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Ampeer

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What's In This Issue:
Power Systems for Electrically Powered Aircraft – Markys Hobby Shop – S&B Models Focke Wulf – Upcoming Events for 2000

Power Systems for Electric Aircraft
By Ken Myers – January 2000

Forward

This series of articles is intended for beginners to radio controlled (R/C) and electrically powered flight (electrics or e-flight). The inevitable question of "What motor should I use?" always seems to come first. As will be explained, it is really the last question that should be answered. The easiest way to find out what works is to look up articles in the R/C airplane magazines or the online electric web sites, but knowing where to look can be problematic. Hopefully, this document will be widely circulated and help with the introduction to electrics. Beginners to electric R/C flight do not need to know all of the technicalities, just as they don't need to know them for any other type of R/C flying. It is my intent to keep it simple and successful.
Ken Myers

Whether a person is totally new to the hobby of flying R/C aircraft, or trying electrics after successfully flying internal combustion powered or sailplane R/C aircraft, figuring out the "*mysteries*" of successful electrically powered flight can be a little troublesome. Much initial confusion is caused when the manufacturer of a kit, or the designer of a plan, does not do a good job of explaining the power system options or gives poor advice on the selection of a power system. Unfortunately, neither the beginner, nor seasoned R/C flier, has any background or experience in what really works with electrically powered aircraft. All the beginner wants to know is "What motor should I use?"

Keith Shaw, Bob Kopski, Mitch Poling, Bob Aberle and many others have shared a great deal of information for those who are interested in successful electrically powered flight. Much of this information is not widely available to the beginner. The experienced R/C flier has a totally different background and reference, which at times may be confusing when trying electrically powered flight.

Unfortunately, there does not seem to be any way to help the beginner to R/C flight, since the manufacturers of commonly available electrically powered kits, or their suppliers, do not supply adequate or honest information. Hobby shop personnel aren't knowledgeable enough to help, and many shops just follow the erroneous information provided by manufactures and suppliers.

Experienced R/C fliers should find it quite easy to create successful electrically powered aircraft. They have access to back issues of magazines and newsletters, and many will have an experienced "electric" flier in their club. By using the following information, experienced R/C fliers, as well as R/C beginners, should be able to create successful electrically powered aircraft.

Whether a model aircraft is powered with a glow, gas, CO_2 or an electric motor, the part of the system that is the most important to successful flight is the available potential power and its relationship to the total weight of the completed aircraft system and ultimately the wing loading and "*aerodynamic cleanliness*."

THE MOST DETERMINANT VARIABLE in the electrically powered aircraft system is the battery and its relationship to the total weight and performance of the finished aircraft. The potential battery energy, as with all fuel and its storage container, limits both the available power and duration of that power. A motor or engine changes the available power into usable power. In the case of electrically powered aircraft it is usually measured in watts. Watts is volts times amps.

Keith Shaw, using some of Bob Kopski's information, stated that certain types of performance could be expected from a certain number of motor input watts per pound. Using Keith's method, it is very easy check the input watts with a voltmeter and ammeter. A digital voltmeter and Astro Flight Super Whatt Meter should be one of the first items acquired by those entering electrically powered flight. The Super Whatt Meter is an ammeter that is especially designed for measuring the relatively high currents used in electric flight.

Keith stated that the input power to take off from the ground is 30 to 50 watts per pound, while input power for sport aerobatics is 40 to 60 watts per pound and input power for good aerobatics is 70 to 100 watts per pound. The variables that affect these input power loadings the most are the wing loading and the "aerodynamic cleanliness" of the plane. By using the wing area and Keith's recommend wing loadings for various types of planes, a reasonably accurate "guestimate" of the power system can be made. In his article "Electric Sport Scale" *Model Builder*, July 1987, Keith suggested the following wing loadings; "Slow-flying planes, such as, WWI or 1920 - 1930 light planes (Cub, Taylorcraft, etc.), use a 14 - 18 oz./sq. ft. wing loading, but for fighters and aerobatic types, a 20-25 oz./sq.ft. loading is more appropriate. Small planes (less than 400 sq. in.) should use the lower wing loadings for their type."

