TRI-COUNTY WINGSNAPPERS

THE CONTROL TOWER NEWSLETTER

AMA 573, IMAA 138 www.tcws.org June 2006

In This Issue:

REMINDER – The June meeting has been moved to June 11th due to the Giant Scale Fun Fly on the 17th & 18th! Meeting will be held at the TCWS field! IMPORTANT THAT YOU ATTEND!

NEXT MEMBER MEETING: SUNDAY, 11 JUNE 2006 @ 1:30 PM TCWS CLUB FIELD

DIRECTIONS TO MOOSE LODGE:

Hamburg Exit from Route 22
2nd Floor, 12 South 3rd Street, Hamburg, PA

OFFICIAL FIELD LOCATION ADDRESS:

Tri-County Wingsnappers, Inc.
329 Balthaser Road
Lenhartsville, PA 19534

Tri-County Wingsnappers, Inc.
c/o David Kilmer
8-6 Heather Hts.
Reading, PA 19606

President's Message…

Dear TCWS Members,

I regret to inform you that, as a result of the review of our club financial records, Dale Loop has resigned as our club treasurer. To fill this position, I've appointed Donald Umbenhauer as Treasurer.

Please attend our next meeting on June 11th! I will ask for a membership approval vote, consistent with our bylaws, to approve Don's appointment to the office of Treasurer. I will also provide more details regarding the club financial review.

Walt Gladney will take Dale's place as CD for our upcoming Giant Scale Fun Fly on June 17th. We will need volunteers to help out at this event. Again, please attend the June 11th meeting to discuss this!

On a lighter note… our Da Vinci Discovery Center Display and Demo went very well. It gave our club some good exposure to the general public, including a 15 second spot on WFMZ's 6pm news on Saturday! Everyone attending the event, including our members, thoroughly enjoyed it! Thanks to all of you who worked the event and/or loaned us planes/helis for the display! And a special thanks to Jeff Shriver and his wife for arranging this event!

It sounds like the Da Vinci Center is inviting us back for another diplay/demo this year over the Columbus Day weekend in October! I'll pass on more info when it's available!

Best Regards,

Paul Hartley

Editor's Two Cents

Thanks to Dan McCoach for this month's article. If you're into electrics (or want to be) Dan has done a great job explaining how to easily figure out how to calculate power, battery, and prop requirements for a 90-100-size plane like the ones he flies frequently at our field. Due to the length of the article, and the helpful graphics he provided to illustrate his points, it seemed unfair to constrain it to my usual two column format, so we've appended the article in its original layout to the end of the newsletter so you can get the full benefit of Dan's expertise.

On a personal note, Dan was kind enough to let me fly his red and yellow 3-D plane described in the article. What a treat! I was just happy to do some basic maneuvers on low rates, but even then, I could tell I had a tiger by the tail! Dan's talent is especially evident when you realize he designed and built that plane himself! Thanks, Dan, for trusting me with your plane (and for not screaming audibly when I almost lost it for you!).

Until next month, I'm off to try to convince Composite ARF to send me a 42% YAK-54 fully kitted out for…….. …uhhh….review purposes….yeah, that's it!

David Kilmer

Club Secretary

iflyslow2002@yahoo.com

****

Unofficial Meeting Minutes...21 May

President Paul Hartley called the meeting to order at 1:30pm at the TCWS Club field. (14) members and (1) associate member were present.

The 50-50 drawing was won by Dave Renninger who graciously donated his winnings back to the club.

David Kilmer read the minutes from the March meeting, and no additions or corrections were made. Motion was made to approve by jim Ellis, seconded by Jim Pauley, and approved unanimously.

Treasurer's Report: Dale Loop read the treasurer's report as of 21 May. Jim Ellis moved to accept, George Case seconded, and the club voted unanimously to accept the report.

OLD BUSINESS

Field Care: No updates.

Union Fire Company Lawsuit: No news since last report.

2006 Events: Sign-up sheets are now posted for the Giant Scale Fun Fly. Also, there are flyers available for the August Pig Roast. Contact a club officer for copies if you'd like to post some of these in your area.

New TCWS Event – Memorial Day Display and Flight Demo at DDC (DaVinci Discovery Center): Sign-up sheets were passed out for those willing to offer planes for display or to volunteer their time at the event.

New Shed – A savings account was set up to be used as a building fund. If you care to donate toward this project, please designate your donation as being for that purpose so it doesn't go into the general fund.

Leader Club Status: No updates.

Audit Update- The club has been set up with Quicken, and all data from existing financial reports and the checkbook register were entered. Paul Hartley went through the data and helped correct errors he was able to locate at that time. It was reported that bank statements from 2004 to present were not available at that time but would be acquired from the bank. Once all the financial information is in the standardized format, we will be able to generate annual reports, which will be made available to the club at the next meeting. The Board of Directors will be provided with copies of the reports as soon as they are available.

Refrigerator: As previously reported, the existing fridge is still operating, but based on past experience, it is not likely to last much longer. So far, $450 has been pledged to buy a replacement fridge ($300 from Lee Buskirk, and $50 each from John Messersmith, Jim Ellis, and Terry Miller). Donations are needed and welcome as the cost will likely be close to $600.

