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WHAT'S THE SCORE IN STUNT?

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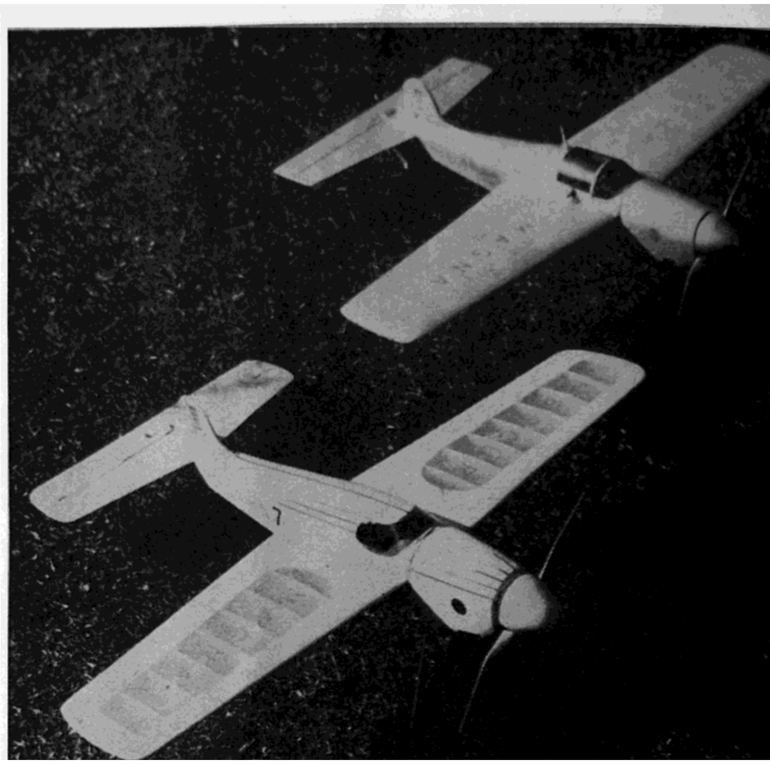


AS WE look back, it was not too long ago that a stunt meet could be won easily with a few wingovers and a loop.

Yes, things have changed in a short length of time, until now we find that stunting is really right out of this world. Vertical eights, double verticals, square verticals, etc. are all taken pretty much for granted, as is our present set of stunt rules. Yet what will be the score in stunt next year?

It is quite plain to see that our present set of rules are very sound fundamentally and include all the basic maneuvers of which our control line models are capable.

It is true that you can elaborate upon them and come up with some concoction such as the rules used in the 1949 Mirror Flying Fair. They had twenty-four maneuvers instead of the AMA's twelve; however the additional twelve were only variations and combinations of the first ones. Some people feel that these rules may be the answer, as very few fliers can go through the Mirror's Flight plan in its entirety. This may be true at the present moment, but we have to think ahead and try to imagine what is going to happen during the coming year. Think back to those old "wingover" days; we didn't believe anyone would be doing vertical eights in 1949. It would be conceivable, then, to say that this "hopped up" Mirror set of rules will only be peanuts by the end of the coming season!

There is another more practical angle to these rules, too—from the contest director's viewpoint. It requires about 14 mins. of flying time for a fast stunt model to go through this pattern; pity the poor contest director with fifty entries in his meet!

The only other way we can look at the situation is to see how we might improve our present rules without changing the maneuvers. This was done to some extent at the '49 nationals and it really worked! The idea is to make the requirements for each separate maneuver more difficult. This works out very well when you have a group of "expert fliers" in your contest. However, in general practice, it may leave a little too much up to the judges' interpretations. It would be possible for a beginner actually to do the maneuver under these rules and yet receive no credit because his flying was a bit sloppy in the judges' opinion. Every maneuver actually performed, no matter how sloppy, should receive some credit a flier shouldn't be allowed to leave the meet and say that he did a maneuver and but was not given any credit for it because the judges did not like it!