Fortunately, Keith follows his own advice of "**Invest in good equipment**. There is an old adage, 'Buy cheap, buy twice.'" That means that Keith was mostly using Astro Flight cobalt motors when he wrote the article.

A Celebration of Electric Flight

SILENT ELECTRIC FLYERS of SAN DIEGO
announces the third annual
MID WINTER ELECTRICS
February 11, 12, 13, 2000

Flying events included:, Old Timer Pylon Racing, Sp400 F5B Racing, Sp400 Pylon Racing, Dragonfly Pylon Racing, LMR Glider Toss, Scale Flight and Exhibition

Friday, February 11, 2000 evening there will an Electric Flight Symposium at the San Diego AeroSpace Museum.

Saturday, February 12, 2000 evening a Mexican Feast a get-together at Marina Village, less than a mile from the flying site.

And don't forget:
Dealer Booths, Event Tee-shirts for $12, Great Raffle

Come fly with us and visit LEGGOLAND, just 45 minutes north on Interstate-5. Don't forget the San Diego Zoo and the Wild Animal Park, the AeroSpace Museum, and the world famous beaches along with Mission Bay Park. Our flight site is within walking distance of Sea World Park.

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Many people tried to apply Keith's principles using much less efficient ferrite magnet type motors [1]. When a ferrite magnet type motor is used, the power in generalization has some problems in relating to the finished aircraft weight. Using a ferrite magnet type motor, the power out is not what Keith was used to when he wrote the article. Of course ferrite magnet type motors can be used successfully to convert the potential power, as Keith does in his King Crimson, but they require some special case considerations. With even more efficient brushless motors being a part of today's arsenal of power converters, the whole potential power conversion becomes even more interesting!

Potential Power

Many folks, including Bob Boucher (Mr. Astro Flight!), have formed the generalization that a NiCad battery makes up about 1/3 of the total finished aircraft weight of a successful electrically powered model. Matt Orme gave us the generalization that the number of cells carried by a model equals the wing area divided by a number between fifty and thirty-five. Therefore a 500 sq.in. model would require between 10 and 14 cells of the Sanyo 1400SCR through RC2000 types. Using Matt's generalization with 10 cells, the model should weigh about 60 ounces (2 oz./cell) and have a wing loading of about 17.25 oz./sq.ft. and with 14 cells, the model could weigh up to 84 ounces and have a wing loading of 24.2 oz./sq.ft. In "real life" this has proven to be a very good range and the computation is just simple division.

Unfortunately, there are a couple of small problems with Matt's generalization. Matt's 500 sq.in. plane would fly very well using his generalization. Matt works for Aveox; therefore he'd probably use an Aveox brushless motor. Matt likes to fly his planes in "high performance" mode. He would most likely use a much higher current draw than in the following example, but to keep things comparative for all three types of motors, I used the following.

For the purpose of example, I have chosen a static amp draw of 27 amps on a freshly charged pack of Sanyo RC2000's. How much current a motor "pulls" is set by the prop's diameter, pitch and design. Input watts from 14 cells would be about 400 watts or about 76 watts input per pound with a plane weight of 84 ounces. Using the Aveox, and saying that it is 85% efficient, would yield 340 watts out, or about 65 watts out per pound. If I were to build the identical 84-ounce plane, I'd probably use an appropriate Astro Flight motor, since I have a bunch just setting around. Using the same 27 amp draw, I would have the same 400 watts of input power, but my Astro Flight motor might be closer to 75% efficient. Therefore, my output would be about 300 watts, or 57 watts per pound of output power. I'd still have a good flying plane, but I'm not using the potential energy as efficiently as Matt is. Mr. or Ms. Beginner sees Matt and I having a ball with our 500 sq.in. planes and decides to build one, but doesn't want to spend the money for an Aveox or MaxCim brushless or an Astro Flight cobalt. There are ferrite magnet type motors that can handle the 400 watts of input power, but only at an efficiency of about 65%. The ferrite magnet type motor power out is about 260 watts, yielding about 50 watts out per pound. The aircraft would still have nice flying characteristics, but the owner would notice the difference when flying with Matt and me.

