the Ampeer

December | The EFO Officers | 2014

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The Next Meeting:
Thursday, Dec. 11, 7:30 p.m., Ken Myers' house, Commerce Twp., MI

What's In This Issue:

The Electric Motor Constant Kv AKA The Generator Constant, RPM/volt, Annotated as Kv -
Sullivan Products acquires Harry B. Higley and Sons, Inc. - Wing and Power Loading From 1952 -
Very Large Depron Monocoupe - Upcoming Events

The Electric Motor Constant K_v AKA The Generator Constant, RPM/volt, Annotated as K_v

By Ken Myers

Ampeer Articles Relating to the Motor Constant Kv

Finding R and K, December 1989
http://www.theampeer.org/ampeer/ampdec89/ampdec89.htm#page2

Kv for Robbie 600, Aug. 1999
http://www.theampeer.org/ampeer/ampaug99/ampaug99.htm#KV

Motor Kv Question, January 2005
http://www.theampeer.org/ampeer/ampjan05/ampjan05.htm#KV

Measuring Kv Using the Drill Press Method, January 2009
http://www.theampeer.org/ampeer/ampjan09/ampjan09.htm#KV

It Is Not Just the Kv, May 2009
http://www.theampeer.org/ampeer/ampmay09/ampmay09.htm#KV

Ke variation, November 2010 (note: not a typing error; Ke is related to Kv)
http://www.theampeer.org/ampeer/ampnov10/ampnov10.htm#KE

Identifying the Usefulness of an Unknown Brushless Outrunner, October 2011
http://www.theampeer.org/ampeer/ampoct11/ampoct11.htm#UNK

Kv says nothing about a motors max.power, max.current and rpm, Ron van Sommeren explains why Kv is not a rating.
http://www.rcgroups.com/forums/showthread.php?t=2131492&pp=100&highlight=kv#post27882342

Reliable Information - NOT!!! An RC Groups thread started by Ken Myers on Oct. 22, 2014 after reading an article on the Model Airplane News Web site. Discussion of how people use the term for RPM/Volt (aka K_v) incorrectly.
http://www.rcgroups.com/forums/showthread.php?t=2270305

Tips for Getting Started with Electric Airplanes by Gerry Yarrish The article where RPM/Volt (Kv) is defined incorrectly.
http://www.modelairplanenews.com/blog/2014/10/14/tips-for-getting-started-with-electric-airplanes/

In the Glossary of the article it originally stated, "KV: A rating for brushless motor that equals a 1000 RPM per volt. So a 5KV motor would spin at 55,500rpm approximately if you applied 11.1 volts (3s)."

Preface, November 2014

For almost two decades I used the annotation of Kv for the generator constant of an electric motor expressed as RPM/volt.

GENERATOR CONSTANT

"The internal voltage generated when a motor is turning. This is also known as the voltage constant or the speed constant. The most common unit of measure is RPM/Volt." - Bob Boucher, AstroFlight Inc., Electric Motor Handbook, GLOSSARY OF TECHNICAL TERMS

Bob Boucher's book used no subscripts in any annotations, so I never have, and have always referenced the generator constant and torque constant as Kv and Kt respectively.

I am not the only one with annotation errors regarding this motor constant. Various forms of annotating the letters k and v, placed side-by-side, abound on the Web and in printed materials. The best thing to do is use the context of the two letters together and note whether the author's intent was to reference the RPM/Volt generator constant.

Some examples of the letters k and v together referring to RPM/Volt.

Hobby King uses kv. Innov8tive Designs and Horizon Hobby use Kv. Tower Hobbies uses kV. NitroPlanes and Heads Up RC use KV. Model Airplane News, in the referenced article, also used KV.

* * * * *

K_v is a motor constant and is directly related to K_t, the motor torque constant. K_v is most often expressed as RPM/Volt or RPM/v. K_t is often expressed in the units of inch ounces per amp. K_v (expressed as RPM/v) * K_t (inch ounces per amp) = 1352.4 (Note: Bob Boucher used 1355 as the constant.) The constant is used to covert SI (metric units) to inch ounces of torque per RPM.