NEW BUSINESS

BCTV Donation – BCTV is soliciting a donation from the club. Paul Hartley proposed that we offer a similar donation to last year ($100). Dave Renninger made a motion to do so and Jim Pauley seconded. The members voted unanimously to approve the donation as proposed.

Adding Safety Benches – Paul suggested that we build 2 or 3 new benches to be added to the ends of the existing row. After some discussion, the proposal was tabled until a future meeting.

Williams Family Restaurant Display - Dave Renninger has loaned a Hangar 9 P-47 ARF for display at the Williams Family Restaurant at 9th and Exeter in Reading. Bud Wunder also provided the restaurant with maps to our field since the display has generated interest. Dave showed pictures of the display, which also includes various military memorabilia, uniforms of local veterans, etc. I hear there's also a picture of a certain map-giving member in his younger days in uniform! Go check it out!

Web Site – George Case noted that the web site needs updating. Anyone who has the ability to redesign the web site should notify Paul.

ANNOUNCEMENTS: Next meeting will be Sunday, June 11th at the TCWS field. THIS IS A WEEK EARLIER THAN NORMAL, SO PLEASE MARK YOUR CALENDAR!!

Motion was made by George Case to adjourn the meeting. Jim Ellis seconded, and all present voted to close the meeting.

****

What a Fun Day!

By David Kilmer

Recently, the Club had the pleasure of participating in a two day display of members' planes at the DaVinci Discovery Center in Allentown. Thanks to Jeff Shriver and his lovely wife, the club was able to "show the flag" and to present our hobby in a positive light to parents and children in the area. At the same time, we hopefully planted the seeds of interest for potential future club members.

TCWS had an entire large room to itself, and the perimeter was lined with a wonderful variety of some of the finest models our members had to offer. It really was impressive, and showed off the skill and craftsmanship possible in the hobby today.

Just a piece of the display room at the DDC

Another impressive feature of the display area was the inclusion of not one, but two large projection TV's, on which Michael Umbenhauer was showing a steady rotation of videos throughout our time there. On the left screen were DVD's featuring past Top Gun events, and on the right screen were a series of "crash" videos, showing a spectacular variety of methods to re-kit r/c airplanes.

In addition, there was a terrific display provided by Paul Hartley (which originally debuted at the Hamburg Swap Meet) showing off the TCWS facilities, directions to the field, and offering flyers that showed interested parents and kids how to get into the hobby. Also on this table was a brand new HobbyZone RTF plane that was donated by the Allentown Hobbytown USA store. Sales of raffle tickets for thios plane raised an additional $115 for the club (it was eventually won by Jim Messinger, who also works at DDC!).

Outside, meanwhile, there was plenty of other activity going on! About every half hour, several club members were able to perform flight displays of several aircraft, much to the delight of the kids and parents who consistently filled the bleachers. John Messersmith flew his U-Can-Do 46, showing off its agility and slow flight capability, while remaining safely within the available flying area. John always amazes me with his ability to manage almost any wind with his planes, and this was no exception. I only wish I could land a plane in a crosswind as consistently as he does!

Paul Hartley added to the fun with demo flights of one of his helicopters. I noticed he stayed away from any 3-D maneuvers, but I have confidence we'll see him get inverted one of these days! But seriously, Paul's flights offered a nice contrast to the antics of John's UCD. For kids that had never seen a model helicopter hover and move slowly around in a controlled fashion, this must have been a treat!

Jeff Shriver also contributed, with flights of his profile Mustang with a fat symmetrical wing that was just made for 3D. Jeff really made this beast dance, tumbling and rolling

through the sky, seemingly on the edge all the time, yet he had total control. Like John's UCD, this plane was ideally suited for the tight confines of the available display area.

Finally, yours truly was thrilled (and a little scared!) to contribute with several flights of the Great Planes Siren I wrote about last month. Flying with an audience is easy for some (Paul, John, and Jeff seemed unfazed), but I admit I had a little stage fright. Even so, once the plane was airborne, I forgot about the strangers, and concentrated of keeping my plane out of the trees across the field! Besides, nobody was even paying attention to me…although they did seem pretty impressed by the **whoosh** of my glider as it pulled out of a vertical dive!

If the applause of the crowd was any indication, the flight demos were a big success, and provided Paul , John and Jeff several opportunities to answer questions from the peanut gallery and explain a little of the science behind the flying.

OK…so it wasn't a HUGE crowd….

All in all, it seemed like everyone had a good time, and the folks at the DaVinci Discovery Center couldn't have been more accommodating and friendly. Our gratitude goes out to Jeff's wife too, for helping to make this happen! I hope our club has more opportunities like this to showcase the positive aspects of this hobby in the future!

****

UPCOMING R/C EVENTS

June 17th & 18th : Giant Scale Fun Fly at TCWS club field.