It's all about using the potential energy that is carried aloft. The above illustration only shows the effect that one variable, motor selection, has on the conversion of potential power to output power. The reality is that all of the aircraft system variables have an effect on how well the plane is determined to fly by its owner and those who watch it.

Having flown electrically powered aircraft for many years, I have the background and experience to suggest viable power systems for many types of electrically powered models. I still have a lot to learn, but I've come up with a method that relates the form of the potential power, the battery, to the completed airframe [2]. This generalization applies to sport and sport scale type aircraft. My definition of sport means what some people might call common, typical or everyday types of models. In other words, they are the most generally model types. It does NOT apply to high performance gliders, electrically powered sailplanes, old-timers, racers, ducted fans or extremely low-powered/low-wing loaded types (indoor fliers) and the rest of the "on the fringe" types of planes that do not make good first electrically powered model aircraft.

The Relationship of Potential Energy and the Plane

Over a decade ago, I started stating that planes were 7-cell, or 10-cell, or 18-cell, etc. Many of my

Gordy Cells

From: Gordy Stahl GordySoar@aol.com

I have plenty of Gordy Cells right now, just for your information :-)

Gordy Stahl
9303 LeBeau Ct
Louisville Ky 40299
502-491- 5001

contemporaries were doing this as well. Somehow, it never seemed to catch on, since people wanted to know what motor to put in the plane. Determining what motor to put in a certain plane is the last variable of the power system to be determined, not the first. That is why answering the question, "What motor should I use?" is so difficult, even for the "experts."

In creating my current generalization, or rule of thumb, presented in Table 1, the completed airframe weight without any power system or R/C system components installed is the most important determinant. Realizing that Reynolds numbers also have an important affect on the "flyability" of any given model aircraft, the generalization that I used to create the table varied the initial wing loading along with the number of square inches.

Also, in creating the table, there is a "break point" where the weight of the onboard R/C system decreases in relationship to the overall completed aircraft weight.

The table "***Completed Empty Airframe Weight***" can be used to select or verify the number of cells a successful electrically powered aircraft should be carrying for its completed airframe weight. That is its potential power.

To use the table, determine the completed empty airframe weight, look for the corresponding battery weight and find the number of cells. The number of cells is determined by the cell's capacity rating. The capacity rating relates to the cell's mass. To find the number of cells for the battery weight suggested in "***Completed Empty Airframe Weight***" table, use the following; Sanyo 500AR/600AE – 0.7 oz./cell, Sanyo 700AR/800AR - 1 oz./cell, Sanyo 1000SCR/1250SCR – 1.5 oz./cell and Sanyo 1400SCR through RC2000 – 2 oz./cell. These are not the "true" weights of the cells, but they can be used when figuring the number of cells, using the suggested battery weights.

Typical onboard R/C component weights are listed in "***Component Weight***" ***Table*** and use the manufacturer's weights, except where noted. The typical onboard R/C components that were selected as the examples are not the only ones that can be used, but they can be used for a quick reference. They were chosen because they have proved themselves to be trusted representatives in the electric flight field, and they are commonly available through easily obtainable sources.

What Motor Should I Use?

Once the completed airframe weight is determined, the "***Completed Empty Airframe Weight***" table is used as a guide to select the onboard R/C components and power system.

The remainder of the article contains examples of power systems that start to answer **THE QUESTION**. Since it is not practical to test all power systems, mathematical simulations of power systems, based on the work of Mitch Poling and Bob Boucher, were used.

About Prop Sizing

A minimum prop diameter is listed in the "***Completed Empty Airframe Weight***" table. For sport and sport scale planes I use the smallest prop size possible, which when combined with the pitch equals the commonly used amp draw for the cell type and motor. Using this method allows the landing gear to be as short as possible and the potential speed to be as fast as possible. Some suggested prop sizes may not be available. By "trimming down" and carefully balancing "standard" props, you can make them. The suggested prop sizes are a starting point to reach the recommended amp draw. Adjust the prop size to achieve the recommended amp draw as necessary. Do not run the motor longer than necessary to achieve an amp reading to adjust the prop size. Running a motor with "too big" of a prop will ruin it in a short period of time.

About the Motors

The motors that are used for examples in the weight ranges are not the only ones that are available in the specific weight range. The representative motors were chosen as they are easily obtained from major sources, and therefore easily obtained by beginners to electrically powered flight.