Some Sources for the constant.

Jim Oddino

http://www.rcgroups.com/forums/showpost.php?p=3423302&postcount=11

http://www.rcgroups.com/forums/showpost.php?p=3423873&postcount=12

Bob Boucher's AstroFlight, Inc. Electric Motor Handbook, copyright 1994

K_v, the generator motor constant, is 'set' by the motor's physical makeup. The voltage used to multiply the K_v constant by, to determine the RPM, is **NOT** the input voltage at the motor for a brushed motor or the input voltage at the Electronic Speed Control (ESC) for a brushless motor.

There is a **voltage drop** from the input voltage. The drop is caused by the resistance of the motor and its load for a brushed motor. For brushless motors, there are additional voltage drops caused by the resistance of the ESC, wire and connectors.

The Math

V (volts) = **I** (current) * **R** (resistance)

In a math equation, as expressed above, an asterisk (*) means multiplied by.

It is read as: volts equals current multiplied by resistance

The **net voltage** (Vnet) equals the input voltage (Vin) minus the current multiplied by the resistance (the voltage drop).

Vnet = (Vin - (I * R))

ALSO

Vnet = RPM / K_v

In a math equation, as expressed above, a slash (/) means divide by.

It is read as: Net voltage equals RPM divided by K_v

Measuring a motor's K_v Using the Drill Press Method

As previously mentioned, K_v is also known as the generator constant or dynamo constant. When any electric motor's shaft is physically spun, it generates electricity. It doesn't matter whether it is a brushed or brushless motor.

A typical hobby brushed motor can be spun by a drill press at a relatively constant speed. The DC voltage is measured across the terminals, with the brushes set to neutral timing. Using the known RPM of the drill press, the K_v, RPM per volt, can be calculated. i.e. 1560 RPM (known drill press RPM) / 1.6 volts (DC measured volts across the two terminals) = 975 RPM per volt. (To see how timing affects a motor, read Timing Test.)

http://www.theampeer.org/timing/timing.htm

A brushless motor isn't quite as simple to test. A bit of math is required. Don't panic about the math. Download the Excel-based workbook and use the spreadsheet on tab Kv.
http://www.theampeer.org/Kv/Kv-Worksheet.xls

A brushless motor has three possible lead combinations that need to be measured using the **AC** voltage setting on a multimeter.

First, determine the constant drill press RPM (1545 in this example).

Measure the AC voltage on each pair of leads. Be sure not to let any of the three leads or multimeter probes touch each other.
There are three possible combinations with a brushless motor.
Lead combination A - 1.879
Lead combination B - 1.867
Lead combination C - 1.868
Average: 1.871
Note, most brushless motors do not have all three lead combinations providing the exact same voltage.

REMINDER!!! The workbook spreadsheet (tab Kv) does all of the math. The following is only for the intellectually curious.

Find the V-peak by multiplying the average AC volts by 1.414.
In this example 1.871 * 1.414 = 2.645594v
Divide 1000 (a constant) by the RPM (1545 in this case) = 0.6472491909
Ke = V-peak (2.645594 * 0.6472491909)/1000 = 0.0017123586
Find the inverse of Ke (1/Ke) (1/0.0017123586 in this case) = 583.9898254957
Divide the inverse of Ke by 0.95, 583.9898254957 / 0.95, = 614.7 RPM/v or the approximate K_v expressed as RPM/v
Brushless K_v formula using drill press
K_v = (1 / ((Vac * 1.414) * (1000 / drill press rpm)) / 1000) / 0.95
K_t = 1352.4 / K_v

It should be noted that many manufacturers and suppliers, even the good ones, provide inaccurate information about a motor's K_v. Some of the inaccuracies are caused by individual variations introduced in the manufacturing process and some just by the manufacturer or supplier not knowing, or caring about, how to do it correctly.

