

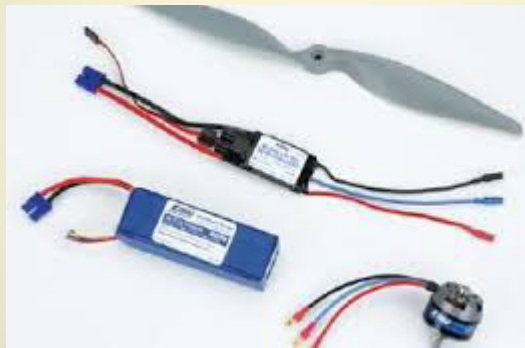
Electric Power System Selection

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Lucien Miller

Innov8tive Designs

- An electric power system consists of a battery, a speed controller, a motor, and a prop.



SIMPLE!

Battery Ratings - The Dreaded C

- Numerically equal to the capacity of a battery.
 - For a 2200mah battery, C equals 2.2 amps.
 - A 1C charge or discharge rate is equal to 2.2 amps
 - An electric system pulling 20C is pulling $20 \times 2.2 = 44$ amps
- A 1C discharge rate will drain the battery in 1 Hour.
- To calculate flight time, you divide 60 by the C rate of your power system.
 - $10C = 60/10 = 6$ minutes
 - $15C = 60/15 = 4$ minutes
 - $20C = 60/20 = 3$ minutes

Electronic Speed Controller (ESC)

- Converts the DC energy from the battery into 3-phase AC to power the motor.
- The speed controller should be sized to handle the full rated current of the motor.
- A larger speed controller not will harm the motor
- Keep 'em cool, man.

Battery Eliminator Circuit (BEC)

- Drops battery voltage to ~5v for servos & receiver
- Basically 2 types: Linear and Switching
- Linear BEC's are typically seen in smaller ESC's
 - They convert excess voltage to heat energy
 - Must be de-rated as battery voltage goes up
 - Typically must be disabled for use on 4+ Li-Po cells
- Switching BEC's work by chopping up the input voltage into small pieces and filtering it to get 5 volts output
 - They are very efficient, up to 95%, so there is little waste
 - They can work with a wide range of input voltages, and deliver full power, regardless of input voltage

Brushless Motor

- Like name implies, no brushes or commutator
- Typically 3 Parameters: Size, Power Rating and Kv
- Two motors that weigh the same and have similar Kv's will be in the same performance ballpark
- Motor size can be confusing since manufacturers use different naming conventions

Some use outside dimensions for model number:

Turnigy 3536-1050



Some use stator size to determine model number:

Scorpion 3014-1040



Some use glow motor size equivalents:

Eflite Power 10



Some use old brushed size designations:

Value Hobby GeForce E450



Motor Ratings

- Current rating: How many amps?
 - Current based on size of wire used to wind motor
- Power rating: How many watts?
 - Basically a function of the mass of a motor
- Kv value: How fast does it Spin? RPM per Volt
 - A 1000Kv motor will spin 10,000 RPM on 10 V
 - Kv is the “No-Load” speed of the motor
 - Kv has nothing to do with size or power output

Electric Motor vs. Glow/Gas Engine

- Engines produce a given amount of power from combustion during each ignition cycle
 - The speed of the engine varies with changing load
- Motors try to spin at a constant speed
 - The current draw of a motor changes with load
- Engines can be damaged by using a prop that is too small
 - The engine will speed up until something breaks
- Electric motors can be damaged by using a prop that is too large
 - The motor will pull more current until it burns up

Determining Power Needed

- If you purchase an electric kit, you normally get a motor recommendation. This simplifies motor selection.
- For powering a glow model with electric power, you need to figure out what size motor to use yourself
- For glow to electric conversion, there are a few rules of thumb to follow:
 - 1 cubic inch of glow engine = 2000 watts electric power
 - For a .60 size Glow Engine, $2000 \times .60 = 1200$ Watts
 - For a .40 size Glow Engine, $2000 \times .40 = 800$ Watts
 - For a .15 size Glow Engine, $2000 \times .15 = 300$ Watts
- For 4-stroke engines, use 1500 watts per cubic inch

