WINNING WITH 15% MOTORS

by Bill Henn

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Here in New England, the FAC mass launch events have been flown under the 15% rule for more than a decade. This rule stipulates that the motor weight must not exceed 15% of the weight of the empty airframe. The purpose of this rule was to cut down retrieval times and reduce the chance of a model flying beyond the field. In addition, with the "graying" of the competitors, long retrievals were becoming a challenge. It was an ingenious solution to a growing list of problems, conceived by Dave Stott, the cofounder of the FAC. .

The 15% rule took me by surprise upon returning to the hobby in 1999 after a 20 year layoff. I hated it, although the reasoning behind it was sound. it took me an entire season before I got the hang of it. The first models that I campaigned in the WW II and Greve events were a 27" wingspan Barracuda and a peanut sized Chambermaid, both from my own plans. After being equipped with what I thought to be near optimum prop/motor combos, they were unbeatable. The Barracuda went on winning local events until one of the FAC Air Marshals in our club said, just before the last heat of a WW II event, "The only way we can beat that thing is if you break it." At that point I decided to retire the model.

The next thing off my board was a 23" wingspan Fiat G.55 which was built from a Dave G. Smith plan with a few of my own modifications. The Fiat turned out to be an even better flyer than the Barracuda, and it went on garnering Kanones for years until it was lost in a thermal a year ago. Collectively, these three models won dozens of local events, placing less than first only about 5-6 times. The losses were mainly due to crashes on launch or broken motors. I cannot recall a time when any of them were outflown.

All three models had a number of things in common, very light wing loading, flat bottom cambered stabs, long noses, props with the same pitch/diameter ratio and motors that would take about the same number of maximum turns. The 27" WS Barracuda weighed 34 grams, the Chambermaid peanut weighed 10 grams and the 23" WS Fiat G.55, 19 grams. Despite their light weight, the three models were built rugged enough to withstand years of mass launch flying, often in windy weather. No special skill was required to build these models to the noted weights. MicroX strip wood (circa 1975!) and 6lb. sheet balsa was used exclusively. Tiny portions of thin CyA was used on all tight fitting wood to wood joints and Duco for gap filling. The tissue was affixed to the frame with Titebond thinned to 50% with water. After the tissue was shrunk with water misted from a perfume atomizer, a few mist coats of nitrate dope mixed with about 60% thinner was applied. Had these models been equipped with plastic props, they would have become nose heavy and ballast would have to have been added to the tails increasing the final weight and defeating attempts to build them light. Besides, plastic props do not fit into my equation for success with 15% motors. Unless scraped down severely, they are very heavy and their pitch is too low. In addition, the Peck style props will cause excessive drag when freewheeling because their blades are very wide towards the tip where the pitch angle flattens. The advertised pitch of the Gizmo props is too high for my purposes. Sleek streak props may be OK for smaller models but, since I have not tried them, I cannot say for sure.

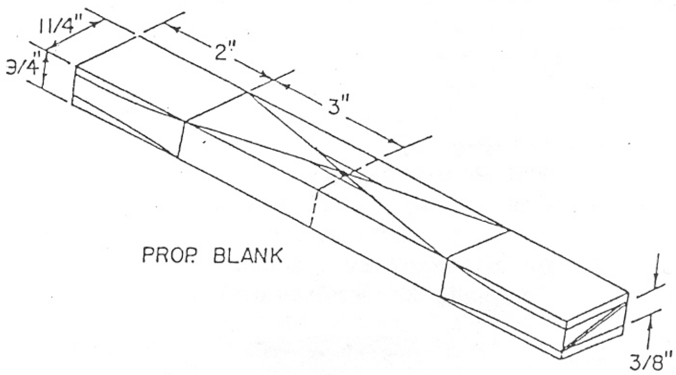
Thanks to the generous tail volume of the models noted in the foregoing, the CG's could be safely set at about 35-36% chord. The effect of the cambered stabs contributed to an increase in the tail volume. It is a shame that cambered stabs have been bad mouthed on some of the internet forums (what hasn't? - Ed) and a major national newsletter in recent years. I have used them on all my scale models built during the 70's and every one built after returning to competition with excellent results. Cambered stabs are stronger and more warp resistant than flat-plate stabs. The lift they create does not cause any instability, but it does allow the CG to be moved slightly rearward. This reduces drag (less decalage required), looping tendencies, and the need for ballast. The critics of cambered stabs claim that their lifting effect causes the nose to drop and the model to "dive in". Seems to make sense but sound theory and practical application prove it wrong.

