HAL deBolt's

ENCORE

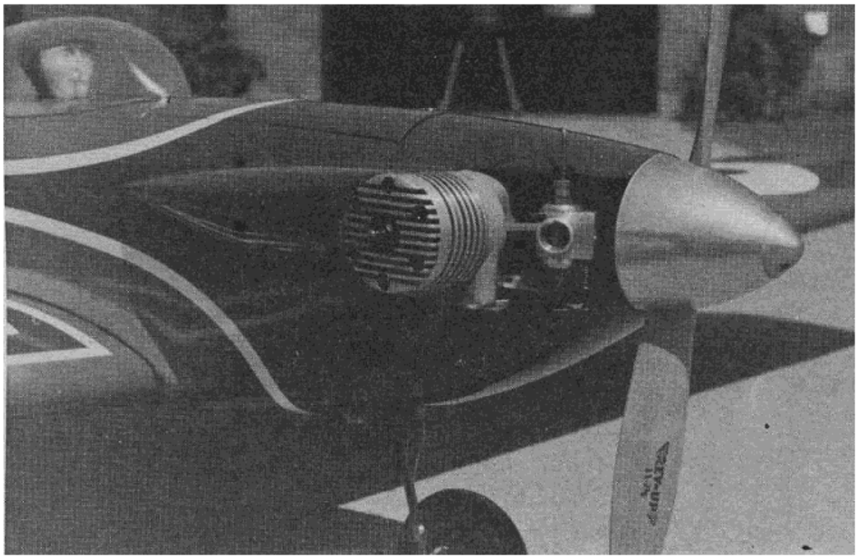
". . . That Which Comes After."
A Pretty Good Mixture of Most of the Finer Points That Have Proven Attractive Over the Past Several Years.

A POPULAR definition of the word "encore" could be "that which comes after," and usually encores are only demanded after some pretty sweet music! Finding interesting names for model designs these days is getting a bit rough, but frankly, I think it would be hard to find one more fitting for this design. This Class III bird is a pretty good mixture of most of the finer points that have proven attractive over the past several years. So, in a way, you could say that it is the aftermath, or perhaps, even the result of much hard work which has been put into the design and flight testing of many different designs during this period. Many of its predecessors were fancy, and even complicated, machines, but like many other things, when you know the answers it is usually possible to get similar results with something much less exotic.

Last summer, when a new Class III model was needed for the Nats, a lot of thought was being given to the idea that a fully competitive Class III model could be designed that would not require the many hours of torture that usually goes into this type of endeavor. We had a pretty good idea as to what aerodynamics were required for a winning design, which left only the problem of getting these things into an airframe that would go together in a hurry — a "competition quickie," if you like.

Now, to come back at you again, if you think choosing names for models is rough, how about trying to get a model, itself, to look different from the other guy's? With the stalemate that we now have in our contest flying, there is only one layout that consistently fits the bill — you just have to have a trike geared, low wing design to be "one of the boys." This same stalemate has brought us to the point where contests are no longer being won at the higher levels by ability or superior model design alone. Instead, it is circumstances which make you a winner or, alternately, an "also ran." Some circumstances you can create yourself. One of them is a "different" appearing model, as evidenced by the wide variety of designs which have shown up on the flying fields. One of the few remaining basic design ideas which had not been used was the "Goodyear" racer concept. These are cute and appealing airplanes which have a distinction of their own. It is true that they do not use three wheels, but perhaps we could start a trend in them with a trike-geared Goodyear type model. Laugh if you like! The truth is that there are some good aerodynamic reasons for following this concept, which brings us to the heart of this article.