To be sure you have the K_v that will be useful to you, use the drill press method to measure a received motor. Using this method, nothing really needs to be done to the motor. The cross mount needs to be affixed to the motor and the shaft chucked into a drill press. The motor should be returnable if the K_v is found to be not suitable.
Note: Advancing the timing on a brushed motor (using rotation of the brushes) or brushless motor (via an ESC setting) changes the apparent K_v, increases the RPM and Io (no load amp draw), and increases the heat (wasted energy) more than neutral timing, but also increases the power out.

The photo shows a drill press set up to measure its RPM. A white band of paper was placed on the drill press chuck with two vertical black lines marked on the paper 180 degrees apart. To operate correctly, an optical tachometer requires either natural or DC generated light. Standard AC house lighting will not work. The flashlight provides the DC light source for using an optical tachometer when the AC lights are shut off.

The optical tachometer readings will vary only slightly as the drill press turns. Use the average or median RPM of the drill press for the K_v calculations.

Also in the photo, a brushless outrunner has been chucked into the drill press and held in place using two paper clips and a rubber band attached to its cross mount. Once the drill press RPM is known and the motor chucked into the drill press chuck, it is ready for the AC multimeter readings. Take several readings for each phase and average them.

Mathematically Calculating the K_v

This method is a bit more involved. It requires mounting the motor, ESC and battery to be used on a test stand. A propeller that will load the motor well into its operating range and a means of capturing the no load RPM, or extremely light load RPM, is also required.

For brushless motors, the most accurate Kv calculation is obtained with the ESC set to zero (0) degrees neutral timing. Remember that advancing the timing on a brushed motor (using rotation of the brushes) or brushless motor (via an ESC setting) changes the apparent Kv, increases the RPM and Io (no load amp draw).

A power meter (aka watt meter) is used to record the volts and amps of the two widely varying loads. A tachometer is used to capture each loadings RPM at the same instant the volt and amp readings are taken.

An optical tachometer can be made to work, but a phase tachometer is much easier to use for this purpose. The RPM, volts and amps must be captured at exactly the same instant in time. The Hyperion Emeter II with an RDU (remote data unit) is an excellent tool for this purpose. It is a power meter with a built in phase tachometer and much more. The Emeter II saves up to eight data point "Snapshots". The data saved includes the RPM, volt and amp readings gathered at the same instant. http://www.rcdude.com/servlet/the-2749/Hyperion-Emeter-%26-RDU/Detail

Alternately, the Emeter II with RDU can record or log the data. The logged data can be transferred to a computer and viewed in a spreadsheet format.

The data from a Castle Creations ICE or EDGE ESC **cannot be used**.

Can the Data From the Castle Creations' Phoenix ICE 50 (8S) Be Used to Collect Inputs for Drive Calculator?
http://www.theampeer.org/ampeer/ampjul12/ampjul12.htm#ICE50

Comments On the July 2012 Ampeer Articles "Can the Data From the Castle Creations' Phoenix ICE 50 (8S) Be Used to Collect Inputs for Drive Calculator?
http://www.theampeer.org/ampeer/ampsep12/ampsep12.htm#COMMENT

More on "Can the Data From the Castle Creations' Phoenix ICE 50 (8S) Be Used to Collect Inputs for Drive Calculator?"
http://www.theampeer.org/ampeer/ampjun13/ampjun13.htm#ICE

All of the data point measurements are taken at FULL THROTTLE! Do NOT use partial throttle readings! Data should be gathered as quickly and accurately as possible. The motor should not be run for any extended period of time, ever!

One of the earliest iterations of this method was presented in the December 1989 Ampeer.
http://www.theampeer.org/ampeer/ampdec89/ampdec89.htm#page2

Collecting the Data

High Load **Data Point 1**

Mount a propeller that should provide an amp draw well into the usable range. (For help in selecting the prop, review "Selecting the CORRECT Supplier Recommended Props".
http://www.theampeer.org/e-basics/e-basics.htm#CORRECT%20PROP

You should try to get as close to the maximum current rating of the motor as possible, without going over it or exceeding the amp rating of the ESC. The data captures should be gathered as close as possible to the same instant in time. Record the current, voltage, and RPM readings. They will be known as I1 (current), V1 (volts), and RPM1 (RPM).