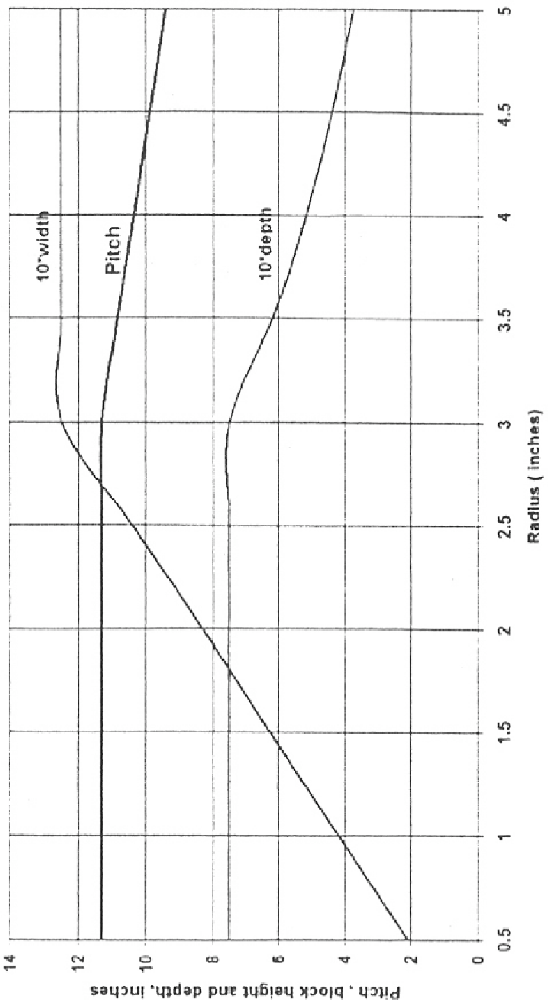
The scientific explanation as to why this anti-cambered stab argument is incorrect has been posted on various internet forums, but it is much to lengthy and beyond the scope of this article. Indeed, models can exhibit symptoms of pitch instability such as failure to recover from stalls if the CG is set too far back. However, in my opinion, the most common cause for a model "diving in" when the thrust drops off is improper decalage. Thrust keeps the nose up during the power mode, but surface alignment takes over during the glide mode. Some modelers still insist on test gliding models with the free wheeling props attached and the motor installed. Their reasoning is that this simulates how the model will glide when power runs down and it begins to glide. Seems logical but the problem is that, when hand gliding a model on level ground, the sink rate will be so rapid, due to the drag of the prop and the weight of the motor, that it is very difficult to tell what the model is actually doing in the few seconds that it is airborne. Hand gliding a model from a hill or rooftop would extend the time the model is in the air and, with such a test, it might be possible to make fairly accurate decalage adjustments. However, it is doubtful if many modelers would undertake such a procedure.

It has been my experience that the best way to test glide a model for the purpose of setting surface alignment is to hand glide it balanced, but with the prop and motor removed. This is a tried and true method that I have been using for decades without a single problem. Rest assured, it's no more difficult to do than the more frequently used procedure described above. After proceeding to test my models under power, they rarely need anything more than thrust adjustments to bring them into full trim. I have included detailed explanations of my trimming procedures in every construction article I have ever written for magazines and newsletters if anyone Is interested in pursuing the subject

The prop/motor combination is absolutely the most important factor when flying with 15% motors, regardless of the weight of the model. I use carved balsa props with the same pitch distribution on models ranging from peanuts to my twins which have won Jumbo and Giant Scale at Geneseo numerous times. These non-helical props do not have any undercamber and are strengthened by a rubbed-down coat of CYA. I generally use old CYA which has become thickened and useless for regular purposes. I rub it on the blades with a fingertip and then sand when hard. The finish comes out like glass. A prop block diagram and a pitch distribution chart is included with this article. As with popular F1B props, the pitch diminishes towards the tip. Since these props work well with heavy motors, they do not have to be changed when switching events such as from the Shell Speed Dash (unlimited motor) to the Greve Race (15% motor).