2.1 oz. – 3.5 oz. Motors

Speed 400 Motors

The Graupner Speed 400 motors are very popular in small R/C sport and sport scale aircraft. The direct drive 6v and 7.2v versions weigh about 2.6 ounces when used in direct drive applications and 3.5 ounces with a gearbox. They are part of the Mabuchi "380" family of motors. The "***Completed Empty Airframe Weight***" table shows that direct drive versions of this motor with a weight of 2.6 ounces can be used with airframes weighing up to about 6 ounces and geared versions weighing 3.5 ounces can be used with an airframe weight of up to about 7.7 ounces. Even though many experienced electric fliers have found acceptable uses for the 7.2v version of this motor, it is not included here because of its inefficiency at sport and sport scale currents.

For direct drive applications up to the 6 ounce airframe weight, the battery could weigh 5.7 ounces. 5.7 / .7 = 8.14 or 8 500AR/600AE cells or 5.7 / 1 = 5.7 or 6 700AR/800AR cells. Up to a certain point, the higher the voltage the better, so 8 500AR/600AE cells would be a better choice. The usual practice is to prop these motors to about 11 amps static, although 12 amps static has been used by many well known electric fliers.

The table below shows the suggested prop sizes for a direct drive Speed 400 6v motor on 8 cells.

Speed 400 6v direct drive motor on 8 cells

Motor:	Amps:	Prop Diameter:	Motor Efficiency:
6v	11	5x4.5, 5.5x3	64%
6v	12	5.5x4, 6x3	62%

For geared applications with an airframe weight of up to 7.7 ounces, the battery could weigh about 7.3 ounces according to the table. 7.3 / .7 = 10.42 or 10 500AR/600AE cells or 7.3 / 1 = 7.3 or 7 700AR/800AR cells. Remember that up to a point, the higher the voltage the better, so 10 500AR/600AE cells would be a better choice, except that it is pushing the limit of electronic speed controls (ESC) with battery eliminator circuits (BEC). To be safe, a separate, small receiver battery is needed and factored into the R/C component weight. A 110mAh receiver pack weighs about an ounce, therefore the receiver, servos and ESC should not weigh over 2.3 ounces, according to the "***Completed Empty Airframe Weight***" table for the R/C components. With careful selection of components, it can be done.

The table below shows the suggested prop sizes and gear ratios for geared Speed 400 6v motor on 10 cells.

Speed 400 6v geared motor on 10 cells

Motor:	Amps:	Ratio:	Prop Diameter:	Motor Eff:
6v	11	2:1	7x5	70%

Astro Flight Brushless 020 22-turn

Direct drive would be an airframe weight of 6 ounces (see above). With 8 500AR/600AE the prop diameter would fall below the minimum recommended because the current draw is limited to about 12 amps maximum on these cells. The motor can handle double this current, the cells can't. 6 700AR/800AR cells would be the choice.

Astro Flight Brushless 020 7-turn on 6 cells

Motor:	Amps:	Ratio:	Prop Diameter:	Motor Eff:
020	14	1:1	5.5x4.5, 6x3	67%

The available gear ratios are high and higher, which means large diameter props. This is not a good thing on a sport plane. To get the voltage high enough, the 500AR/600AE cells must be used, limiting the current to 11 to 12 amps. The battery weight can be up to 7.3 ounces.

Astro Flight Brushless 020 7-turn on 10 cells

Motor:	Amps:	Ratio	Prop Diameter:	Motor Efficiency:
020	10.5	3.3:1	8x6	81%

It should be noted that this setup is running near the maximum recommended 12 volts. How well the ESC with BEC will work with this combination is a question.

1. **Ferrite magnet type motor**: most commonly found in hobby shops and mail order establishments. They include motors generally used in R/C cars, Graupner Speed motors, Kyosho motors and motors placed in model aircraft kits by manufacturers.
2. **Airframe weight**: the weight of the completed and covered airframe ready to mount the R/C onboard components and power system.