If you do some checking you will find that the secret of the Encore is that it is a little bit lighter, somewhat larger in wing area, yet more compact than the average Class III design. The sum total of these criteria, from a performance standpoint, is increased maneuverability plus a higher flying speed. Additional maneuverability is an obvious asset, while a higher flying speed is also mandatory if you fly in heavy wind conditions. Normally, a higher flying speed is coupled with a higher landing speed, but fortunately this is not true of the Encore. The basically lighter weight, plus ample wing area, means that the landing approach can be made tail-low, adding both drag and lift, which work together to slow down the landing speed — somewhat similar to built-in flaps. I believe this is quite the opposite from most other designs which require a flat appoach in order to prevent a troublesome stall. After watching this one fly, many modelers have asked how I liked the way my Merco .61 performed, only to be shocked to learn that it is only a



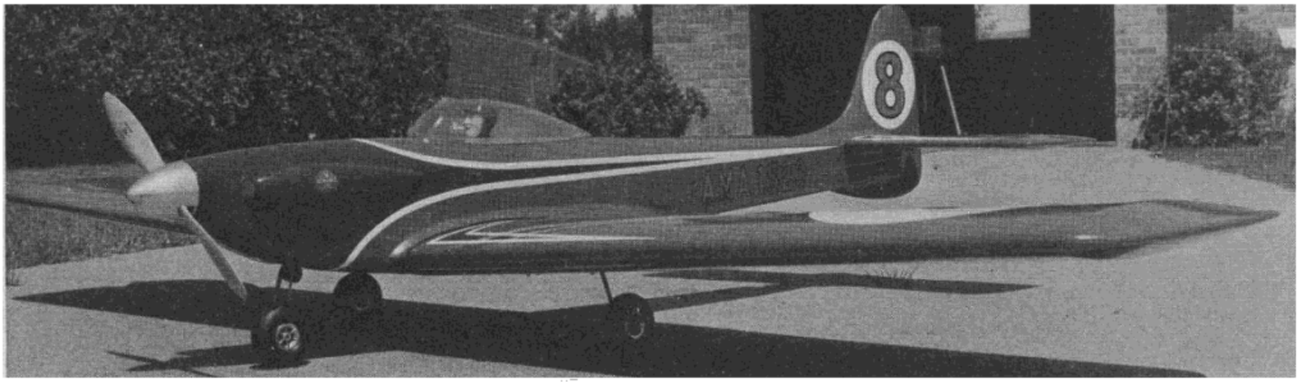
because they are the best that can be achieved under the circumstances.

To understand what happens, you should realize that every model has a size of turning radius which is "natural" to it. For example, a Jap "Zero" could easily turn inside our WW II fighters. Perhaps the Zero would loop or turn with a radius of, say, 300 feet. When our P-40 tried the same turn, it was too tight for them and the pilot would either have to pay much closer attention to controlling the airplane, or else if this size was too drastic, the P-40 might even fall out of control. The difference would be that the 300-foot turn was natural for the light and compact Zero. When the P-40 entered the same turn the control action required to assume this size turn created drag which slowed it down. Its greater weight required more lift to keep flying which was just the opposite from what it was getting from the reduction in speed. The neutral turning radius of any airplane is one which uses the maximum amount of control action that can be obtained without going beyond the point of diminishing return with the drag created. As the drag is created, it not only slows the airplane down, but also creates turbulence which can have an effect on the stabilizing effort of the tail surfaces. An example with models would be a common effect which we have all seen — your model falling off or screwing out of loops. Quite often a good remedy is simply to open up the size of the maneuver. The apparent answer is that the amount of elevator used for the tight loop was enough to create excessive turbulence, which in turn, was creating an unbalance of forces on the two elevators, or else affecting the work of the vertical tail.

Aerodynamically, the smallest natural turning radius is created by two things — one being wing loading, and the other the reaction force created by the tail. Naturally, the lighter the airplane the less force it will take to turn it, thus when an equal amount of tail force power is applied to two airplanes of given size but different weights, the

"puny" .49! It has been a hard job to convince them that the well used .49 was not, in some way, a "special" mill. What they have failed to realize is that power is not the only way to achieve a given speed. Efficient aerodynamics is often a much better method. Let's use the Encore as an example. Another design, similar in size, would normally use a .60 for power, which would mean 3 or 4 ounces of additional engine weight, plus a minimum of 12 ounces of fuel. With this one you save the weight of the heavier engine plus that of the fuel. In addition, the higher fuel consumption is costly and it becomes difficult to find room in the fuselage in which to squeeze the bigger tank. So you see that with a bit more attention to aerodynamics, you can not only use a smaller engine and reduce the fuel bill, but also fly faster and maneuver better! Hard to fight that? To be truthful, I must say that I occasionally have used a Merco .61 in the Encore, but I will be darned if I could see any difference between the two sizes when a good stunt prop was used. Going to a higher pitch and smaller diameter on the .60 would up the flying speed, but nothing else improved, so why fight it? I have found one advantage of the interchangeability, however, and that is when you know that you will be flying at a much higher altitude than normal, it's easy to have your normal amount of power simply by substituting the .61 for the .49!