****

CLUB OFFICERS

Paul Hartley - President 610-730-1029
tcws@pkhartley.com
Terry Miller - Vice President 610-944-0300
trmflies@ptd.net
Dave Kilmer – Secretary 484-431-4700
dc.kilmer@verizon.net
Don Umbenhauer - Treasurer 610-670-2844
dumbenhauer@neapco.com
(pending member approval vote)

BOARD OF DIRECTORS

Vince Indelicato (12/31/06) 610-845-3222
vince@southeast-pa.com
George Case (12/31/07) 610-264-9782
gcase@enter.net
John Messersmith (12/31/07) 610-562-4767
blu-ftas@comcast.net

BUILDING & GROUNDS COMMITTEE

Dennis Christman -Chairman 610-562-3680
christmanlake@aol.com
George Case 610-264-9782
gcase@enter.net
Dave Renninger 610-374-2306
xxspeed@comcast.net
Terry Miller 610-944-0300
trmflies@ptd.net
Lee Buskirk 610-751-1464
lbjms@verizon.net

FLIGHT INSTRUCTORS (INTRO PILOTS)

Jim Ellis 484-951-4322
racer8297@verizon.net
Lee Buskirk 610-751-1464
lbjms@verizon.net
Greg Sheets 610-737-2246
Sheetsg77@msn.com
Dave Renninger 610-374-2306
xxspeed@comcast.net
Erik Rudjord (Turbines) 610-285-2176
erudjord@ptd.net
Paul Hartley (Helicopters) 610-730-1029
tcws@pkhartley.com

FIELD MARSHALS

Kip Daubert
spinrb8@webtv.net
Jack Hilbert 610-767-6938
jdhilbert@aol.com

SAFETY OFFICERS

Kip Daubert
spinrb8@webtv.net

Larry Dunkle
larry4113@netzero.net

MEMBERSHIP OFFICER

Lee Buskirk 610-751-1464
lbjms@verizon.net

Electric Power for 90 to 100 Scale Models

By Dan McCoach

Introduction

Well, hat's off to Paul! I read his article on electric power in last month's news-letter where he said he is "*…far from an expert on the topic…*" but I was impressed and think he is quite knowledgeable, don't you? Paul also asked me to write a follow-on article and perhaps explain what is required to "electrify" larger, 90 to 100 size models. I am happy to (hopefully) contribute because I am a bit passionate about electric flight and aerobatic airplanes. Also, I find 90 to 100 sized airplanes (usually approximating 20% scale) convenient to haul around, quick to set up and "just large enough" for honing flying skills without a large-scale commitment. Furthermore, this is a good time to for me to discuss my approach to larger-scale electrics because I am currently choosing a new power system for an even larger bird (Chip Hyde's 80-inch Tunnel Vision) that I hope to have out to the field soon. So I will do my best to explain my own thought process and calculations as I select the largest electric power system I have assembled to-date.

Before I begin, I am not an engineer (as is Paul and other well qualified club members who may read this), so I need to remind you of this to qualify all that I am about to say. I will however try to convey some real-world experience, my approach, philosophy, and several calculations I have accumulated over a few years. As an additional qualifier, you may notice that I rely on "higher-amp" (usually defined as above 70 amps) and lower-voltage setups than you may see publicized in other sources. I do this for reasons that I will try to explain later in this article. You will also notice that I reference Steve Neu's motors throughout my examples (www.neumotor.com). I do this for no reason other than I like them and have purchased a few – you can repeat the calculations and selection process with any type/brand you wish. Finally, I may retrace a few steps Paul outlined, but will do so with larger motors, batteries and speed controllers (uh oh, you are thinking – "what's a speed controller?" – hang in there, we will get to the components soon).

Electric Power

First, some basics on how to develop a mind set for thinking about electricity as a power source for flight – it's all about watts… and specifically *the watts that finally make it to the propeller*. With Nitro or Gas, we traditionally think in terms of horse power (HP). However, with electricity as a power source, we think in terms of watts because watts are power. And the math to calculate watts is simple:

Watts = Volts x Amps

As a real world example, many of the "foamies" so popular at the field are in the 125 to 250 watt range. That is to say, they (typically) have 11.1 volt Lithium Polymer batteries (to be explained later), with motors that are drawing 15 to (maybe) 25 amps (at full throttle depending on how "hot" the motor is – more on that later too) driving 9x6 to 11x7 propellers. So the math is: 11.1 volts x 15 amps = 199.8 watts (full throttle) consumed by the motor. However, the watts that go into the motor must be reduced by its inefficiency to determine how many "leftover" watts are making it to the propeller (less any gearbox losses if you are using one). We typically lose about 15% to 20% of our power in these little setups, so maybe 169.8 watts are making it to the propeller (199.8 x 85% = 169.83 watts, again at full throttle). By the way, what happened to the 30 watts lost? They become heat due to both resistance within the motor and any gear box losses. And how much energy is 30 watts? Try holding onto a lit 30 watt light bulb to understand that energy. So you can see right away that efficiency is important. Look for brushless motors with high efficiency (above perhaps 83%). Scale up the numbers to see exactly how much heat you generate for inefficient motors if you are, running, for example a 2,000 watt motor!