(To Be Continued)

Markys Hobby Shop

From Marc Mamiye email: Hobbymaster@aol.com
www.monmouth.com/~mmm208
Phone: 732.539.8002

I have a new hobby shop and sell Parkflyers as well as EPP Foam WW2 fighters. I am the only one importing an EPP Focke Wulf at this time. It's a very durable almost indestructible Speed 400 sport scale WW2 fighter plane. Controls are elevator and ailerons. It is capable of high speed aerobatics as well as having good low speed characteristics. As you know EPP foam is very tough and resilient. The introductory price is $99.00.

I also carry the Nora, Micro HLG, Draggonette, Elfi, Chubby, Lady, Twinstar, Smiley and all Hobbyflite products.

More on the Focke Wulf

From: Geoff Barker geoffbarker@ozemail.com.au

Hi Ken,

It is great to hear that there are other flyers who appreciate (near) scale warbirds. We have only just started out and have sold kits to modellers locally, interstate and globally including the US, all from word of mouth. The interest has been staggering, and we are just trying to keep up with it all and still squeeze some flying in.

The first two made (the two Focke Wulfs in the pictures on the web site: http://www.users.bigpond.com/bananaman/S&B%20Models.htm) were not intended to be kited, but after countless requests we relented and wella. All the feed back so far has been very, very positive. With comments from one person, "What can I say. WOW!!!!" Glenn Salisbury, Melbourne.

S&B Models is a small group of modellers like you, who take pride in hand making quality kits for fellow

Component Weights:	All are Hitec, except at noted	
Receivers		
Feather Rx	0.25	
Micro 555 Rx	0.5	without case
Micro 555	0.75	with case
Super Slim 8	0.9	
Servos	**Weight**	**Torque**
HS-50	0.22	8 oz./in.
HS-55	0.28	16 oz./in.
HS-60	0.49	15 oz./in.
HS-80	0.62	31 oz./in.
HS-81	0.59	36 oz./in.
HS-85	0.7	38 oz./in.
HS-205BB	0.98	43 oz./in.
HS-225BB	1	55 oz./in.
ESC		
Pixie-14	0.5	
AF-215D or 217D	1.2	weighed w/ connectors
AF - 204D	2	
250/270 Rx pack	2	
550/600 Rx pack	3.6	

modellers. However, we believe our kits are unique as they all feature the nearly indestructible EPP foam pre-shaped very near scale fuselage with a clear pre cut canopy. Unlike other EPP kits, ours REQUIRE NO SANDING OR SHAPING IN ANY WAY for a very near scale finish comparable to an expensive composite kit.

The URL for our web sit is http: www.users.bigpond.com/bananaman/ S&B%20Models.htm (actually a customer who liked the kit so much did a web site for us!). We now have distributor for the USA, Marky's Hobby. Cheers, Geoff

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Completed Empty Airframe Weight

airframe wt.	battery wt.	total wt.	motor wt.	radio wt.	min. prop dia.
4.4	4.2	12.5	2.1	1.9	4.0
4.8	4.5	13.6	2.3	2.0	4.2
5.2	4.9	14.7	2.5	2.2	4.3
5.6	5.3	15.9	2.6	2.4	4.5
6.0	5.7	17.1	2.8	2.6	4.7
6.4	6.1	18.3	3.0	2.7	4.8
6.8	6.5	19.5	3.3	2.9	5.0
7.3	6.9	20.8	3.5	3.1	5.1
7.7	7.3	22.0	3.7	3.3	5.3

