the Ampeer

January The EFO Officers 2012

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The Next Meeting:
Thursday, January 5, 7:30 p.m. Ken Myers' house

What's In This Issue:

Dave Thacker on Motor Selection

From Dave Thacker davthacker@aol.com

Ken,

I had some thoughts to offer on the Ryan STA setup (*Featured in the December 2011 Ampeer KM*). I just read the header of the article and started writing. I wanted to get my thoughts down before seeing your answer just for fun. I hope your readers find something worthwhile here.

It's a strong overall strategy to try to imagine what an ideal range of propeller diameters and pitches would be (pitches as a fraction of diameter depending on application) then use ElectriCalc, (http://www.slkelectronics.com/ecalc/index.htm) or your favorite calculator, to arrive at suitable Kv (*RPM per volt KM*) and voltage ranges.

On a scale project, I like to consider the scale prop size. Considering "**only**" the scale prop diameters is overly narrow minded and rigid and can lead to errors. (*Especially if the aircraft used a multi-blade prop. KM*)

I've discovered, from past experience, the setups that I am most happy with often end up close to the scale prop diameter. I like to consider the scale diameter as a good place to start looking.

I looked up the scale specifications of a Ryan STA and found the wingspan to be 30 feet.

I found the specifications for the full scale here:
http://www.airventuremuseum.org/collection/aircraft/Ryan%20STA%20Specifications.asp

The model has a 72 inch or 6 feet wingspan according to the specifications you provided. Thus it's a 1/5th scale kit.

I found 2 props for the full-scale, both 70", certified for the Ryan STA here:
http://www.modernwoodenpropellers.com/sensenich.htm

I found the key to reading the prop number here: http://www.sensenich.com

Let's think about 14" props (70"/5th scale = 14"). The other important piece of data here is how large a prop the airframe can stand (considering if it's flying on pavement or grass) which is not provided.

I am presuming 8 lb. (should be lighter as electric beats glow weights usually) I wouldn't consider foot per minute climb rates (FT/MIN) below 1000 for models of this nature. For this type of model, I like pitch speeds 60 mph or better. (Anything above the mid 70's, the pilot often likes to trade some of the excess pitch speed for better climb angle).

A comment from Ken: *I have found pitch speed to be a function of the wing cube loading (WCL) as well as the mission.*

As of December 3, 2011 Pitch Speeds	Electric Avg.	Electric Median	Glow/Gas Avg.	Glow/Gas Median
(Level 1 0.00 - 2.99) Indoor	25.66	25.28	NA	NA
(Level 2 3.00 - 4.99) Backyard	**36.56**	**36.70**	**69.63**	**63.92**
(Level 3 5.00 - 6.99) Park	43.10	41.43	56.13	56.82
(Level 4 7.00 - 9.99) Sport/Trainer	**48.45**	**49.28**	**61.84**	**59.47**
(Level 5 10.00 - 12.99) Adv. Sport	55.09	57.05	64.15	63.71
(Level 6 13 - 16.99) Expert Sport	**58.86**	**61.05**	**63.93**	**66.48**
(Level 7 17+) Expert	61.73	62.50	72.07	74.10

The table is based on data from hundreds of actual flying models presented in an Excel workbook located online at http://homepage.mac.com/kmyersefo/new-power-theory/metricnewtheory.xls

The Sig Ryan STA has a wing area of 770 sq.in. At 8 lb. to 9 lb., the wing cube loading would be between 10.35 oz./cu.ft. and 11.65 oz./cu.ft. That is what I call Advanced Sport. The "typical" electric pitch speeds are in the mid to upper 50 mph range and the "typical" glow pitch speeds are near the middle of the 60 mph range. That certainly agrees with what Dave said . KM

ElectriCalc shows a Himax 5018-530 (*5053-530, 280g*) using an APC 14x12E prop with a 5S battery pack yields 835 watts in at 44.9 amps, with an 85% motor efficiency, 71 mph pitch speed (*That's about 6250 RPM KM*), and 81 oz. of static thrust. The maximum climb angle is 35 degrees with the best climb at 1303 FT/MIN at 25 degrees.