No Load or extremely light load **Data Point 2**

For a very light load, affix a very small propeller or even small, flat 'stick' just large enough to get an optical tachometer reading. Servo arms have been used on small motors. This is NOT the best method, but it will yield usable results.

With a phase tachometer, nothing needs to be attached to the motor, as the phase tach, inserted in one lead between the motor and ESC, will yield the no load RPM, which is even better.

Measure the light load or no load current, voltage, and RPM. They become I2 (current), V2 (volts), and RPM2 (RPM).

The math is completed using the previously downloaded Excel workbook spreadsheet titled Rm (the Rm tab).

The results are obtained using differential equations. The results not only include the mathematically calculated K_v but what has been often noted as the Rm, motor resistance.

Rm (motor resistance) is a term used to describe the motor resistance of a brushed motor. For a brushed motor it meant only the motor resistance. The term Rd, as used here, means the motor resistance plus the ESC resistance and the resistance of the wire and connectors, so that it may apply equally to brushed and brushless systems.

The dynamic resistance, Rd, because it is dynamic, is not a true constant. It varies slightly with the applied voltage and thus the RPM, but it is good enough for our purposes.

An example of some actual measured values: (see the spreadsheet Rm for the math)

INPUTS:
I1 - current: 36.6 amps
V1 - voltage: 17.28 volts
RPM1: 8814 RPM

I2 - current: 1.4 amps
V2 - voltage: 17.88 volts
RPM2: 10954 RPM

OUTPUTS:
Resistance in milliohms: 81.6
Resistance in ohms: 0.0816
Kv - generator constant: 617 RPM/volt

NOTE: The values above are from the same motor as the K_v drill press method which yielded 615 RPM/volt.

One More Motor 'Constant'
Calculating the Motor's No Load Current (Io)

The Io (no load current) is also a valuable motor constant. The Io is used to compensate for the hysteresis loss and the loss from the high rotational speed caused by circulating electrical currents in the armature laminations and other losses.

According to Bob Boucher, "For the purposes of calculating motor performance, one can assume that there is a leakage current or loss current shunting the ideal motor by an amount equal to the measured no load current or Io. The net effective current, and the torque it produces, are decreased to the values:
Inet = Iin (current in) - Io (no load current)

Torque = K_t x Inet"
also from Bob Boucher
"Please note: the no load current is measured at some nominal speed usually close to the anticipated running speed."

'Speed/RPM' is governed by the voltage, so that means at approximately at the same input voltage.

To calculate the Io, measure the volts and amps using a power meter with no propeller attached to the motor. As Bob Boucher intimated, it is best to use a battery or power supply that applies the approximate anticipated input voltage. Testing at that voltage provides an Io close to the actual running voltage.

Some ways to get the suggested lower voltages to use to determine the Io

Adjust a power supply to approximately 3.7 volts per anticipated number of LiPo cells and approximately 3.2 volts per anticipated number for "A123" cells for the Io test.

Packs to use for testing the Io

For LiPo (Li-Polly) packs use the same number of cells as will be used for the onboard system but at storage, or slightly below storage, voltage.

To obtain a 'running voltage' for the Io for A123" $LiFePO^4$ batteries is a bit more involved because they do not have a storage voltage. For 4S through 12S packs, a fully charged pack with one less cell than will be used for the onboard system can be used. 2S and 3S packs need to have their voltage discharged or reduced so that the resting voltage is under 3.3 volts per cell.

This does vary depending on the pilot's throttle management technique and what the pilot expects from the airframe, that's its mission.

DO NOT ATTEMPT TO CONTROL THE VOLTAGE DUING THE Io CHECK USING AN ESC!