One answer to the problem has been used by the Flying Bisons of Buffalo, New York. They call it "Bonus Point Stunt Rules" and it seems to work out well, with very few close decisions being in evidence. They use the basic AMA stunt pattern and point setup, to which they add the so-called bonus points. As an example, it works something like this:

The AMA says you should receive 10 points for your first loop and five points for each of the next four, with a total of 30 points. The judges may deduct 2 points for each loop "not smoothly executed," and the decision is left up to them. The requirements are that the loops should be performed under 60°, and the whole series must be done within one-fourth of a lap. In this case the bonus system works in this manner: if you do your loops within the AMA requirements, you receive the whole credit (30 points) no matter how sloppy they are done. After that the bonus comes in, for if you did your loops all in the same spot in the air and made them nicely rounded, you receive an additional bonus of 10 points. If you were able to hold them all under 45° you receive another 10 points for a possible total of 50.

So many fliers can actually do the maneuvers within the requirements that you now have a considerable number of close decisions. The winner is usually the flier who pleased the judges in more ways than his competitors. Under the bonus system, the winner is the one who has the better aircraft, plus more ability.

For it says in black and white what he must do to receive his points, both basic and bonus-wise. In operation these rules have created very few close decisions as it is extremely difficult for a flier to obtain all of the bonus points in any one flight; he usually slips at least once during the flight. From the judges' point of view, it leaves him clear, as he has no tough decisions to make himself—they are all in the rules. On the other hand, this system gives the beginner a break also as he can get full credit for any maneuver that he does within the requirements!

The whole set of rules showing the various bonus points are printed at the end of this article so you can visualize them clearly. Looking into the future, with these rules it is quite easy to see how we can keep them up to date simply by making the requirements for the bonus a bit more rigid. For example, when we get our models so they will perform loops under 45°, the requirements may be lowered to 30°, and in that way the rules can always be up to date.

Whatever our flight requirements continue to be, it would seem that the "appearance points" should continue, so that the flier with a really well-built model receives credit for his additional work. One angle that we feel should not enter into consideration, however, is "scale appearance"; stunt models are designed to maneuver and they should not be handicapped by having to resemble full size aircraft. We have a scale event for that purpose, and all scale requirements should remain in that event!

After looking over some of the tricks our stunt models (as well as the fliers themselves) are going to have to do, one immediately begins to wonder just what kind of a model will be able to perform all these "inside-out" maneuvers. Actually it will have to be a highly specialized aircraft, with plenty of development behind it. The problems are many, with one leading to another, until the end seems never to be within reach. First, you work the model until it will turn in its own length (which is quite an accomplishment in itself); then you discover that it practically disintegrates in the air! Sharp turns mean heavy loads on the flying surfaces, especially with the high-speed popular models that are becoming so it becomes a matter of aerodynamic design, plus structural engineering, before you can have a completely successful model.

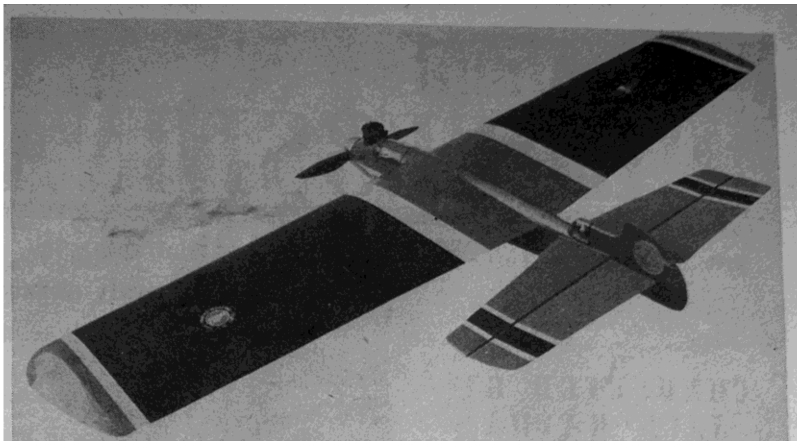
I believe that at this time I have a model which fills the bill, at least as well as any other. Perhaps if we run over its basic design, the fundamental requirements will become somewhat clearer and a bit of the "fog" can be cleared away.