Batteries and Capacity

I assume you know what volts are since, as a kid (or maybe recently!), you stuck your finger in an electrical outlet and felt 110 of them in alternating current form, but what are the amps in the equation watts = volts x amps? Amps can be thought of as a rate of flow, and as capacity, or, for comparison, like the size of your nitro fuel tank. Here's an example: some of you may see me walk around at the field with a large Lithium Polymer (LIPO) battery pack and many have asked "how big is that?" I respond by saying "8 amp hours" (8,000mah). This means the electrical "tank" of the battery will deliver 8 amps at its nominal voltage (in this case 11.1 volts) for one hour… So, I have a "fuel tank" that provides 88.8 watts of power for exactly one hour if I drained the battery to zero volts (8 amps x 11.1 volts nominal = 88.8 watts). By the way, for LIPO cells 3.7 volts is nominal, 4.2 volts is fully charged, so a 3 series (3S) pack is 12.6 volts fully charged. However, never drain LIPO packs to below 3 volts per cell or they are severely impaired.

This one-hour discharge rate is also known as the "C" rating for the battery. 1C is equal to one (1) multiplied by its rated capacity – pretty simple math. So, in our example, a "1C draw" on the 8 amp hour battery is the draw required (88 watts) to discharge it completely within one hour. Often you will see advertisements for LIPO batteries with rating such as: 10C, 12C, 15C, or even 20C. What do these numbers mean? As an example, with my 8 amp hour pack, 10C = 80 amps, 12C = 96 amps, 15C=120 amps that can be drawn from the pack at any instant. LIPO battery packs are designated by an average and maximum C rating. As a further example,

with a pack designated at 15C maximum, and 12C average draw, at any moment your motor and speed controller may draw up to 15 times the LIPO pack's rated capacity in amps to make watts. *You may safely average 12 times its rated capacity in amp draw over the course of a flight.*

Again, as an example, with my 8 amp hour pack, it can supply up to 120 amps for usually about 60 seconds before it really heats up (8 amp hours capacity x 15C, or 120 amps x 11.1 volts = 1,332 watts maximum), and 96 amps average (1,065 watts) over the length of the flight into any motor that can handle those wattage levels. By the way, the heat a LIPO battery produces while discharging is important to monitor (draw the energy out quicker i.e. higher amp draw and it will get hotter). Exceed 160 degrees Fahrenheit and you will shorten the life span of the cells. Life span – what do I mean? Some tests (and I am not making any claims) indicate that we can expect between 300 and 500 cycles on the large LIPO packs assembled for model flight. So what is "shorter" – I have cooked a few and gotten maybe 50 cycles out of them.

C rating is also how battery chargers designate their charging "speed." In the case of LIPO batteries, most manufacturers recommend not exceeding 1C charge rates (again, exceed these rates and risk shortening the life of the pack and worst case – you can burn your house/car, etc. to the ground). For my battery referenced above, I do indeed charge it at 1C, which means I am putting 88 watts back into it at 11.1 volts for one hour (it actually charges in about 50 minutes since I never drain it entirely – to protect LIPO cells, they should never be drained to below 3 volts per cell, or they will "puff" up like mini-balloons and are ruined and can be dangerous in that state).

And how are LIPO packs assembled to achieve the various voltage and amperage ratings? By soldering individual cells in a combination of series and parallel connections to make (as an example) the 11.1 voltage and 8,000mah capacity we've been discussing. LIPO cells (which are currently the highest energy density cells for their weight) are manufactured as individual wafer-like cells, each with a nominal 3.7 voltage made to the capacity specified (the larger the cell the more capacity potential it will have). To communicate their composition, LIPO packs are designated (x)S(y)P where (x) = number of cells in Series and (y) = number of Parallel cells (when you put two cells in a series you increase voltage; in parallel – increases capacity). The example pack that I own carries a 3S4P designation which means that the pack is made up of three, 3.7 volt, 2,000mah LIPO wafer-cells, wired in series, with four of them wired in parallel (4 x 2,000mah = 8,000mah). So the 3S4P pack contains 12 wafer cells total. By the way, the manufacturer of the battery pack (in this case, Thunder Power: http://www.thunderpower-batteries.com/) does all of this soldering and assembly for you (thank goodness!) you just need to select the appropriate volt and capacity-pack for your motor/model.

Duration

Now that you understand watts (power), amps (capacity/flow), volts, and something about batteries and chargers, let's discuss flight durations. To do this we need a few more components in the airplane in addition to the battery, and another simple calculation. Specifically, we need an electric motor (to turn volts and amps into watts for the propeller), and an Electronic Speed Controller (ESC) to control the flow of volts and amps to the motor (throttle). At this point, we actually know our first duration data point – as shown above, with an 8 amp hour 11.1 volt battery pack, you could set your throttle stick at partial throttle "telling" the ESC to only allow enough volts into the motor to generate 88 watts of power, so you could fly – although very slowly – for nearly one hour. However, how would you determine duration for a motor, say, at full throttle, or a motor developing more than 88 watts using this same 8 amp hour pack (or for any pack)? With the following formula:

Duration in minutes = Battery Capacity (in amp hours) x 60 / amp draw of the ESC/motor