A major problem with many suppliers' is that they give an Io without noting the voltage. Io varies somewhat with the volts applied. This causes a problem when the Io is used to estimate the current loss in the power out motor formula.

There is also a problem when a supplier gives an Io based on a 'too high' or 'too low' input voltage for the pack being chosen to use in the onboard power system.

Cobra C-3525/12 No-Load Current Io = 1.48 AMPS @ 20v

http://innov8tivedesigns.com/images/specs/Cobra_3525-12_Specs.htm

How Knowing the K_v, Rm (aka Rd here) and Io Can Be Useful

Adding one more formula is useful.

Power Out Formula

Pout = (Iin - Io) * (Vin - (In * Rm))

While called constants, the Rm and Io are not truly constant. They vary slightly with the applied voltage.

Some Examples

It is important to note that the Rm derived in the following examples is **NOT** the Rm that is often provided by the suppliers.

Cobra C2203/52, wt. 17.5g

http://innov8tivedesigns.com/Cobra/Cobra_2203-52_Specs.htm

I1 = 6.93, V1 = 7.4, RPM = 6740

I2 = 0.36, V2 = 8.0, RPM = 12,080*

*Adjusted to yield a Kv of 1540 RPM/Volt - found in the Examples on the Rm sheet.

Results from spreadsheet:

Rm = 0.4363 ohms, Kv = 1540 RPM/Volt

Io was given as 0.36 amps at 8 volts

The maximum amp draw is given as 7 amps. 80% of the maximum is 5.6 amps. On the Innov8tive Designs' prop test table the APC 7x5SF draws 5.6 amps.

The voltage drop at 5.6 amps with 7.4Vin.

7.4Vin - (0.4363ohms * 5.6 amps) = 4.96Vnet

RPM at 5.6 amps = 4.96Vnet * 1540Kv = **7638** RPM

The actual measured data for the APC 7x5SF is, 7.4Vin, 5.60 amps, **7,620** RPM

The Vnet is 67% of the Vin. That is not unusual for such a small motor (17.5g).

The Io is used to calculate the Pout in watts.

(5.6 amps - 0.36 amps) * (7.4 - (0.4363ohms * 5.6 amps)) = 26 watts **out**

Efficiency = 26 watts out / (7.4v * 5.6 amps) watts in = 0.627 or 63%

Again, this is pretty typical efficiency for such a small motor.

Cobra C4130/14, wt. 400g

http://innov8tivedesigns.com/Cobra/Cobra_4130-14_Specs.htm

I1 = 58.26, V1 = 29.6, RPM = 10581

I2 = 1.46, V2 = 20, RPM = 8940*

*Adjusted to yield a Kv of 450 RPM/Volt - found in the Examples on the Rm sheet.

Results from spreadsheet:

Rm = 0.1049 ohms, Kv = 450 RPM/Volt

Io was given as 1.46 amps at 20 volts

The maximum amp draw is given as 60 amps. 80% of the maximum is 48 amps. 46.04 amps is used for the example as the measured APC 12x8E draws 46.04 amps at 29.6v.

The voltage drop at 46.04 amps with 29.6v in.

29.6Vin - (0.1049ohms * 46.04 amps) = 24.77Vnet

RPM at 46.04 amps = 24.77Vnet * 450Kv = **11,146** RPM

The actual measured data for the APC 12x12E is, 29.6Vin, 46.04 amps, **11,063** RPM

The Vnet is 83.7% of the Vin. That is not unusual for the larger motor (400g).

The Io is used to calculate the Pout in watts.

(46.04 amps - 1.46 amps) * (29.6 - (0.1049ohms * 46.04 amps)) = 1104 watts **out**

Efficiency = 1104 watts out / (29.6v * 46.04 amps) watts in = 0.81 or 81%

Again, this is pretty typical efficiency for this larger motor.