airframe wt.	battery wt.	total wt.	motor wt.	radio wt.	min. prop dia.
8.2	7.8	23.3	3.9	3.5	5.4
8.6	8.2	24.6	4.1	3.7	5.6
9.1	8.6	25.9	4.3	3.9	5.7
9.5	9.1	27.3	4.5	4.1	5.9
10.0	9.5	28.6	4.8	4.3	6.0
10.5	10.0	30.0	5.0	4.5	6.2
11.0	10.5	31.4	5.2	4.7	6.3
11.5	10.9	32.8	5.5	4.9	6.5
12.0	11.4	34.2	5.7	5.1	6.6
12.5	11.9	35.6	5.9	5.3	6.7
13.0	12.4	37.1	6.2	5.6	6.9
13.5	12.8	38.5	6.4	5.8	7.0
14.0	13.3	40.0	6.7	6.0	7.1
14.5	13.8	41.5	6.9	6.2	7.3
15.1	14.3	43.0	7.2	6.5	7.4
15.6	14.8	44.5	7.4	6.7	7.5
16.1	15.4	46.1	7.7	6.9	7.7
16.7	15.9	47.6	7.9	7.1	7.8
17.2	16.4	49.1	8.2	7.4	7.9
17.7	16.9	50.7	8.5	7.6	8.0
18.3	17.4	52.3	8.7	7.8	8.2
18.9	18.0	53.9	9.0	8.1	8.3
19.4	18.5	55.5	9.2	8.3	8.4
20.0	19.0	57.1	9.5	8.6	8.5
20.6	19.6	58.7	9.8	8.8	8.6
21.1	20.1	60.4	10.1	9.1	8.8
21.7	20.7	62.0	10.3	9.3	8.9
22.3	21.2	63.7	10.6	9.6	9.0
22.9	21.8	65.3	10.9	9.8	9.1
23.5	22.3	67.0	11.2	10.1	9.2
24.0	22.9	68.7	11.5	10.3	9.4
24.6	23.5	70.4	11.7	10.6	9.5
25.2	24.0	72.1	12.0	10.8	9.6
25.8	24.6	73.8	12.3	11.1	9.7
26.7	25.2	75.6	12.6	11.1	9.8

airframe wt.	battery wt.	total wt.	motor wt.	radio wt.	min. prop dia.
27.6	25.8	77.3	12.9	11.1	9.9
28.4	26.4	79.1	13.2	11.1	10.0
29.3	26.9	80.8	13.5	11.1	10.1
30.2	27.5	82.6	13.8	11.1	10.3
31.1	28.1	84.4	14.1	11.1	10.4
32.0	28.7	86.2	14.4	11.1	10.5
32.9	29.3	88.0	14.7	11.1	10.6
33.8	29.9	89.8	15.0	11.1	10.7
34.7	30.5	91.6	15.3	11.1	10.8
35.6	31.1	93.4	15.6	11.1	10.9
36.5	31.8	95.3	15.9	11.1	11.0
37.5	32.4	97.1	16.2	11.1	11.1
38.4	33.0	99.0	16.5	11.1	11.2
39.3	33.6	100.8	16.8	11.1	11.3
40.3	34.2	102.7	17.1	11.1	11.4
41.2	34.9	104.6	17.4	11.1	11.5
42.1	35.5	106.5	17.7	11.1	11.6
43.1	36.1	108.4	18.1	11.1	11.7
44.0	36.8	110.3	18.4	11.1	11.8
45.0	37.4	112.2	18.7	11.1	12.0
46.0	38.0	114.1	19.0	11.1	12.1
46.9	38.7	116.0	19.3	11.1	12.2
47.9	39.3	118.0	19.7	11.1	12.3
48.9	40.0	119.9	20.0	11.1	12.4
49.8	40.6	121.9	20.3	11.1	12.5
50.8	41.3	123.8	20.6	11.1	12.6
51.8	41.9	125.8	21.0	11.1	12.7
52.8	42.6	127.8	21.3	11.1	12.8
53.8	43.3	129.8	21.6	11.1	12.9
54.8	43.9	131.8	22.0	11.1	13.0
55.8	44.6	133.8	22.3	11.1	13.1
56.8	45.3	135.8	22.6	11.1	13.1
57.8	45.9	137.8	23.0	11.1	13.2
58.8	46.6	139.8	23.3	11.1	13.3
59.8	47.3	141.8	23.6	11.1	13.4