Determining Power Needed

- Another common method to determine motor size is to use watts of power per pound of aircraft weight

For power gliders, 50 watts per pound is usually enough



For trainers, like a PT-40 or similar, 75 watts of power per pound works well



For sport models, such as a Great Planes Sportster, 100 watts of power per pound is enough



For pattern planes and warbirds, 150 watts per pound will provide good performance



For 3D and competition Fun-Fly, 200+ watts per pound will allow you to hover at ½ throttle and climb straight up



Selecting a Battery

- After you determine power requirement for your model, you need to choose the correct size battery
- Power (W) = Volts (V) x Amps (A)
- Rule of Thumb: Current should be 2 to 5 times voltage
 - Example: 3-cell (11.1 V) between 22 and 55 amps

Common Power Ranges

- 2-cell Battery –100 to 300 Watts
- 3-cell Battery –250 to 600 Watts
- 4-cell Battery –450 to 1,100 Watts
- 5-cell Battery –700 to 1,700 Watts
- 6-cell Battery –1,000 to 2,500 Watts
- 8-cell Battery –1,800 to 4,000 Watts
- 10-cell Battery –2,800 to 6,500 Watts
- 12-cell Battery –4,000 to 10,000 Watts

Scorpion SII-2208-1280 Motor Propeller Data

Motor Wind 26-Turn Delta		Motor Kv 1280 RPM/Volt		No-Load Current I _o = 0.47 Amps @ 10v		Motor Resistance R _m = 0.150 Ohms		I Max 14 Amps	P Max (3S) 150 W
Outside Diameter 27.9 mm, 1.098in.		Body Length 26.0 mm, 1.024 in.		Total Shaft Length 45.0 mm, 1.772 in.		Shaft Diameter 2.98 mm, 0.117 in.		Motor Weight 45.0 gm, 1.59 oz	
Prop Manf.	Prop Size	Input Voltage	Motor Amps	Watts Input	Prop RPM	Pitch Speed	Thrust Grams	Thrust Ounces	Thrust Eff. Grams/W
APC	8x3.8-SF	7.4	6.32	46.7	7,236	26.0	359.2	12.67	7.69
APC	8x4-E	7.4	5.79	42.9	7,428	28.1	333.1	11.75	7.77
APC	8x6-E	7.4	7.85	58.1	6,684	38.0	341.2	12.04	5.88
APC	8x6-SF	7.4	9.18	67.9	6,228	35.4	387.3	13.66	5.70
APC	8x8-E	7.4	9.86	72.9	6,006	45.5	304.5	10.74	4.18
APC	9x3.8-SF	7.4	8.07	59.7	6,629	23.9	443.2	15.63	7.42
APC	9x4.5-E	7.4	7.67	56.8	6,775	28.9	434.7	15.33	7.66
APC	9x4.7-SF	7.4	8.50	62.9	6,480	28.8	459.4	16.20	7.30
APC	9x6-E	7.4	8.69	64.3	6,413	36.4	427.8	15.09	6.65
APC	9x6-SF	7.4	11.41	84.4	5,455	31.0	466.7	16.46	5.53
APC	9x7.5-E	7.4	11.17	82.6	5,538	39.3	385.4	13.59	4.66
APC	9x7.5-SF	7.4	12.51	92.5	5,013	35.6	420	14.81	4.54
APC	9x9-E	7.4	12.56	92.9	4,983	42.5	331.8	11.70	3.57
APC	10x3.8-SF	7.4	10.70	79.2	5,663	20.4	530.8	18.72	6.70
APC	10x4.7-SF	7.4	11.33	83.9	5,432	24.2	537.5	18.96	6.41
APC	10x5-E	7.4	9.53	70.5	6,085	28.8	496.2	17.50	7.04
APC	10x6-E	7.4	10.40	77.0	5,765	32.8	504.3	17.79	6.55