The examples chosen were not arbitrary. They demonstrate some general trends that can be applied to all motors. 'Smaller, lighter' motors have a higher Rm (motor resistance) than 'larger, heavier' motors and therefore a higher voltage drop. In general, for the way that they are used, 'Smaller, lighter' motors have a lower efficiency than 'larger, heavier' motors.

One thing that was not demonstrated by the examples is that the highest K_v motor in a series will be the most efficient and have a lower Rm. Why? A higher K_v in the same 'size' motor is created by using larger diameter wire for the windings compared to a lower K_v version of the same series motor with the same type of termination. Not all suppliers provided different K_v motors of the same 'size'.

The Cobra C2203/34, which is in the same series of motors as the first example, has a Rm of 0.2255ohms (about 1/2 the resistance of the /52) for a voltage drop of 1.55V at 6.89 amp yielding 5.85Vnet. (Shown in the Examples on the Rm spreadsheet).
http://innov8tivedesigns.com/Cobra/Cobra_2203-34_Specs.htm

At 6.89 amps the Vnet is 79% of the Vin and the efficiency is about 72.6%. The /52 is a 52-wind and /34 is a 34-wind. The fewer winds of larger gauge wire on the /34 means that it has a lower resistance and higher K_v than the /52.

A Quick and Dirty K_v Method

Another way to derive the K_v is with a phase tachometer and voltage measurement. While an optical tachometer can be used with a brushless outrunner with a paper strip attached to the bell and marked with two black stripes 180 degrees apart, it cannot be used for this measurement with an inner runner brushless, as the motor needs to be 'unloaded'.

The Emeter II with the RDU or MDU and the phase tach lead can be used or a device like the AEO Tech KV Meter K0. The motor is run with no load, while the voltage and rpm are recorded. While not the 'true' K_v, it is close enough. For this type of measurement, no load RPM / no load volts = K_v in the units of RPM/volt.

For the motor that already yielded a K_v of 615 with the drill press method this method yielded; no load RPM 10954 RPM / 17.88V = 613 RPM/volt

What's Your Point, Ken?

You may be thinking, "What's with all the math?!? You've gone over this a gazillion times already in the *Ampeer* over the last twenty-five plus years. I don't care about how to calculate motor efficiency, etc. The math just blows my mind. Enough already!"

The point is that the generator constant of RPM per volt, annotated as K_v is NOT a rating. It is indeed a 'motor constant'. By itself, the annotated K_v, is not useful in selecting an electric motor for a given application.

Shaft RPM, therefore prop RPM equals the K_v times the net voltage.
RPM = K_v * Vnet

MORE IMPORTANTLY - Shaft RPM, therefore prop RPM is NOT equal to the K_v times the input voltage at the ESC.
RPM ≠ K_v * Vin

For those not familiar with the sign ≠, it means NOT equal.

Equally important the K in K_v, a motor constant annotation, has nothing to do with 1000. In kilovolt (kV or kv), kilogram (kg) and kilometer (km), the lowercase k is actually representing the word kilo - 1000 in the Si (International System of Units), which is the modern form of the metric system.

More K_v information and the other motor constant information can be found on Skylar's Excellent Motor Constants Page on the Web.
http://www.bavaria-direct.co.za/constants/

Ron van Sommeren does a very nice summation of what K_v is and isn't in an RC Group's post.
http://www.rcgroups.com/forums/showpost.php?p=29868667&postcount=3

"A motor's Kv constant says nothing about max.power & max.current a motor can handle, efficiency, rpm, quality etc.

The K_v constant is not a rating, not a figure of merit, it's just a characteristic. More windings will give lower K_v, less windings will give higher K_v, that's all there is to it. No big deal, anyone can do that.

Motor/battery-current wants to go up with voltage squared and with K_v cubed. Way more than one would expect.

Motors have just one K_v, not e.g. 2500Kv. K_v is physical quantity (length, weight, time, current, ...), it is not a physical unit (meter, kg, s, ampere, ...). Therefore: K_v = 2500rpm/volt."