I don't believe anyone has found a better way to obtain maneuverability than with lift. You can try power and streamlining, both of which will help, but by far the best and most basic way is to have enough lift. Obviously, the superior way is to have all three — power, streamlining, and lift. It seems that with the inherent weights with which we have to contend, approximately 750 square inches of area does a good job on the normal model. Some have tried more and have been successful when the additional drag encountered did not eat up the available power. The problem with 750 square inches is that most designs with this amount of area run close to 72" in wingspan. Such a span means a correspondingly large fuselage and tail, ending up with a large aircraft. The large model, with its necessarily long moment arms, requires generous power. More often than not, this requires more power than even a .60 will provide. Thus, the tendency is to shorten up the radius beyond the "natural" inclination of the model, which results in sloppy maneuvers which are accepted by the pilot simply



lighter airplane will turn more sharply since it has more lift for its weight. An airplane with a larger tail or tail moment arm than is necessary for good stability will not turn as tight either, since it requires more force to move the greater area, and in obtaining the force, the unwanted drag enters the picture.

The point of all this is to explain that there is an advantage to having a smaller, lighter, and more compact model. If you had all the power you could ever need, and all the sky in the world to work with, the advantage would not exist. Unfortunately, however, we are limited on power and we must fly within full view of the judges. Besides, if the model is smaller in overall size, it is a heck of a lot easier to carry!

We are all aware that airplane design is one continuous compromise. Usually we want to add something, but before we do, we have to consider that the addition will affect the rest of the design, with the result that we must consider whether or not the improvement achieved by the addition will offset the effects created by it. Fortunately, this also works in reverse. As an example, if you can reduce the overall size of the model you also reduce the weight of it. The lesser weight requires less power. The smaller engine uses less fuel. The smaller fuel tank is again less weight and more economical. When you get the cycle going in reverse it almost seems like it should "snowball" enough until you would not need an airplane at all!

The Encore has approximately 760 square inches of wing area, which appears ample for the weight of the equipment which must be carried. The advantage of the design is that this area is included in a span of only 64" and it still maintains a good, efficient planform. Obviously, the answer is the straight chord wing which packs in area that is lost in the tapered type. The 64" span, along with conservative moment arms, results in a much more compact design than is normal with this amount of area. The smaller overall airplane obviously takes advantage of the "snowballing" effect we just mentioned. In other words, you get the advantage of the big wing area in a smaller airframe. It's nice, of course, to have the advantage of a smaller engine and fuel bills, but more important to the contest flyer is the shorter "natural" turning radius. This means that you can fly the same size turns and loops as the other guy, and while doing it, **your** airplane will be flying well within its natural turning radius. The result is that your loops are smooth and require no correction.

So far we have spoken only of turns and loops. The remaining maneuvers are in the axial plane. Fortunately, the ability of a model to consecutively roll on an axis is governed by the control drag created in the maneuver, with wing loading and wingspan all more or less dependent on each other. It is important to maintain normal flying speed in this maneuver, or rather, to lose as little of it as possible. So, the less drag created the higher the speed will remain. If you use a high lift symmetrical section, the deflection of the ailerons in a level angle of attack can be compared to flaps. A small deflection will increase the lift of the panel drastically. Thus, in a roll, you can add considerable lift (thus reducing wing loading), simply by applying aileron control. If you also have a short wing span which requires less force to rotate, you will need less aileron movement and thus less drag. The combination of the increase in lift from the aileron flap effect, plus the lesser force required by the comparatively short span and the resulting minimum of drag, creates ideal conditions for our axial rolling maneuvers.