So an 8 amp hour pack delivering 120 amps (yikes! that's a lot of juice, we are probably at full throttle), will last 4 minutes. Here's the calculation: 4 minutes = 8 x 60/120. So if I flew my model at full throttle and drew 120 amps out of the pack and into the ESC/Motor with about 85% to 90% of 1,332 watts making it to the propeller, my flight would last four minutes (if the ESC/Motor are sized to handle 1,300 watts continuous – if not, I would land, and probably have ruined my battery and/or the ESC depending on the size of the motor.) But many set ups do indeed draw that kind of current and produce that many watts in 60 to 100 sized planes for vertical climbs that accelerate up! But let's say 4 minutes is too short and probably a little too fast (we never fly an entire flight at full throttle unless racing, and that is a whole different set of calculations and batteries for that kind of performance) and I want a tamer flight – let's try another example. I would like to fly for 10 minutes – that seems like a nice duration – what will my average amp draw need to be against a 3S4P 8 amp hour LIPO pack to get a 10 minute flight?

10 minutes = 8 x (60/y); solve for y and we have 48 amps

48 amps – that's a nice number particularly for a 12C rated 8 amp hour LIPO pack … And with 48 amps I am getting about 532 watts (less inefficiency) to the propeller – these are really good average numbers for all components involved.

"Motivating" an Airplane
Let's discuss some rules of thumb for how many watts one must put into a propeller to motivate or even "highly motivate" an airplane. In general, most electric pilots discuss watts per pound of airplane weight (Paul discussed watts/ounce in his article, but for large airplanes it is easier to convert ounces to pounds). The rule of thumb is that 50 to 100 watts per pound will fly an airplane "nicely" – which means for sport flying (no prop-hanging, at least not for long). And for many, many pilots, lower power levels are just fine. Many enjoy the nearly-silent flights finding the quiet experience relaxing, even elegant, and very rewarding. However, if you want to fly what is typically called "3D" performance (or if racing), you need to develop 150 to 200 (or more) watts per pound of airplane weight.

You will see these benchmarks mentioned frequently (watts per LB) in the electric model flight literature and web bulletin boards, but what is often overlooked is the empty weight of the model, and total weight once electrified. Because most of the RC airplane market is still for glow/gas models, it is easy to find a heavy airplane and jam enough batteries and motor into it to get 150 watts per pound. However, it is likely you will have created a model that weighs more than its glow/gas counterpart. Now, you may have 150 watts per pounds in your converted airplane, but 3D performance suffers -- 3D and "heavy" are incompatible.

In 90 to 100 sized airframes, what is "heavy?" As a part of the decision process, I like to also look at wing area with advertised weights to decide on the "light" options available. Most 90 to 100 size airframes are in the 60 to 70 inch span range, with 600 to 1,000 square inches of wing area. You will frequently see advertised glow fuel weights of 9 to 11 or even 12 pounds in this category. In my opinion, these are heavy birds. Instead, for a good electric conversion, look for a model in the 600 to 1,000 square inch range to be 4 to 5.5 pounds empty. Here is an example (although I am not sure of its empty weight, its advertised electric weight is good): http://www.hobby-lobby.com/telemaster6.htm (5.5 lbs flying weight is pretty good – this looks like a good electric "larger" trainer, and we certainly know the Telemaster heritage). Here is another good example: http://www.nesail.com/detail.php?productID=2978. There are many on the market, another good source for a simple and quick-to-assemble airplanes suitable for electric conversion are the many "profiles" out there from Ohio Model Products, and other manufacturers.

The lesson is to *become weight conscious when converting to electric*. Why? Because electric airframes do not have to put up with the vibration that fossil-fuel motors produce, so they CAN be lighter… Start with the lightest airframe weight you can find, and you will require fewer batteries, smaller electric motors, and will gain better all-round performance.

Actual Airplane Components and Calculations
So where are we? Oh yes, watts per pound… OK, some of you have seen my recent scratch build that is terrific fun that gives me about 10 minutes of hard 3D flight on that same 11.1 volt, 8 amp hour pack we have been discussing. The set up and motor performance for this 100-size airplane is as follows:

Airplane – 66in wing span, and about 950 square inches on the wing, it weighs 5.5 lbs with out a battery, and about 6.5 with that same 8 amp hour, 11.1 volt pack discussed above.

Motor - Neumotor 1509/1Y – motor weight about 8 oz (http://66.241.195.91/motors/neu1506.asp?path1=motors&path2=neu) The 1509/1Y as you can see is good for about 1,000 watts (1KW) continuous run and 2KW in bursts! (find the row on 1509 motor labeled "1Y" and see the specs.)

Battery – Thunder Power 3S4P 11.1 volt, 8 amp hour pack, weight 16 oz.