airframe wt.	battery wt.	total wt.	motor wt.	radio wt.	min. prop dia.
60.8	48.0	143.9	24.0	11.1	13.5
61.9	48.6	145.9	24.3	11.1	13.6
62.9	49.3	148.0	24.7	11.1	13.7
63.9	50.0	150.0	25.0	11.1	13.8
64.9	50.7	152.1	25.3	11.1	13.9
66.0	51.4	154.2	25.7	11.1	14.0
67.0	52.1	156.3	26.0	11.1	14.1
68.1	52.8	158.3	26.4	11.1	14.2
69.1	53.5	160.4	26.7	11.1	14.3
70.2	54.2	162.5	27.1	11.1	14.4
71.2	54.9	164.6	27.4	11.1	14.5
72.3	55.6	166.8	27.8	11.1	14.6
73.3	56.3	168.9	28.1	11.1	14.7
74.4	57.0	171.0	28.5	11.1	14.8
75.5	57.7	173.1	28.9	11.1	14.8
76.5	58.4	175.3	29.2	11.1	14.9
77.6	59.1	177.4	29.6	11.1	15.0
78.7	59.9	179.6	29.9	11.1	15.1
79.8	60.6	181.7	30.3	11.1	15.2
80.9	61.3	183.9	30.7	11.1	15.3
81.9	62.0	186.1	31.0	11.1	15.4
83.0	62.8	188.3	31.4	11.1	15.5
84.1	63.5	190.4	31.7	11.1	15.6
85.2	64.2	192.6	32.1	11.1	15.7
86.3	64.9	194.8	32.5	11.1	15.8
87.4	65.7	197.0	32.8	11.1	15.8
88.7	66.4	199.2	33.0	11.1	15.9
90.2	67.2	201.5	33.0	11.1	16.0
91.7	67.9	203.7	33.0	11.1	16.1
93.2	68.6	205.9	33.0	11.1	16.2
94.7	69.4	208.2	33.0	11.1	16.3
96.2	70.1	210.4	33.0	11.1	16.4
97.7	70.9	212.6	33.0	11.1	16.5
99.2	71.6	214.9	33.0	11.1	16.5
100.7	72.4	217.2	33.0	11.1	16.6

Upcoming Events:

January 23: Wingdingers Model Aircraft Club 22nd Annual Swap Shop - 9 AM 'till 3 PM Sturgis Armory - North Centerville Road (across from Kirsch Airport) Admission $3.00 - Children under 12 Free - ***FREE Parking*** Table Fee (8' table) - $12.00 - One FREE admission with three table purchase

February 11, 12, 13: A Celebration of Electric Flight – Visit our web site a sefds.org for details or contact, Don Wemple, at DonK126@aol.com or call (619) 469-5566. (see details in Ampeer)

May 6 & 7: Triad Electric Weekend (North Carolina)
Day 1, Winston Salem R/C field - CD Randy Covington, 336.983.9126 for info
Day 2, Riverside Aero Modelers Field - CD Colin McKinley, 336.928.5890 for info

May 13: Donnelsville, OH Azarr (more details to follow)

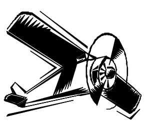
May 19-20: Indoor R/C Fun Fly 2000 at the Southwestern Aeromodeling Conference, Arlington Texas Convention Center, 1200 Ballpark Way AMA Members Only! Balloon Bust, Carrier Landing, Limbo, Aerobatics, & More
Contact: Bob Wilder 817.498.6316

May 27 & 28: CASA "Spring Sizzle" E-FunFly the site is in Rockville, MD, just outside the Washington beltway (Maps at http://www.cp-inc-us.com/casa/flysites/casa_flysite_gude.htm) Site will be open 9:00AM each day and Saturday night flying is being looked at!

June 10 & 11: Wisconsin Rapids, WI Third Annual Electric Fun Fly, Rich Ida 715.325.5309 or email Inspector@tznet.com or Chuck Benner 715.424.5179 or email cjbenner@tznet.com

July 8 & 9 (tentative) Mid-Am

Aug. 3-6 IEFF & Aug. 6-12: (F5) **International Electric Flight Festival (IEFF) and the F5 World Championships** The Silent Electric Flyers of San Diego and SANYO Energy (USA) will host these events San Diego, California. The IEFF (Aug. 3-6), which is open to all pilots, precedes the F5 World Championships (Aug 6-12). Ron Scharck, Director (858) 454-4900 email: Scharck@aol.com



The Ampeer/Ken Myers
1911 Bradshaw Ct.
Walled Lake, MI 48390
http://members.aol.com/KMyersEFO

The Next Meeting:
Date: Thursday, January 6, 2000
Time: 7:30   Place: Ken Myers's House
Important issues to discuss – please attend