What we are actually looking for is the "ideal stunt model," one which would be stable in level flight, extremely maneuverable, rugged enough to last for at least one season and yet pleasing to look at! Yes—that is a lot to ask for, but it is not impossible to obtain if you go about it in a systematic way.

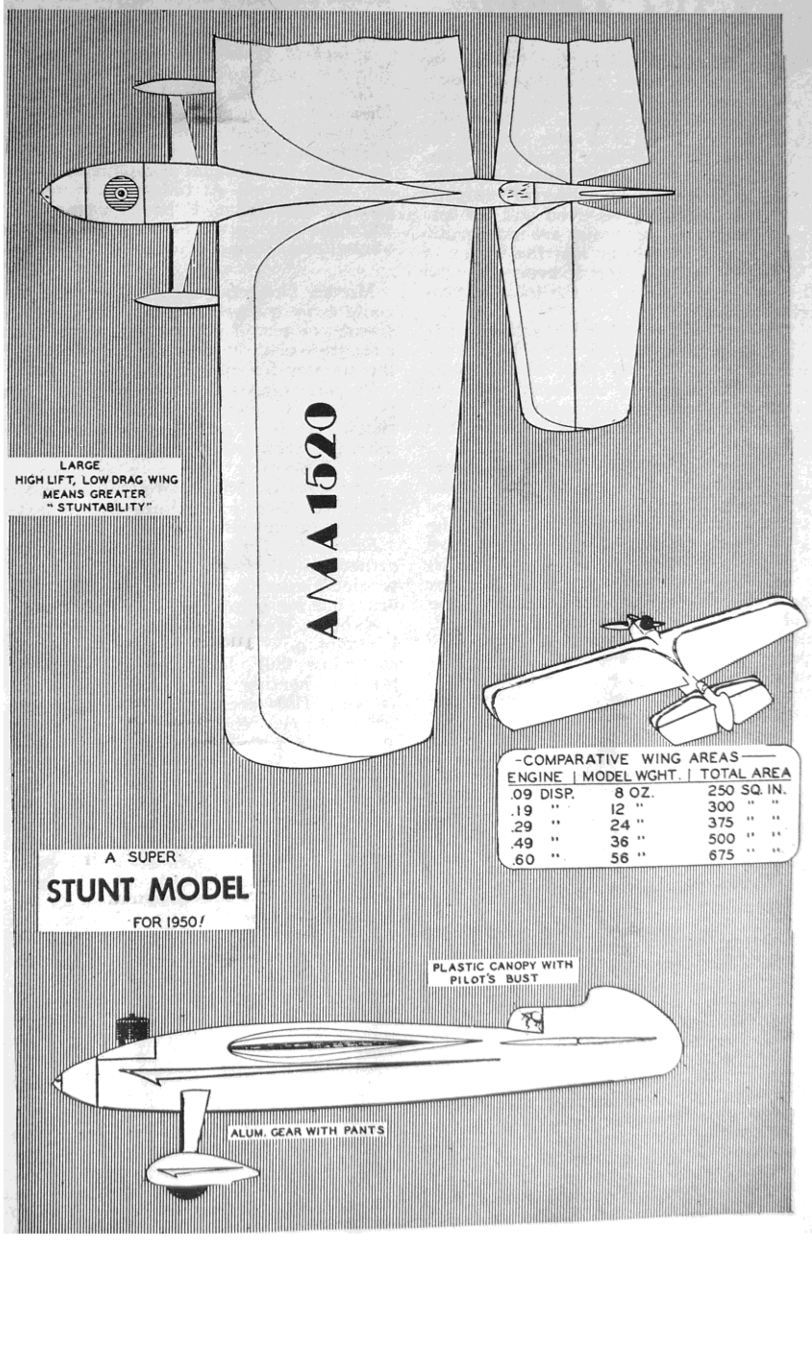
Let's see what can be done by starting from the flying end, or aerodynamic design. Foremost in our needs is a tight turning radius and ability to perform maneuvers in the smallest possible area.

This is governed by several things, among which are the wing loading, flying speed, moment arm length and total drag. One of the essential assets is a relatively high flying speed, as this allows the model to snap around tight corners without stalling out or losing its speed. At the same time it must stay on the end of the lines without allowing them to become slack. Therefore, all features we use in the model must be of a low-drag nature, with every part as clean as we can possibly design it.

