarters, and should adjust this menu accordingly to achieve a more accurate estimate of the flight time.
Once these values are added, the results will automatically calculate.

The Amps value is an important variable since it will give you the approximate maximum Amps the system will be drawing. It will determine the absolute minimum speed controller rating that you will need.

The Watts is a function of Amps and volts, and it will determine if the motor, battery, ESC, and propeller setup is sufficient to power your airframe.

If you know the Amps, Watts, or RPMs of your system, you can adjust the Kv Efficiency up or down until the values coincide with your meter readings. This will help you to determine the true efficiency of the setup, and bring all values into a formulated relationship. In some cases, this could be more accurate than your meter readings.
If you are not sure what the other calculated fields are, then this application will probably not be valuable to you since those of us that use calculators like this are anticipating these results.

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Click Here to enter the PropEngine.