Links to Innov8tive Designs

Lucien Miller's Test Stand
www.rcgroups.com/forums/showpost.php?p=7440927&postcount=255
How Lucien measures for continuous current

www.rcgroups.com/forums/showpost.php?p=18733182&postcount=18
How Lucien Calculates the K_v
www.rcgroups.com/forums/showpost.php?p=29849404&postcount=542

One final question remains.

If none of this information is useful in selecting a motor and propeller, what is?

Stay tuned. ;-)

Sullivan Products acquires Harry B. Higley and Sons, Inc.

Jim Cross, EFO member, recently alerted me to this via email.
http://harryhigley.com

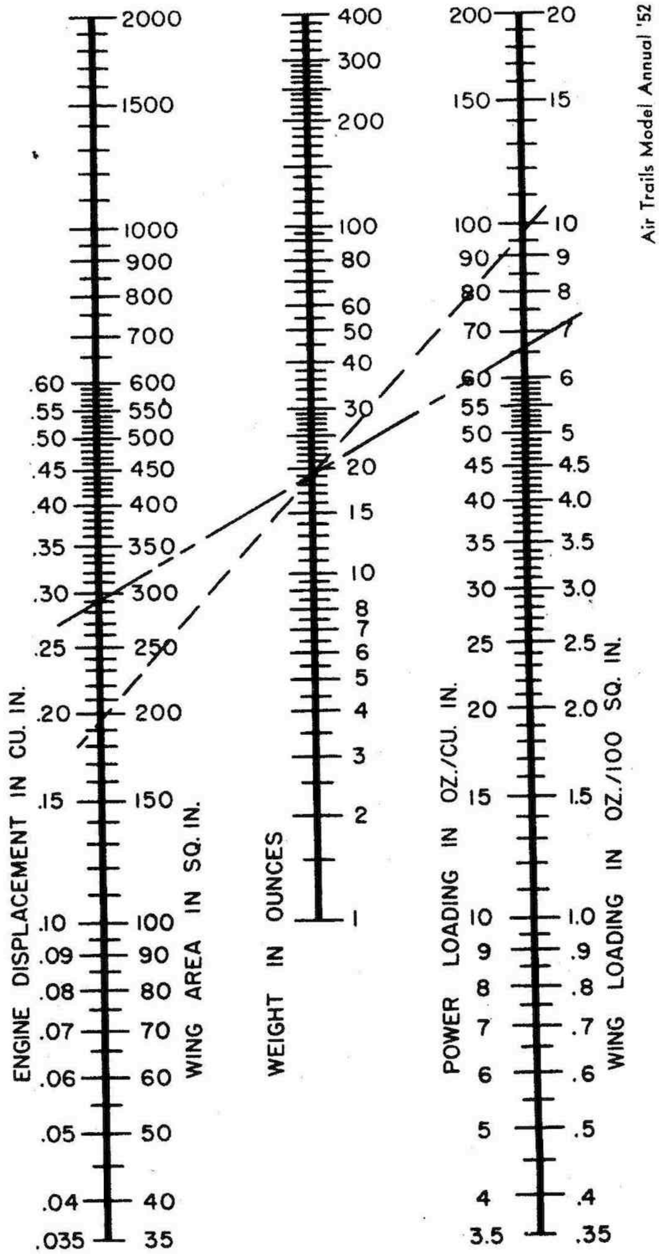
It is very good news.

According to the Web site, "Sullivan Products has recently purchased all assets of Harry B. Higley and Sons. We now have the Harry Higley technical building books, tools and model accessories inventory at a suitable level and ready to serve you."

Wing and Power Loading From 1952
Related to Wing Cube Loading
From Andy Kunz via email

Hi Ken,

I thought you'd like to see WCL concept in models, way before Francis Reynolds MB article in 1989. It's applied to engine power, but the same concept.