The above setup shows that on 5S, 530 Kv is workable. We are approaching square pitch (pitch and diameter the same), which is usually only in the range of pattern or racing type aircraft and sometimes warbirds where the low hot pass is the best trick the pilot wants to bring out.

Usually when you see a square diameter to pitch ratio or nearly square prop on a model not in a high speed emphasis category, it's a sign the owner has tried to fix the mistake of choosing a Kv or voltage that is too low. The hole shot, or zero to X speed times, will be slower with square props or nearly square props. A model will often feel like it takes a little longer than it should to feel "on step". This can be worth it for a high speed model but probably not in the case of a scale or sport ship. I imagine the flight speed envelope of the Ryan STA to be similar to many sport ships.

The Himax 5018-530 using an APC 13x8E prop with a 6S battery pack yields 879 watts in, 39 amps, an 88% efficient motor, 92 watts in per pound and a 63 mph pitch speed with 93 oz. of static thrust. The maximum climb angle is 42 degrees and the best climb is 1506 FT/MIN at 29 degrees.

The above meets the criteria of a modeler wanting a fairly strong but not overpowered performance. This would be good in a scale model with spare power to get out of trouble. The prop is about 3⁄4 square and only slightly less than scale diameter (both indicators of solid setups). The pitch speed is good.

The Himax 5018-530 turning an APC 13x10E prop with a 6S battery pack yields 975 watts in, 43.7 amps, an 87% efficient motor, 99 watts in per pound with a 75 mph pitch speed and 93 oz. of thrust. The maximum climb angle is 43 degrees and the best best climb is 1583 FT/MIN at 29 degrees.

This is about perfect for a strong sport performance setup that's high, but not overboard, in the pitch speed department. This model will do larger diameter loops and feel pretty strong when flown outside of scale style. The rate of climb is good. It won't take too much distance for this setup to feel "on step".

The Himax 5018-530 using an APC 14x10 prop with a 6S battery pack yields 1120 watts in, 50.2 amps, an 86% efficient motor, 108 watts in per pound with a 69 mph pitch speed and 105 oz. of static thrust. The maximum climb angle is 50 degrees and best climb is 1786 FT/MIN at 33 degrees.

The above setup is stronger yet in steep climb lines, but a little softer on pitch speed. This is another setup I would consider ideal and strong sport performance capable. The prop is close to 3⁄4 square and at the scale diameter. Both are indications of a good setup.

A Change of Motors

The Himax 5030-390 (*5065-390, 395g*) using an APC 14x10E prop with an 8S pack yields 1321 watts in, 44.4 amps, a 90% efficient motor, 130 watts in per pound with a 76 mph pitch speed and 126 oz. static thrust. The maximum climb rate is 70 degrees and best climb is 2352 FT/MIN at 42 degrees.

This 8S setup is quite strong. Anything over a 2000 FT/MIN climb rate provides "very strong sport performance". This model requires a little more throttle skill to fly in a scale-like manor, yet it retains the ability to perform with some of today's strongest sport models.

The Himax 5030-390 using an APC 14x8E prop with a 10S pack yields 1886 watts in, 50.7 amps, a 91% efficient motor, 171 watts in per pound, a 72 mph pitch speed and 163 oz. of static thrust. The maximum climb angle is 90 degrees and best climb is 3226 FT/MIN at 52 degrees.

The above would be an extreme sport performance model. It would have almost unlimited vertical and be challenging to fly in a scale-like manner. How do you tame those watts? It is not something I'd suggest for this model, but a good example of what happens to your FT/MIN climb rates when you pump up the watts.

The number of setups that could be calculated for this are nearly unlimited.

I am offering some insight into some good quality, high efficiency setups and how I think through these problems.

After working out these power systems, I paused to read the rest of the article. I will try to apply the 16x10 you suggest as a starting point. (*Actually it was an APC 16x12E KM*)

The Himax 5030-390 using an APC 16x10E prop with a 6S pack yields 1027 watts in, 54 amps, an 88% efficient motor, 97 watts in per pound and a 65 mph pitch speed with 108 oz. of static thrust. The greatest climb angle is 54 degrees with the best climb of 1874 FT/MIN at 35 degrees.