With a high-speed flying, an extremely short tail moment arm will be an asset, allowing us to turn sharply. If this arm is too long, it will tend to dampen out the effect of our control surfaces, so that the model will go around in a sweeping arc, instead of the nose chasing the tail around, so to speak. The short moment arm has another advantage too—it helps keep the size of the fuselage to a minimum, which in turn reduces over-all weight. Above everything else our model must be short-coupled.



Typical American stunt plane with short fuselage and huge surfaces



COMPARATIVE WING AREAS

ENGINE	MODEL WGHT.	TOTAL AREA
.09 DISP.	8 OZ.	250 SQ. IN.
.19 "	12 "	300 " "
.29 "	24 "	375 " "
.49 "	36 "	500 " "
.60 "	56 "	675 " "

We now have a model that will turn sharply at a high speed, but we find that it loses speed in consecutive maneuvers which is not good from the appearance standpoint, nor is it easy to fly in this manner. Experience has shown that this trouble can be traced directly to wing loading. In figuring wing loading we must use the total weight our wing must lift, that is, the weight of the model ready to fly plus the weight of the lines used.

In designing the wing, we really should not consider it by area, but by total lift generated, for it is lift, and not just area, that must offset the total weight. This lift is generated by an airfoil, and airfoils vary to extremes—some develop tremendous lift and others have practically no drag. We are looking for one which produces a great amount of lift to offset model weight; at the same time, however, it must not create too much drag. or our flying speed will fall off. So we choose one with medium lifting powers, and which also creates the least amount of drag.

With the airfoil chosen, the next step is to lay out our wing planform so that it provides enough lift at all times to offset the flying weight and maintain flying speed. This is done by choosing a wing which has a large amount of lifting surface—this large wing gives the required lift and yet has a low-drag ratio, due to the carefully chosen airfoil. To give any sort of a formula which would tell how much area to use for a given weight, would be beyond the capabilities of the average modeler, as well as my own. However the areas indicated on my "Super Stunt Model" drawing have proven out in practice, and seem to be correct at this time.

One other item to bear in mind when choosing wing sizes is the power the engine develops. Most fellows like to use 70' lines no matter what size engine used (excepting for the small bore jobs, of course). This must be taken into consideration if we are to obtain equal results with all engines.

When making comparisons between our Class B model and the 60's, remember that the weight and drag of the lines stays fairly constant. Therefore, if we are to have equal success with all size models we must use more wing area by comparison, on our

Class B models, than we do with the larger ones.

Now that the wing problem is fairly well settled, about all that is left is the horizontal tail surfaces and fuselage. Once again we can let experience work with us in determining tail area; 25% of the wing area seems to work well with short-coupled aircraft, the longer moment armed jobs require less, due to the mechanical advantage obtained with the additional moment arm. Also, the stabilizer should constitute 45% of the total tail area; with such a setup there is very little chance of the tail blanking out completely, no matter what attitude the model gets into. Weight is a factor here and it should be held to a minimum.

The fuselage is actually nothing more than a means by which we tie the whole works together. Therefore, it is here that we should concentrate on good looks; at the same time drag should be held to a minimum. The best way to start is to lay out the desired location of the engine with its fuel tank and design the fuselage around it. Everything should be done to keep it as streamlined as possible and yet it should possess plenty of strength. Careful attention should be given to motor mounts so that they are anchored firmly enough to absorb the engine's vibration. This will provide a longer lasting model and at the same time it will allow for more consistent engine runs due to the reduction of "boiling" in the fuel tank. With a well laid out fuselage on the drawing board, the basic design problems are pretty well covered and about all that remains are to get the model built.

To get an idea of how all this shapes up, let's look over the drawing of my model, and see how it ties in with all that has been said.