Wing and Power Loading Nomograph

WING LOADING: Locate area on left line and plane's weight on center line. Connect two points and extend straight line across right graduated line. Intersection point gives wing loading in oz. per 100 sq. in. Example (dotted line), plane with wing area of 196 sq. in. and wt. of 19 oz. has 9.75 oz. per 100 sq. in. wing loading. POWER LOADING: Locate engine displacement on left line and plane's weight on center line. Connect two points and extend straight line to right. Intersection point gives power loading in oz. per cu. inch. Example (broken line) plane with motor of .29 cu. in. and wt. of 19 oz. has a power loading of 65.5 ounces per cubic inch.—T. J. McMurray

Andy

Thanks so much Andy. Very interesting.

Very Large Depron Monocoupe
From Scott McKie via email

Hi Ken,

I'm forwarding these pictures to you so that maybe they can be sent to Keith Shaw. I just read his section in

the latest *Ampeer* where he is thinking of building a "different" larger model -- just to be different. Lutz Nakel is one of the premiere European Depron builders. His models are spectacular and he has been a great friend too me over the years showing me what is possible with the stuff and also with different building foam building techniques. If Keith doesn't know of him, he should because Lutz has shown that "big" electric powered true scale foam models can indeed be built, and those models will most likely end up being lighter in weight than anything else. ALSO, scale details do not

need to be left out as can be seen in some of the pictures of Lutz's 1929 Monocoupe.

I also have more pictures of other Depron models built by Lutz including an incredible Bulldog, and Caravel twin EDF Jet model. If you would like to see them, please let me know and I will forward them to you.

As usual, the *Ampeer* was very informative this issue and I gleaned a lot of info from it.

Two questions -- where are you and Keith getting your A123 cells now that the company has gone belly up; and would it be possible to buy made up sells from either one of you two guys as I don't have the gear to put together my own sells sets?

Thanks in advance,
Scott

From: Lutz Näkel

Hi Scott,

Here are some pictures of my latest Depron model. It's an 1929 Monocoupé, 100" span, weight 9 lb., 1100 watt outrunner motor.

Have fun.
Lutz

My response to Scott regarding A123 Cells and packs.

Hi Scott,

Thanks for the info on the big Monocoupe.

You can get pre-made A123 packs from Buddy RC and Radical RC.

Dave Thacker, at Radical RC, custom makes each pack to your configuration and with the type of balance taps you want. You can also tell him what power lead connectors you'd like.
http://www.radicalrc.com/category/A123-Cells-Packs-199
http://www.buddyrc.com/battery/a123-life-batteries.html

For just the cells, I use Radical RC, since Dave has a flat rate $3 shipping charge.
You can also get just cells at
http://www.buyA123batteries.com

Later,
Ken

Upcoming E-vents

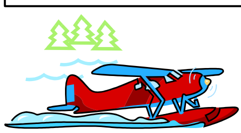
Nov. 30, Sunday, Indoor Flying Special Day at the Ultimate Soccer Arenas, Pontiac, MI, 11 a.m. to 2 p.m., three hours for $10, or use your season pass, Thats one free additional hour of flying time complements of John Hoover from Flight Line Hobby Shop and most recent AMA Carl Goldberg Award Winner.
Congratulations John!!

Dec. 2, Tuesday, Skymasters' Indoor flying continues at the Ultimate Soccer Arenas, Pontiac, MI, 11 a.m. to 1 p.m.

Dec. 4, Thursday, Indoor flying continues at the Legacy Center, Brighton, MI, noon to 2 p.m.

Dec. 11, Thursday, EFO Monthly Meeting, 7:30 p.m., everyone with an interest is welcome, meeting at Ken Myers' house, 1911 Bradshaw Ct., Commerce Twp., MI 48390, Hope to see you then!

Giant Depron Monocoupe (cont. from p. 9)



The Ampeer/Ken Myers
1911 Bradshaw Ct.
Commerce Twp., MI 48390
http://www.theampeer.org

The Next Monthly Flying Meeting:
Date: December 11, 2014 **Time:** 7:30 p.m.
Place: Ken Myers' House (address above)