The above setup is also very plausible for this model. I'd want to double check the ground clearance, as it is going over scale diameter by 2" and it's not likely they made the original gear much longer than it needed to be. However, I do like the pitch speed, FT/MIN climb rates and the fact the prop is 3⁄4 square. A good choice to be sure.

I am surprised that at 1000 watts in you found more than 60 mph pitch speed in this diameter. I'd only consider the larger 60 series motors here if it was needed for balance. It would be a bit pointless to add weight after choosing a low weight motor of course. To get down to 30 amps or so, you certainly would need to get into 60 series motors to get the Kv's low enough for the roughly 9S-10S packs you'd need to get the watts back up to 1000. However, you'd be carrying a lot of motor mass and potential (most of them are capable of 60 amps or more constant) that would not be put to work here.

My lines of thought here mostly agree with your suggestions here. I hope some find the read worthwhile.

Happy Flying!
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Check out my new blog site and pod casts:
http://www.radicalrc.com/blog/

Thank you Dave for sharing that with us and enlightening us even more!

I was extremely pleased when I received your email with this article in it. If I can get just one Ampeer reader to think about what they are reading, I feel that I've had great success with that issue. KM

Power for an AT-6

From Bill Mackey via email

Hi Ken,

Maybe you could take a look at some emails I sent to a company that sells electric RC motors. They are very dependable and responsible people. I have never had any problems with them but would like your thoughts on the emails. I bought a 60 size outrunner for an 8.5 lb. AT-6 that I have. Looking for about 900-1000 watts *in*.

Thanks,
Bill Mackey

Ken's reply:

First, let's look at your requirement of about 1000 watts in for your 8.5 lb. AT-6. Li-Poly cells have a nominal voltage of 3.7v per cell. That is not the fully charged voltage, which is 4.2v per cell or *the "top of the pack" measured voltage in the first few seconds of a motor run.*

*The nominal voltage may be used to **guesstimate** the number of cells needed at an approximate amp draw for a specific target watts in.*

*1000 watts in / 3S * 3.7 or 11.1v = 90 amps*
*1000 watts in / 4S * 3.7 or 14.8v = 68 amps*
*1000 watts in / 5S * 3.7v or 18.5v = 54 amps*
*1000 watts in / 6S * 3.7v or 22.2v = 45 amps*
*1000 watts in / 7S * 3.7v or 25.9v = 39 amps*
*1000 watts in / 8S * 3.7v or 29.6v = 34 amps*
*1000 watts in / 9S * 3.7v or 33.3v = 30 amps*
*1000 watts in / 10S * 3.7v or 37v = 27 amps*

As you can see, there are a lot of ways to get there from here! Which way to go?

Many folks select the number of cells and amp draw based on what ESC or what battery packs are already on hand.

In your case, you already have the motor. http://www.headsuprc.com/servlet/the-1955/Power-Up-60-400kv/Detail

From their Web page, generically (exterior diameter mm, length mm - Kv, wt. in grams) it is a 5060-400, 371g. It characteristics are quite similar to the Himax 5030-390 that Dave Thacker discussed. Comparing the generic names of 5060-400, 371g for the Power-Up 60 with the 5065-390, 395g for the Himax 5030-390 shows that the can is 5mm longer on the Himax, the Kv is close enough to call it the same and there is only a 24g (0.85 oz.) difference in weight.

Your estimated flying weight is also almost the same as the example used by Dave, so all of his comments actually apply to your motor and airframe as well.

*A 371g motor weight indicates that it is a useful outrunner brushless motor for between (371g * 1.75 watts in/g of motor weight =) 649 watts in (low end) to (371g / 3.0 watts in/g =) 1113 watts in (high end). On their Web page, the supplier states, "Watts = maximum of 1400 watts for 60 seconds". That really tells us nothing except that 1400 watts in / 371g = 3.77 watts in/g of motor weight. Many, including myself, consider 3.77 watts in/g to be excessive, except for "burst" flying like 3D and racing. Your 1000 watts in target is pretty close to the acceptable maximum for this motor. It will be working quite hard, creating quite a bit of heat or wasted energy.*

****

Bill's initial email to them:

Hate to bother you on Sunday, but my Power Up 60-400 Kv isn't giving me the numbers I had expected. Using a 5S1P 3000mAh 20C Li-Poly at 20.4v with an APC 16x8 prop, I get, after 10 seconds, 620 watts @ 33 Amps (*620 / 33 = 18.788v or 3.75v per cell KM*). Using your published data I should be getting 720 watts. I'm going to try a 6S1P battery, but I don't see how using 20% more voltage will give me anymore than 750 watts max. Your data shows 1200 watts.