Beginning with the engine, I am inclined to use the most powerful one that I can get; it always seems better to have too much available power than to have too little. The most potent engines of course are the glow plug 60's; the glow fuel contains the power and the .60 allows us to use most of it. I use the Atwood Glo-Devil; to get a long consistent run, this engine requires a tank of about 4 cu. in. in capacity with the true wedge type working as well as any. A baffle in the tank or a loop in the fuel line will help to maintain a constant flow of fuel during all sharp maneuvers. These engines seem to develop their peak power on 12" props with a pitch to match their different power curves. The exact pitch can only be found by experimenting.

The wing is of tapered design for both appearance and efficiency. The airfoil is one which has proved to have a tremendous lift and yet it seems to have very little drag. A speed of over 100 mph can be expected from the model. The wing is nearly 5' in span with a total area of 670 sq. in. With the high speed and the huge wing there will be no slowing down or stalling out with this aircraft. The construction of the wing includes plenty of balsa with both spars and sheet covering being used. This has been found to be very necessary due to the terrific loads imposed upon it during sharp turns and maneuvers; previous models which had a lighter wing construction actually folded in mid-air! The controls are also located in the wing where they have a good solid anchorage.

The horizontal tail is almost the size of some wings, therefore it had to be given considerable thought. It was kept as thin as possible to reduce drag and yet by using a built-up construction, weight was held to a minimum and the strength was enhanced.

With such large flippers on a really high speed model such as this, extra attention must be given to the hinges and control horn. In this case they are made from metal and heavily reinforced. It is also necessary to use a push rod of at least 3/32" music wire to prevent flexing under load. The actual movement used in ordinary maneuvers is relatively small, about 10° in either direction; however, it is always a good idea to have more for emergencies, when an additional foot of altitude may prevent a crack-up.

The fuselage in this model is of sheet balsa construction, faired with balsa blocks. The sheet gives extreme strength, especially when laminated in highly stressed areas; lamination is used around the wing joint and the motor compartment. The contours of the fuselage are held to the minimum in which the engine and tank can be fitted; at the same time every effort has been made to attain the maximum in streamlining. The large spinner on the nose with the partially cowled engine allows these contours to flow smoothly from the nose to the tail. The characteristic rudder-cabin on the design is a compromise whereby good looks can be had with the least amount of additional drag and weight.

An additional touch of originality can be had by making a simple form block and molding a plastic canopy to use as the cabin. A pilot's head, with an instrument panel and controls add a nice touch to the inside of this canopy and actually require but little extra time to install.

I have been using aluminum gears on all my stunt models this past year, for several reasons. They add a nice realistic touch for one thing, and have proved to be very rugged. Installation is simplicity itself; they are screwed to the bottom of the motor mounts which makes for a solid fastening, Then, too, no firewall as we know it is necessary with them, which keeps the gear out of the way of the fuel tank. The wheel pants are the only doubtful addition—they certainly add looks but just how practical they are remains to be seen. They are fastened to the gear with small metal brackets by means of plywood which is imbedded in the balsa pant.

One of the paramount items in a successful stunt model is balance. It is the root of all evil and at the same time it is the stepping stone to success. With this model as an example and using the front line as a reference point, we can change the ship from an extremely stable flier to one which is practically impossible to fly. The farther forward we locate the C.G., the more stable the model becomes; the further aft from the front control line that we shift the C.G., the more maneuverability we get until a point is reached where instability sets in. Actually the safest and best compromise is to have the balance point or C.G. right at the front line, especially with the short-coupled type of model. My C.G. is always located slightly behind the front line where the point of maximum maneuverability lies: if any instability shows up, I simply add a bit of weight to the nose until it disappears.

Actually, the best method to use no matter what type of model you are using is to locate the C.G. where indicated (if you are building a kit model) by checking balance carefully while installing the wing. It takes a bit longer to put all the parts in their correct places and actually locate the C.G. where it belongs while you are building, but it really gives you the utmost in performance, once the model is completed. If you build kit models, this is even more important. With the prefabrication that is in use today you can get into trouble very easily; the manufacturer locates his wing cutout where it proved best on the test models. However, balsa varies to extremes in density which means that the actual center of gravity in your model can be considerably different from that in the original. Suppose the aft part of your model is built from very heavy wood as an example, while the original had wood of the other extreme. Your C.G. could come out quite a bit farther back, which would mean that your wing should be moved aft no matter where the cutout for it lies.