ESC – Phoenix 125 (http://www.castlecreations.com/products/phoenix-125.html)

Gear Box – MEC Super Box geared 4.666 to 1 (15 tooth pinion on the motor shaft, 70 tooth spur gear driving the propeller http://www.modelelectronicscorp.com)

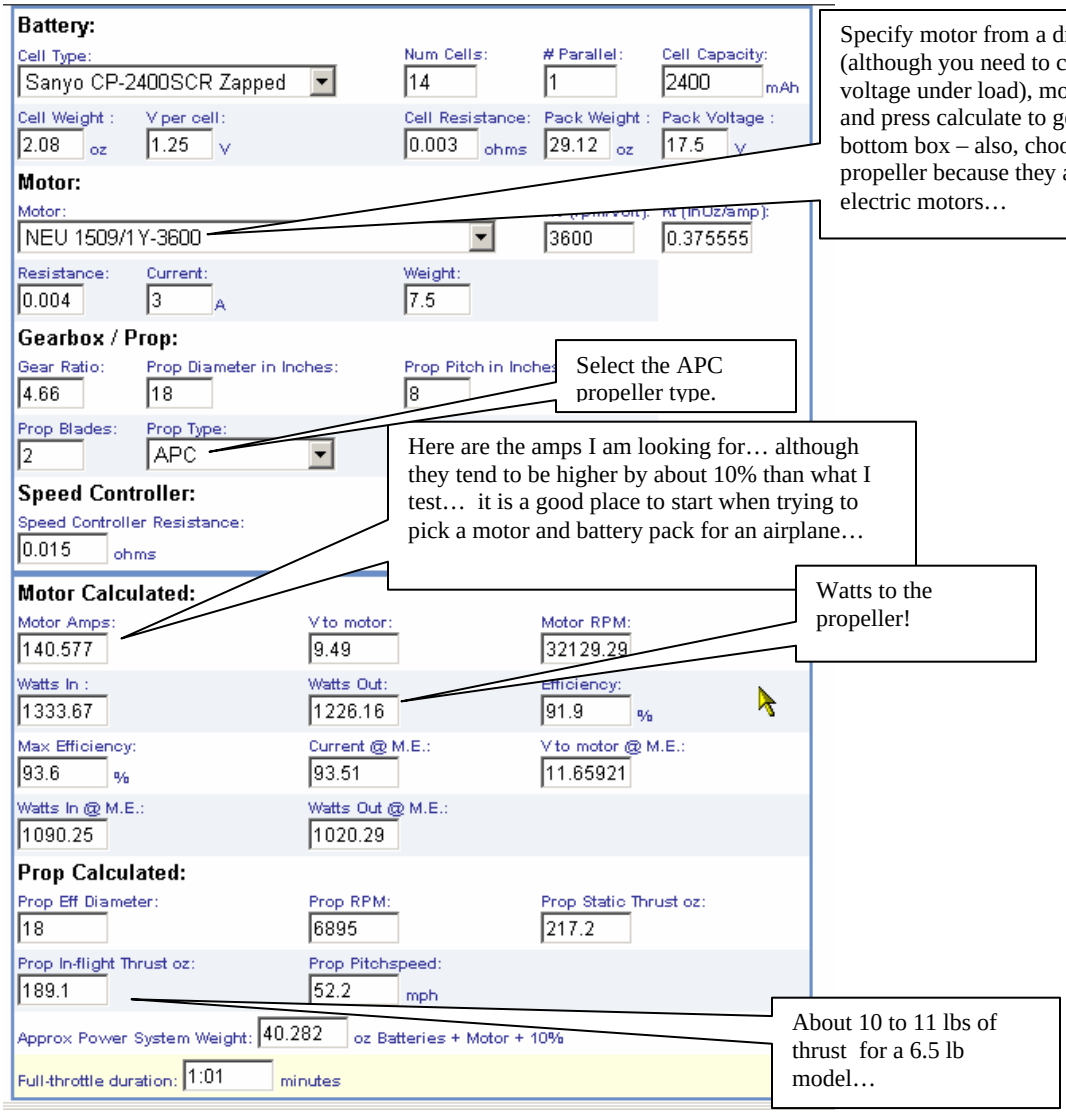
Propeller – 18x8 APC Prop: (http://www.apcprop.com)

This set up produces about 1200 watts at full throttle into a reasonably light (for its size) 6.5 pound airplane driving an 18 inch propeller for about 180 watts per pound at 11 to 12 lbs of thrust. How do I know that this motor is producing approximately 1200 watts – two methods – I have measured it with the Watt Meter Paul showed to you in the prior article (and buy one right away from Astro Flight if you want to get into electric flight, along with his LIPO charger: http://www.astroflight.com), and I tested my guess before I bought this motor with this on-line calculator here http://brantuas.com/ezcalc/dma1.asp (the results are displayed in Reference 1 below).