Their response is paraphrased in red:

Compared to yours, a higher C rated and larger capacity battery was used to do the tests. Using a similar battery should yield approximately the same results. 700 watts might be possible with the 5S1P 3000mAh 20C pack by using a larger diameter prop. That battery will heat up a lot during use.

Ken's reply:

Their data appears to be a bit "off". According to their Web page, "APC 16 x 8E: 137 oz thrust at 36 amps (720 watts)". 720 watts in / 36 amps = 20 volts or 4 volts per cell. 4 volts per cell is NOT a very good place, in my opinion, to measure data and present it to the buying public. While today's Li-Poly cells are pretty good at delivering the power, the 4v per cell will not last very long, even on the best cells at that amp draw. Your 3.75 volts per cell seems quite reasonable for the "size and capacity" battery you used.

Going to a 6S 5000mAh Li-Poly, using the APC 16x8E prop you already have, should get the amp draw and watts in right about your target of 1000 watts in or just a bit more.

Bill's reply back to the supplier:

As always, Thank you! I just happened to have that battery available. However, I thought that "if you are only pulling 40 amps and had a 60 amp battery" (such as the one I used) you were in good shape. Can you give me one more answer? How does having a 147 amp "capacity" give you more amp draw? Or watts?

The supplier's paraphrased response:

A 3000mAh battery may be rated at 20C but that is the maximum. That battery will get hot at a

40 amp draw. Heat damages batteries. Use 50% of what the battery is rated for. For the 3000mAh 20C, that would be 30 amps maximum.

Ken's reply to Bill:

*I agree with that statement, except that I use the 10C rule, like Tom Hunt, for ALL Li-Poly batteries regardless of the manufacturer's C rating. Therefore, for your 3Ah pack I would not use it at a higher than 30 amp draw static. (3Ah * 10).*

That is why I mentioned a 5000mAh (5Ah) 6S pack, as the expected amp draw "should" be around 50.

Bill again to the supplier:

Can you give me one more answer? How does having a 147 amp "capacity" give you more amps draw? Or watts?

Their response:

They used a milkshake analogy. My response explains it.

Ken's reply:

I really liked the milkshake analogy, except he forgot one thing. The milkshakes are two different sizes or capacities and one milkshake is thicker than the other. The thickness represents the resistance.

Let's say you really like milkshakes and the doctor says it is okay to have one on occasion. You are presented a 4 oz. glass of a really think milkshake and an 8 oz. glass of a little bit thinner milk shake. Also, the 4 oz. glass has a smaller straw diameter than the 8 oz. glass. The straw diameters represent the battery resistance along with the thickness of the liquid. The smaller the battery, the higher the resistance is, that is why you are stuck with a smaller diameter straw in the thicker shake. No fair moving the straws or thinning the 4 oz. shake! You will need to suck harder and longer on the smaller straw to get the same volume of milkshake into your mouth before you swallow compared to the larger diameter straw in the 8 oz. shake. If the milkshake is a battery, the harder sucking means more heat. If you drank only the 4 oz. glass, you would have worked harder (sucked harder) than drinking the 8 oz. glass and you'd not be as satisfied. That means that you would have not have had the same amount of time to enjoy your milkshake (fly) and the work you were doing (flying) would have created more wasted energy.

*It really is about **both** C rating (larger diameter straw as the C rating goes up) and capacity (thickness of the shake).*

Using Drive Calculator with a somewhat similar motor and prop combination (E-flite Power 60 & APC 16x8E):

6S True RC 4000mAh 15C 44.8 amps, 20.72v,, 928.9 watts in

6S BlackLine 3800mAh 35C 46.8 amps, 21.14v, 980.2 watts in

Notice that the voltage goes up and therefore the amps and <u>watts in</u>.