Would you believe that I have been trying to sell you on a compact design? I hope that you may have gotten the message because, above all else, that has been the lesson which I learned from the Encore.

Other aspects of the design come from experience. The wing uses a progressive airfoil which I have found to be more than worth the additional effort. A little review shows that the center foil is 18% and about the maximum lift available in this 65000 series. It has a fairly decent lift-drag ratio for an airfoil creating this amount of lift. The tip foil is a 65012, similar to the center, but thinner. The use of this foil at the tip does two things. Most important is that it is more stable than the center foil, which means that it will stall after the latter. Obviously, a good attribute on landing approaches, the tips will not tend to drop off as you slow way down close to a full stall. Its second advantage is that it has much less drag than the 18% section, which moves the aerodynamic center of resistance of the wing much closer to the center of the airplane. This means greater directional stability, which in pilot terminology, means positive tracking through the loops.

I have found it a definite asset to use wing fillets, especially with this airfoil. Apparently, at the speeds at which we fly, this airfoil creates conditions where it is not hard for it to start turbulating. The easiest place for the turbulence to start is at the fuselage junction. The fillets serve to smooth out the flow at this point and keep the turbulence from starting.

The Encore continues the use of a force arrangement which I have found to be most effective and one of the most outstanding advances I have yet seen in our modeling art. I don't believe that it is yet developed to its ultimate, but what we have now is so much better than what has been used before, it almost seems as though we can let evaluation take its course and obtain the additional benefits which may be there later on. I have said before that the ideal situation would be to have the tail force, or lift, exactly balance out the wings lift **at all flying speeds**, and whether upright or inverted. So much of our piloting is applied to keep the model flying level, a much easier way would be if the model would do this automatically for us. The Encore force arrangement comes awfully close to doing just that. It flys full bore with neutral elevator and flat out. Reduction in power can be drastic without any trim change required. The drag of the prop on full low engine requires some up-trim to keep the nose level, but if the engine is dead, very little, if any, is required for a level guide. Going inverted from the top or bottom of a loop requires only neutral elevator for level inverted flight. Rolling inverted requires a touch of down to bring the nose up as the roll is completed. Just why the difference I don't know at this time. I can say, however, that the range of flying speeds over which no trim change is required is the greatest I have seen yet. Don't be afraid that the drawings are wrong — there truly should be a ¾ degree more positive in the stabilizer than in the wing!

The side mounted engine accomplished something other than the cheek cowl effect. Aerodynamically, the shorter you can have the nose moment arm, the greater will be both the stability and the maneuverability of the airplane. Thus, the idea is to keep the nose as short as possible. Unfortunately, we need the nose length for balance, along with the fact that we have been stuffing more and more into it! With this type of design we want to use a big bulky engine, a half pint bottle for fuel, and also a nose gear. At the same time we want to keep the size of the fuselage down for streamlining and place the center of that big bottle level with the needle valve of our engine. If you have given this a try, and then added a power pack on top of it all, you know what I am talking about! If I had my way, I would invert the engine, since this puts the entire engine within the normal cross section of the fuselage and thus creates the least amount of drag. However, it automatically lowers the needle valve and the fuel tank, leaving no room for batteries and nose gears. You can put it upright and have room for both, leaving the cylinder fanning the breeze. The compromise in the Encore is to side mount, which raises the fuel tank enough to slip the batteries under it, and at the same time, lets you get away with some fairing for the engine cylinder. So, you would seem to have the advantage of "Goodyear looks" with a cleaner airplane and the shortest nose moment possible.

I wish I could close this article by telling you to build an Encore and you would have the same airplane the winners of all the BIG contests used last year. Sorry about that, but I can't! I **can** say that it is a fine performing machine which should make any owner proud. It will go together quicker than most any other model of its type and is well proven in competition.

Oh, yes — it **has** won several regional meets, placed quite high in all others, and **should** have done well at the NATS and FAI, but then there were those "circumstances" . . .

Have fun!

From
RCModeler
Mar. 1967