APC	10x7-E	7.4	11.42	84.5	5,414	35.9	474.2	16.73	5.61
APC	10x7-SF	7.4	13.36	98.9	4,670	31.0	511.9	18.06	5.18
APC	10x10-E	7.4	14.02	103.7	4,433	42.0	335	11.82	3.23
APC	11x3.8-SF	7.4	11.37	84.1	5,373	19.3	567.3	20.01	6.74
APC	11x4.7-SF	7.4	12.72	94.2	4,849	21.6	578.7	20.41	6.15
APC	11x5.5-E	7.4	11.47	84.8	5,336	27.8	566.4	19.98	6.68
APC	11x7-E	7.4	12.63	93.5	4,909	32.5	553.1	19.51	5.92
APC	11x7-SF	7.4	14.65	108.4	4,117	27.3	555.5	19.59	5.12
APC	11x8-E	7.4	13.34	98.7	4,611	34.9	460.3	16.24	4.66
APC	11x8.5-E	7.4	13.56	100.3	4,506	36.3	497.7	17.56	4.96
APC	11x10-E	7.4	15.11	111.8	4,056	38.4	375.1	13.23	3.35
Manf.	Size	Voltage	Amps	Input	RPM	Speed	Grams	Ounces	Grams/W
APC	6x5.5-E	11.1	6.74	74.8	11,462	59.7	289	10.19	3.86
APC	7x4-E	11.1	7.84	87.0	11,034	41.8	484.9	17.10	5.57
APC	7x4-SF	11.1	7.78	86.3	11,052	41.9	464.4	16.38	5.38
APC	7x5-E	11.1	9.43	104.7	10,421	49.3	477.9	16.86	4.56
APC	7x5-SF	11.1	9.39	104.2	10,443	49.4	502	17.71	4.82
APC	7x6-E	11.1	9.89	109.8	10,226	58.1	522.7	18.44	4.76
APC	7x6-SF	11.1	10.93	121.3	9,851	56.0	475.9	16.79	3.92
APC	8x3.8-SF	11.1	11.67	129.5	9,549	34.4	667.8	23.56	5.16
APC	8x4-E	11.1	10.68	118.5	9,957	37.7	622	21.94	5.25
APC	8x6-E	11.1	13.45	149.3	8,817	50.1	641.7	22.64	4.30
APC	8x6-SF	11.1	15.59	173.0	7,705	43.8	621.7	21.93	3.59
APC	8x8-E	11.1	15.95	177.1	7,568	57.3	508.9	17.95	2.87
APC	9x3.8-SF	11.1	14.04	155.8	8,440	30.4	765.8	27.01	4.92
APC	9x4.7-SF	11.1	13.98	155.2	8,439	37.6	778.1	27.45	5.01

Electric Motors and Propellers

- The propeller is one of the most important parts of an electric power system
- Every time you change the prop, you change the power output of an electric motor
- Choosing the wrong prop can destroy the motor, speed controller or the battery

The 80% Rule

- Try to operate your electric system components at 80% or less of their maximum rating.
- If a motor is rated for 80 Amps, use 64 Amps max
- If an ESC is rated for 100 Amps, use 80 amps max
- If a battery is rated for 4000mah, use 3200mah
- If a battery is rated at 25C, run it at 20C

A Few Words about Soldering

- One bad solder joint can destroy a motor or ESC
- Do not trust “Pre-Tinned” leads on components
- RoHS (Restriction of Hazardous Substances) solder melts at a higher temperature than standard 60-40 or 63-37 Tin-Lead solder
- Always re-tin the leads and connectors before soldering any motor or ESC connections
- Never use acid core plumbing solder

Some Useful Tools

- Watt Meter
- Multimeter
- Clamp on Amp Meter
- Different Power Soldering Irons
- Soldering Clamps
- Pulse Meter
- Discharger