Using Drive Calculator with the same motor and prop combination from above:

6S SLS-APL 3000/45C 46.0 amps, 21.04v, 967.5 watts in

6S SLS-APL 5000/45C 47.3 amps, 21.41v, 1012.9 watts in

Again, notice that the voltage goes up and therefore the amps and <u>watts in</u>.

Either way gets you there, and in some ways, they are actually related.

One thing that is interesting to note is that the 3800mAh 35C pack "does slightly better" than the 3000mAh 45C pack, so it is not just the C rating, as implied by the answer of the motor supplier.

A final email to me from Bill:

Thanks Ken,

I didn't think that two batteries of sufficient size and voltage would change the power due to "C" ratings. Live and learn.

I didn't mention the company, but it's Heads Up RC in Florida. Good prices, quick service, quick response to email and $2.00 shipping. Bought two motors costing roughly $98.00 and there was only a two dollar shipping fee!

Thanks again for your expertise.

Bill

Diameter to Pitch Ratio or Pitch to Diameter Ratio

By Ken Myers

Keith Shaw called on the Friday after Thanksgiving. We considered going flying, but it was just too windy. We had a nice long chat that included the fact that A123 Systems, Inc. has come out with a new 26650 M1b battery with a 2500mAh rating (http://www.a123systems.com/products-cells-26650-cylindrical-cell.htm) and also about why we see so many folks using what we consider to be "under-pitched" props, those with a less than 50% pitch to diameter ratio, on electric sport and sport-scale models.

I decided to look into that topic a bit more.

Here is what Keith said about diameter to pitch ratios in his landmark article "Electric Sport Scale" in the July 1987 *Model Builder* magazine.

"Another factor to consider is the diameter/pitch ratio of the prop. A 1:1 ratio may be usable for high speed pylon racers, but for scale planes and aerobatic types 1.3:1 (*i.e. 1.3 x 6" pitch = 7.8" diameter KM*) to 1.7:1 (*i.e. 1.7 x 6" pitch = 10.2" diameter KM*) are better ratios. For high drag or slow-flying aircraft a 2:1 ratio is more suitable (*i.e. 2 x 6" pitch = 12" diameter KM*)."

Another way to look at the same thing is by calling it the pitch to diameter ratio, as Bob Boucher does in the Electric Motor Handbook. i.e. 8" diameter x 0.77 [that is the inverse of 1.3] = 6.16" pitch; 10" diameter x 0.59 [inverse of 1.7] = 5.9" pitch; 12" diameter x 0.5 [inverse of 2] = 6" pitch.

Using that method, the pitch is then a percentage of the diameter.

Dave Thacker alluded to this in his article when he mentioned 3/4 and 2/3 pitch to diameter ratios.
3/4 = 0.75 or 75% of something
2/3 = 0.67 (rounded) or 67% of something

What Keith is saying is that for high speed pylon racers a diameter * 1 (square prop) is suitable, just as Dave noted. i.e. 12x12, 10x10, 8x8, etc.

For scale and typical fly on the wing electrically powered sport models the pitches of the diameter * 0.59 to the diameter * 0.77 works well. i.e. 12x7 to 12x9 or 10x6 to 10x8, etc. Of course it could just be round to pitches equalling 60% of the diameter to 80% of the diameter.

For "draggy" models like scale biplanes, old-timers and scale models of some civilian aircraft that should not appear to be flying too quickly, the diameter * 0.5 usually works well. i.e. 14x7, 12x6, 10x5, 8x4, etc.

There are several valid reasons to use pitch to diameter ratios of under 50% with electrically powered planes. Several types of planes and flying did not exist when Keith made his original statement back in 1987.

3D type flying, both electric powered and internal combustion engine powered, has become quite popular. During much of what is typically called 3D flying the aircraft is flying on the thrust from the propeller more than "on the aerodynamics of the wing." In some ways, the 3D plane is flying more like a helicopter than a winged aircraft. 3D flying also tends to be airspace limited.

Flying in a limited airspace requires a slower air speed to stay within the confines of the limited airspace. Other types of electrically powered planes are frequently flown in limited airspace. They are often known as electric indoor, backyard and park flyers.