I believe this all goes to show that stunt flying has really grown up, until it now has become as much of a science as are all the other phases of modeling. One nice feature of it all is that a fairly rank amateur can take one of the new-type stunt models and in a short time master most of the maneuvers; it's much harder to fly these new jobs into the ground as it takes far less altitude to recover from abnormal positions. These advancements are a boon to the seasoned flier too, for he can now build a model which is really nice to look it, and know that performance will be something he has always dreamed of. The built-in ruggedness and stuntability mean that he can have that much more flying time during which he can really polish up his technique and know that his every flight will be one of near perfection!

Flying Bison Bonus Point System

STARTING. (Take-off within I min.) 5 points.

TAKE-OFF. (Ability to control.) Sloppy-1 point; Rough-3; Smooth-5. Bonus: Within 5'—.

LEVEL FLIGHT. (2 laps at 6' altitude.) Rough-1; Wavy-3; Smooth-5.

CLIMB. (At least 15' measured vertically, with a precise change of direction into and out of maneuver.) Vertical climb-10 points. Bonus: 60° angle—5; 90° angle-10.

DIVE. (At least I5' measured vertically, with a precise change of direction into and out of maneuver.) Vertical Dive-10 points. Bonus: 60° angle-5; 90° angle-10.

WING-OVER. (Vertical climb and dive with model passing directly over flier's head, cutting the ground circle in half.)

Wing-Over-15 points. Bonus: square entrance & exit-10; 90° angle—I0.

CONSECUTIVE INSIDE LOOPS. (Entire series should be done within 1/4 lap with control lines at an angle of 60° or less to the ground at all times during maneuver.) / loop-10 points; 2nd to 5th incl.-5 each. Bonus: Smooth and round—I0; Under 45°-10.

CONSECUTIVE OUTSIDE LOOPS. (Entire series should be done within 1/4 lap with control lines at an angle of 60° or less to the ground at all times during maneuver. Loops may be entered from inverted or normal flight, so long as complete loops are made.) 1st loop-10 points; 2nd to 5th incl.-5 each. Bonus: Smooth and round-10; Under 45°-10.

INVERTED FLIGHT. (Must start and end with model in normal upright position. Flight direction must be opposite to that of take-off. Model should be flown at a 6' altitude.) 1st lap-10 points; 2nd lap—/O; Recovery—/O. Bonus: Under 6' altitude-10; Recovery under 45°-10.

HORIZONTAL FIGURE EIGHT. (Should be done within 1/2 lap, with control lines at an angle of 60° or less to the ground at all times during maneuvers.) 1st eight-20 points; 2nd and 3rd-10 each. Bonus: Within 1/4 lap-10; Under 45°-10; Well rounded-10.

II. VERTICAL FIGURE EIGHT. (Control lines should not exceed an angle of more than 90° to the ground.) 1st eight-20 points; 2nd and 3rd-10 each. Bonus: Under 60°-10; Well rounded-10.

OVERHEAD FIGURE EIGHT. (Center of figure to be directly over flier's head. Control lines should not be at less than a 30° angle to the ground at any time during maneuver.) 1st eight-20 points; 2nd and 3rd-10 each. Bonus: Not less than 60°-10; Well rounded—I0 points.

SQUARE LOOP. (Horizontal flight portion of maneuver should consume at least 1/4 lap. Corners should have a radius of approximately 5'. Angle of control lines to ground should not exceed 60° at any time during maneuver.) 1st corner-5 points; 2nd-5; 3rd-10; 4th-20. Corners with greater than the approximate 5' radius specified--0. Bonus points: Under 45°-10 points.

SPECIAL MANEUVER. (Must be described in detail to judges prior to flight. Only one such maneuver may be made, and must be an aerodynamic or mechanical maneuver of the model itself; not a stunt of the contestant alone.) Best special maneuver to receive 15 points, with those of other contestants being graded in proportion.

LANDING. With gear; Nose-over-3 points; Rough-5; Bounce-10; Smooth-15; Without gear: 2 touches-3; 1 touch-5; Smooth–/O.