The output shown in Reference 1 is the calculated results for the 1509/1Y. Now, this calculator is a bit aggressive because it tends to value the amp draw higher than what I actually test (and as a result lowers the input voltage due to the added amp draw). Additionally

you have to "rig it" a bit to get the input voltage to the level you know your particular battery is supplying (hey, it's free, the better ones you can purchase and down-load to your computer: www.motocalc.com). I know for example that my latest Thunder Power 3S4P (8 amp hour, 11.1 volt) packs hold up real well under current draw, even at 120 amps, and that it is retaining above 11.5 volts under this load (again tested with the Astro Watt Meter). So you need to play with the calculator to get the numbers in the bottom window "about right." What you need to do is tinker with various prop sizes and gear ratios while leaving the batteries and motor selection the same, comparing each output result in the bottom frame-window. For 1KW motors, play with 16" to 18" props, typically 6 to 8 pitch for 3D flying, of course you can drop the diameter and increase the pitch if you are after speed or more sport flying…

Reference 1:



The difficult selection can be the gear ratio. You just have to experiment. You will notice that Steve Neu's motors (Neumotor http://66.241.195.91/motors/motors.asp?path1=motors) and the popular Hacker series motors (http://www.hackerbrushless.com) can be bought with 5.3 or 6.7 ratio Planetary Gear boxes pre-attached to the front of the motor. So this gives you an idea of the ratio range to tinker with. Of course you have to buy something like a Monster Box from MEC: (http://www.modelelectronicscorp.com/products/gearboxes/superbox.html) to get ratios other than the pre-supplied 5.3 and 6.7 gear planetary gear boxes. In that case, you will purchase a motor with out a Gear Box pre-installed, you then call a company like MEC and tell them (as an example): "I've calculated that I should use a 4.6 ratio for propping to 1200 watts on my Neumotor which has a 5mm shaft…" – They will sell you the right pinion to put on the shaft and the right spur gear for the box. They can also sell you several different pinion gears to change the ratio in case you don't like the results of what you thought would work. Another way to get to the gear ratio "range" is to do some simple division with total volts and the motor's KV, or thousand revolutions per minute per one volt input… It's fairly straight forward, multiply the advertised KV by the voltage you expect, then divide by the number required to get the prop speed you know you need for the power and speed you desire. (OK, we can discuss this more in a follow on article if required, and I have a free spreadsheet that helps I can share, but suffice it to state that the higher the KV listing the "hotter" the motor, which is to say

it will run faster for any given volts you put into the motor.) For now, try tinkering with reasonable ratios (typically between 4.5 and 6.7) in the on-line calculator and watch the numbers to approach what you are looking for based on the kind of flying you want to do. The example above is a little extreme and works well for the kind of 3D flying I enjoy. "Cooler" setups may work just fine for you, and will require lower gear ratios (below 4.5). Just keep in mind your watts per pound rule of thumb, and select a prop/gear ratio that is within the limits of the motor and battery's C rating.

Before I leave the topic of gearing electric motors (and I don't understand the physics of this) I wanted you to know another piece of information. By "deep" gearing electric motors you can use larger props at less power than a gas motor would provide. This provides an advantage in efficiency because larger diameter, lower pitched (to a point) propellers are more efficient. So you can get similar performance with fewer watts as compared to a gas/nitro motor with higher, or nearly the same watts to HP comparisons. See the following link for some discussion of this capability: www.modelelectronicscorp.com/products/gearboxes/superbox.html

Summary - 60 to 100 Size Models

To summarize we have a few rules of thumb for the size airplane we are targeting in this article:

- Keep the ***airframe light, light, light***
- ***Keep the drive system light***
  - Add up the weight of the motor, battery, and ESC you are selecting, how does it compare to an OS 91 weight of 27 oz?
  - Try another combination if you are over 32 oz
  - Optimize the components based on how you wish to fly
- All up weight of the model and drive system (and all electronics) ***6 to (maybe) 8.5 lbs*** if possible
- Large ***wing area (800 to 1000 square inches)*** for trainer-like characteristics
- Choose a motor, propeller and gear ratio for ***1000 to 1300 watts full throttle to provide 3D-like performance*** for 6 to 8 lb models
- Choose a motor, propeller and gear ratio for ***600 to 800 watts for sport flying***
- Choose motor, gear ratio (unless you are choosing an "outrunner") and prop size to ***stay at or under average battery pack C rating*** for long battery life

Tunnel Vision Calculations

At the beginning of the article, I said I was assembling a Tunnel Vision from Chip Hyde. See Reference 2 below for the specifications and some of the calculations I used to select the Neumotor 1512/2D, geared at 6.7:1 with a 20x10 propeller. I have not flown this airplane yet, so hopefully we will soon see if I guessed well. (I do have some concern over heat dissipation in the 1512 and that is why they sell them with a finned-case. I don't like the specifications for the next-larger 1515 motor with 22 volts as input. I want to use my investment in several 3S4P 8amp packs that I already have as I will not purchase 9S or 10S packs just for this new model. I wanted to find the power required by using my existing packs, two in series.) I have test run the 1512/2D motor in my basement with a 20x10 prop and it produces above 2KW and about 20 lbs of thrust. So how much power is 2KW in comparison to nitro/gas motors? Well, as indicators for comparison, a Saito 150 (4 stroke) produces (optimistically) about 2.5 HP, or 1.863KW, and DA 50 produces 5 HP, which is about 3.7KW… The calculation is that it takes about 746 watts to produce one HP (I like to remember 750 watts to one HP – the math is quicker). By the way, here is a 4KW electric motor on a QQ 102" Yak: http://www.rcguild.com

Airplane - Tunnel Vision – wing span 80" wing area 1460; weight advertised approx 11 to 12 lbs (this is a "slime" weight, I hope to get at or under 11 lbs as I have replaced the aluminum landing gear and wing tube with carbon parts) http://www.chiphyde.com/html/aircraft/tunnelvision.html

Motor - Neumotor 1512/2D – motor weight 10 oz (http://66.241.195.91/motors/neu1506.asp?path1=motors&path2=neu) The 1512/2D as you can see is good for about 1,200 watts continuous run and 2,500 watts in bursts

Battery – 22.2 volts nominal – I will use my existing 3S4P packs and simply connect two in series. Two (in series) Thunder Power 3S4P 11.1 volt, 8 amp hour packs – weight for both packs will total 32 oz.