The table on page 2 can be referenced for typical median pitch speeds for the various "types" of planes at given wing cube loading (WCL) levels.

What used to be considered "normal" RC flying was usually done at a radio controlled RC club flying field. It was done with aircraft whose typical pitch speeds were between 50 mph and 75 mph. Of course there were exceptions. There are always exceptions!

With the advent of Park, Backyard and Indoor electric flying in limited airspace, the speeds were reduced to keep them within a confined area.

The "smaller" electric motors typically used by Park, Backyard and Indoor planes tend to have a higher Kv compared to the motors used in larger, heavier, faster flying electrically powered models. Overall, smaller electric motors have a higher Kv (RPM per volt) than larger motors. Again, there are exceptions!

Lowering the voltage applied to the motor helps to reduce the pitch speed. and thus the airspeed, by lowering the RPM. Large ratio gearboxes help by lowering the RPM and allowing larger diameter props to be used.

The relatively small E-flite Park 250 outrunner has a 2200 Kv, according to the manufacturer.
http://www.e-fliterc.com/Products/Default.aspx?ProdID=EFLM1130

It is rated for a maximum continuous current draw of 7 amps. The following numbers are NOT measured but representative and taken from Drive Calculator.

http://www.drivecalc.de

It should be noted that E-flite does NOT recommend using 3S Li-Poly packs with this motor. The 3S pack is used for illustration purposes only. The props were matched as closely to a 7 amp draw as possible without going over it.

3S

3S 700mAh Li-Poly, APC 4.2x4E, 16140 RPM pitch speed 61 mph (too fast for limited airspace)
3S 700mAh Li-Poly, APC 6x2 C-2, 15,800 RPM pitch speed 30 mph (too fast for typical indoor but might be okay for backyard or park)

2S

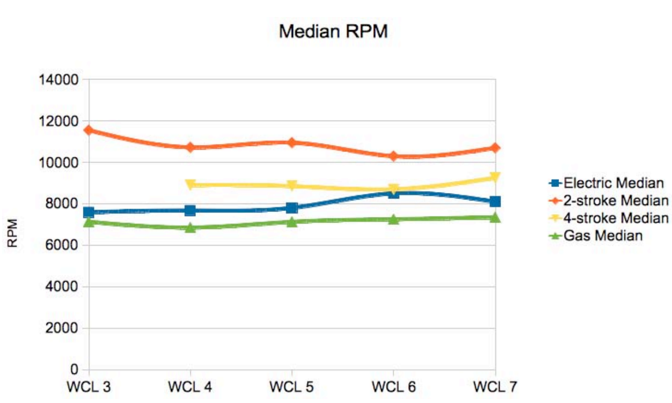
2S 700mAh Li-Poly, 6x6 Graupner Speed, 9253 RPM pitch speed 53 mph (too fast for limited airspace)
2S 700mAh Li-Poly, APC 7x3 Master Airscrew GF/3, 8975 RPM pitch speed 25 mph (good for even indoor limited airspace)

Notice that in both instances, 3S (~16,000) and 2S (~9100), the RPM is close to the same for either prop.

At a given amp draw using the same motor and power supply the RPM will be the same. The required watts in and the watts **out** will be the same. The motor has no clue as to what the various props are doing. It just knows that it is doing the same work.

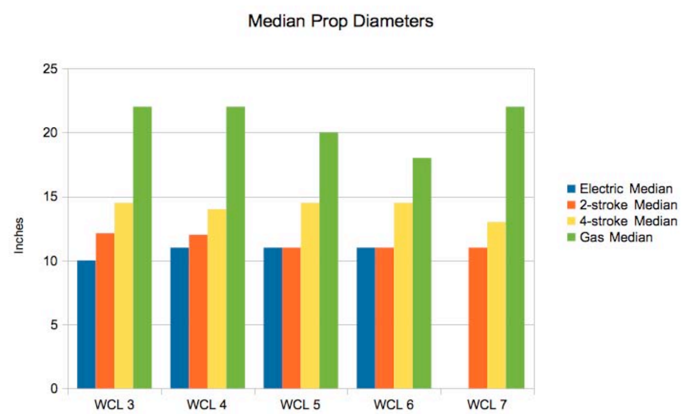
As far as the motor is concerned, there is no difference between the 6x6 and the 7x3, yet the outcome, the way it flies the plane, the type plane and its mission, is very different.