I have devised a very simple and effective means to determine the optimum size of a rubber motor. Since the weight of the motor has been already determined by the weight of the airframe, all that has to be done is to determine the length and cross section of the motor that will <u>safely</u> take about <u>1100 turns.</u> Another way of saying this is that 1100 turns are about <u>90% of maximum turns.</u> It took me years of trial and error flying to get to this particular number, one which works well with all the different sized models I use for the mass launch events. I don't know how to calculate the size of such





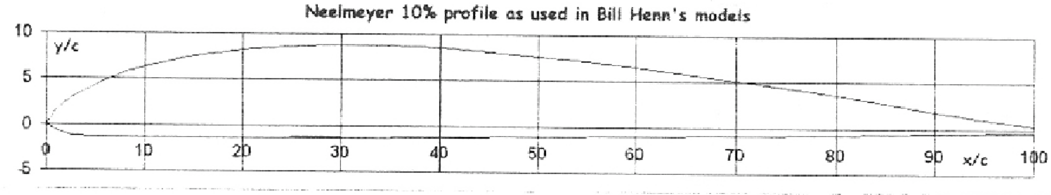
a motor using mathematics but, through years of experience, I have learned to make close estimates. In some cases it is not possible to make a 15% motor which will take 1100 turns with standard width rubber strip, and the use of a rubber stripper is required. Yes, good a rubber stripper is very expensive, but the investment is more than worth it if you're really into FAC competition.

One thing that I have noticed during the heat of competition is that other flyers models will often climb higher and have longer motor runs than mine but invariably, they come down much faster. The low wing loading of my models allows them to glide much longer. Surprisingly, these light models do very well in strong winds. They may flip flop and tumble, but recover rapidly and rise above ground turbulence. Another curious phenomenon that I have noticed is that these small models seem to fly better than larger versions of the same subject. My Chambermaid peanut will fly much better than my 23" WS version with both equipped with 15% motors. The big Chambermaid is no slouch. With a heavy motor, it won the Shell Speed Dash (3 maxes and a flyoff) and the Greve Race at Geneseo in 2006. I built 26" WS versions of both the Fiat G.55 and the Reggiane 2005 (another Smith design). Both models fly well with heavy motors but do not fly as well as the smaller 23" versions with 15% motors.

Since radial engined subjects flown with 15% motors have won the WW II event at a few major contests recently, theories abound as to their superiority. I believe their success to be an anomaly, and that inline engined subjects that have dominated WW II for years will again gravitate to the top when competitors get the hang of flying with the light motors. Radial engine subjects have obvious disadvantages as compared to long nosed subjects with inline engines. They have a larger frontal area, suffer from more drag and tend to be heavier. Although I don't fly the Thompson, I have been watching the event for a long time and it is obvious that the draggy radials with their short noses don't fly nearly as well as subjects with inline engines, cleaner configurations and longer noses. Even with short motors and light tails, radials are likely to still require ballast which results in a higher wing loading. Heavier models must fly faster to stay in the air and drag increases exponentially with speed. I believe that it would be very difficult for even a highly skilled modeler to built a 23" WS radial engined subject to the same weight as one of my 23" WS models such as the G.55 or the Re.2005. One can argue that the radials with their short noses are more stable in the air than models with longer noses. While this may be true, experience with my models has indicated to me that this is not an important factor. My light models with relatively long noses have never had stability problems, even with the rearward CG's I have been using.

While my experiences with lightly built models lead me to believe that they are capable of greater duration with 15% motors, heavy models will also benefit when using the propeller/motor combination noted above. My grossly overweight, battered, and much repaired Mig 9 model, flown for years in local Modem Military events (mass launch/15% motor), has a good contest record. While the 1100 turns figure noted in the foregoing is not an absolute, my experience has indicated that it may be within 50-100 turns of optimum. Naturally, others who have been flying successfully under the 15% rule for a long time have developed their own secrets for winning which may differ from mine. It would be nice to hear from them. All I can say is that the techniques described in this article have worked for me for close to a decade.

Neelmeyer 10% profile as used in Bill Henn's models



Profile coordinates

X%	0.0	0.625	1.250	2.50	5.0	7.5	10	15	20
Upper Y	0.0	1.200	1.812	2.939	4.378	5.458	6.313	7.515	8.268
Lower Y	0.000	-0.520	-0.800	-1.244	-1.388	-1.381	-1.375	-1.359	-1.341

X%	25	30	40	50	60	70	80	90	100
Upper Y	8.629	8.769	8.612	7.689	6.563	5.126	3.619	1.834	1.834
Lower Y	-1.319	-1.293	-1.223	-1.129	-1.011	-0.870	-0.711	-0.538	-0.358