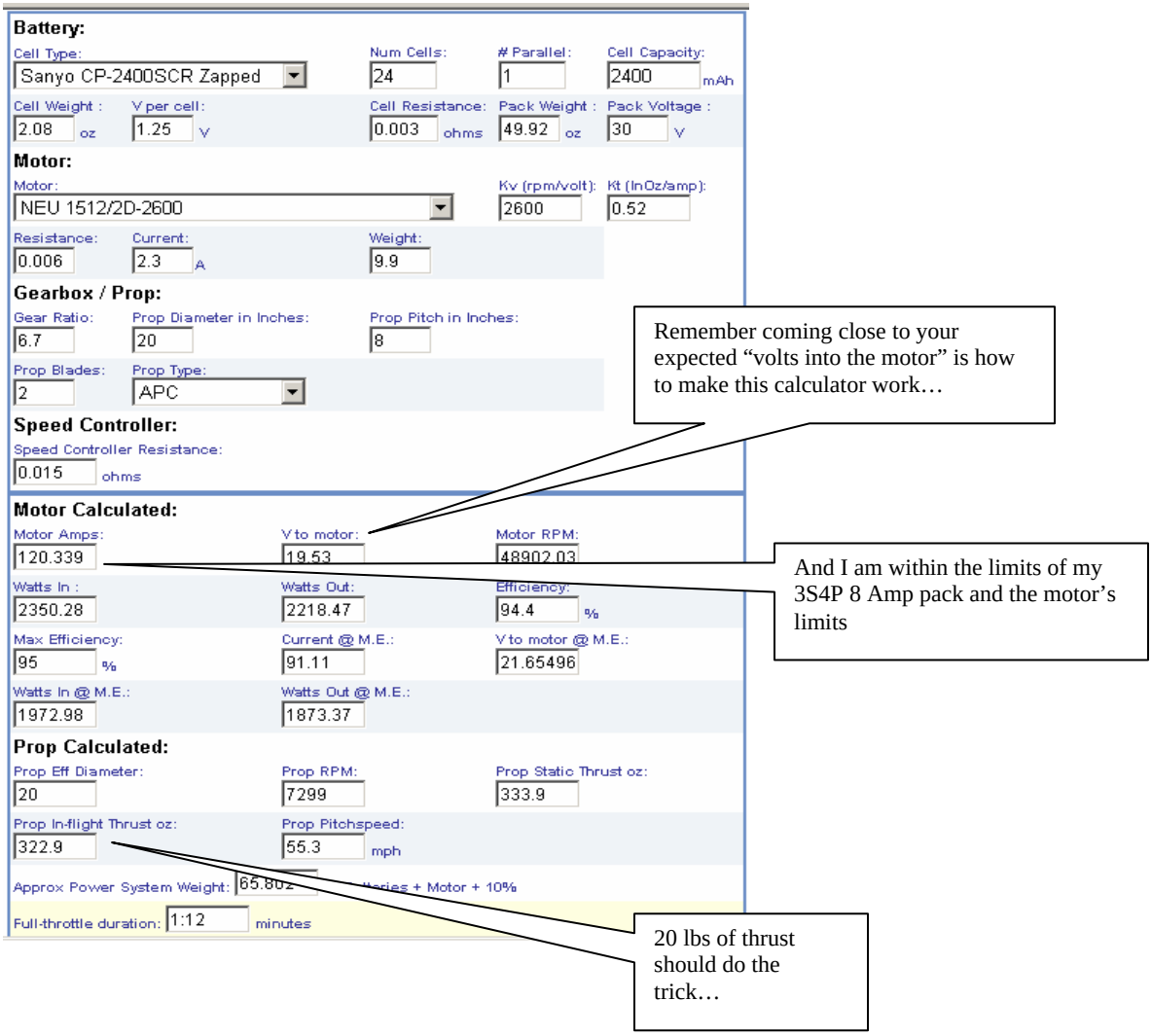
ESC – Phoenix 125 (http://www.castlecreations.com/products/phoenix-125.html)

Gear Box – as supplied on the Neumotor a planetary, 6.7:1 gear ratio

Propeller – 20x8 or 20x10 APC Prop - www.apcprop.com

Below is Reference 2 representing my initial calculations to determine the right volts, motor, gear box, and propeller for my new Tunnel Vision:

Reference 2:



I will see you at the field soon, and I hope this was both a little fun and informative.