Understanding and Using the Power Source



The "Median RPM" graph shows the median RPM for wing cube loading (WCL) levels 3 through 7. This area is where electric power and internal combustion power systems intersect. Using the median means that 1/2 the planes in a given CWL level have lower RPM and 1/2 have a higher RPM. It is used as a point of reference.

The graph shows that 2-stroke glow engines have the highest median RPM and gasoline engines the lowest.



The "Median Prop Diameters" graph illustrates that gasoline engines have the largest median prop diameter with the 4-stroke engines the next largest median diameter. The 2-stroke electric and glow are about the same diameter at WCL Levels 5 and 6, but the electric median diameters are less than the 2-stroke at WCL levels 3 and 4.

	Median Pitch Speeds			
	Electric	**2-stroke**	**4-stroke**	**Gas**
WCL 3	41	57	52	57
WCL 4	**49**	**71**	**62**	**58**
WCL 5	57	70	61	54
WCL 6	**61**	**67**	**63**	**67**
WCL 7	63	77	67	NA

The "Median Pitch Speeds" can be used to illustrate why electrically powered planes, that fly on the wing, need to use higher pitch to diameter ratios.

Using WCL Level 5 (10 oz/cu.ft. to 12.99 oz/cu.ft.) as an Example

Electric: median RPM 7800, median pitch speed 57 mph, median prop diameter 11-inches
57 mph * 1056 = 60192 / 7800 RPM = 7.72 inch pitch or 11x8 prop, 8 pitch / 11 diameter = 0.727 or a 72.7% pitch to diameter ratio.

2-stroke: median RPM 10950, median pitch speed 70 mph, median prop diameter 11-inches
70 mph * 1056 = 73920 / 10950 RPM = 6.75 inch pitch or 11x7 prop, 7 pitch / 11 diameter = 0.636 or a 63.6% pitch to diameter ratio.
4-stroke: median RPM 8700, median pitch speed 61 mph, median prop diameter 15-inches
61 mph * 1056 = 64416 / 8700 RPM = 7.4 inch pitch or 15x7 prop, 7 pitch / 15 diameter = 0.467 or a 46.7% pitch to diameter ratio.
Gasoline: median RPM 7125, median pitch speed 54 mph, median prop diameter 20-inches
54 mph * 1056 = 57024 / 7125 RPM = 8 inch pitch or 20x8 prop, 8 pitch / 20 diameter = 0.4 or a 40% pitch to diameter ratio.

As the diameter is increased, to reach a given pitch speed, the pitch to diameter ratio decreases.

Pitch speed is NOT airspeed. Do not confuse the two.

The data indicates that "typical" RC sport and sport-scale planes, flown at "typical" RC flying fields have pitch speeds between 50 and 75 mph. Selecting a pitch to allow for those pitch speeds is a good starting point. The median and average pitch speeds in the table on page 2 provides a good starting point. Following Keith's advice still applies to these types of planes as well.

Determining the Diameter and Pitch

From "An Easy Way To Select an Electric Outrunner Motor Power System for an ARF, Kit or Plans Built Glow Powered Prop Plane"

http://homepage.mac.com/kmyersefo/Glow2Electric/2011-Glow2Electric.htm

Here is what I actually said in the article. It clarifies why I recommended a 16" diameter for Bill's AT-6 in the December 2011 *Ampeer*.

Step 2: Determine prop diameter

The electric prop diameter is based on a relationship to the 4-stroke Standard Propeller diameter. To determine the prop diameter, add 2 inches in diameter to the 4-stroke recommended Standard Propeller.

The example model's (*BUSA 1/4-scale bipe KM*) recommended 4-stroke engine is a 1.20. The chart shows a 16" diameter propeller as the Standard Propeller for this engine. 16" + 2" = 18" (Input B20)

If only a 2-stroke displacement is given by the supplier, multiply it by 1.5 for a 4-stroke equivalent displacement. It will be close enough. Round to nearest actual 4-stroke displacement found in the chart.

No 4-stroke .30 is shown in the chart, but a 10" diameter prop would be standard.

Engine Size	Standard Propellers
.20 - .21	9x6
.40	11x6
.45 - .48	11x6
.60 - .65	12x6
.80	13x6
.90	14x6
1.20	16x6
1.60	18x6
2.40	18x10
2.70	20x8
3.00	20x10

What if the suggested 4-stroke diameter doesn't allow enough ground clearance?

If the plane has a tricycle landing gear configuration, or for some other reason, a prop with the suggested diameter can't be used using the 4-stroke method, add 2 inches of diameter to the suggested 2-stroke glow engine prop diameter.

Engine Size	Standard Propeller
.049	6x3
.09	7x4
.15	8x4
.19 - .25	9x4
.20 - .30	9x6
.35 - .36	10x6
.40	10x6
.45	10x7
.50	11x6
.60 - .61	11x7
.70	12x6
.78 - .80	13x6
.90 - .91	14x6
1.08	16x6
1.20	16x8
1.50	18x6
1.80	18x8
2.00	20x8

A typical tricycle landing gear, high-wing or shoulder-wing, glow 40 trainer might use a .40 or .45 2-stroke engine using a 10-inch diameter prop. (see table) A 12-inch prop diameter should be a usable.

The diameter range for Bill's .60 2-stroke or .90 4-stroke AT-6 (and the similar Ryan STA from last month), based on the above, would be 13" (2-stroke .60 11" + 2") to 16" (4-stroke .90 14" + 2").

I have placed the Excel workbook for the Ryan STA online. It also applies to Bill's AT-6. It can be accessed at
http://homepage.mac.com/kmyersefo/ampjan12/ryan-sta.xls

The December 2011 EFO Meeting

The EFO meeting was held on December 8 at Ken's house.

Richard Utkan lead off the meeting showing his Dynam A-10 Thunderbolt II EDF that he purchased from NitroPlanes.
http://www.nitroplanes.com/60a-dy8933-a10-grey-arf.html

He replaced the supplies hinges with "real" hinges with pins. He also has a latex military pilot that he's added to the cockpit, as the supplied civilian pilot did not look right!

One of the suggestions from the group was to switch the elevator control horn to the top of the elevator and turn the elevator servo arm 180-deg. (He's already done that.) That will keep the control horn out of the way for belly landings.

Denny Sumner brought along the canopy plug to his LoPresti Fury. His design and build thread is on RC Groups.
http://www.rcgroups.com/forums/showthread.php?t=1511865

Denny's model is 1/7-scale and spans 50".

Jim Young ran us through how to prepare the plug for vacuum forming.
1.) Cover the plug with 1/2 oz. or 3/4 oz. glass cloth using West Systems or Zap Epoxy finishing resin.
2.) Use Duplicolor heavy fill primer on it and then send with 200 grit, then 400 grit, then 600 grit and finally 2000 grit sandpaper.
3.) Use West Systems 410 Light filler to fill any small voids. It sands like balsa.

Ken Myers showed a portion of a Modern Marvels program on Remote Control. The segment was on RC model flying. The group picked out some errors in the segment. It was interesting to see RC flying featured on Modern Marvels.

Ken shared his progress on the wings for his Balsa USA 1/4-scale EAA biplane. He also noted how poorly the plans were done.

Jim Young had drawn up some plans for **Bill Brown** to build a model of a Wright Model B. The

(cont. on page 10)

Upcoming E-vents

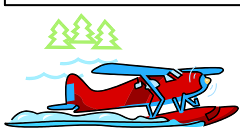
Jan. 5 EFO meeting, 7:30 a.m., Ken Myers' house. Everyone with an interest is welcome to come.

(continued from page 9)

plane is modeled after a replica found at the Wright-Patterson AFB in Dayton. Jim shared the plans and went over the features that he'd designed into it.

Ken also told about how well his 3S "A123" 2300mAh pack is doing after being lost in the elements for over six weeks, but that's another story.

It was a great night with a lot of fun, learning and sharing. Feel free to join us at our January meeting!



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The Next Monthly Meeting:
Date: Thursday, Jan. 5, 2012 **Time:** 7:30 p.m.
Place: Ken Myers' house (see address above)