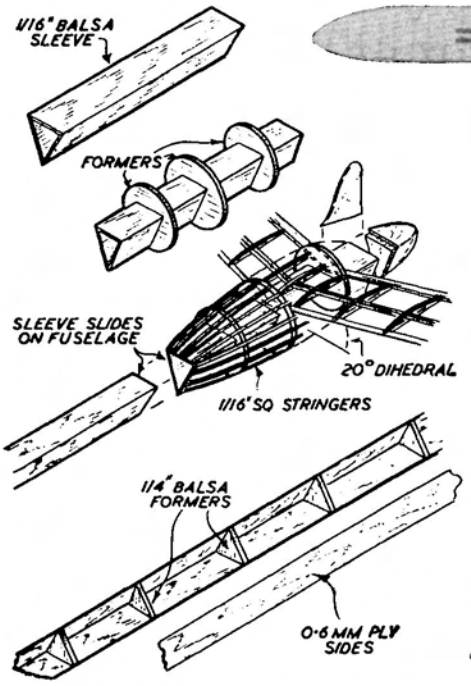
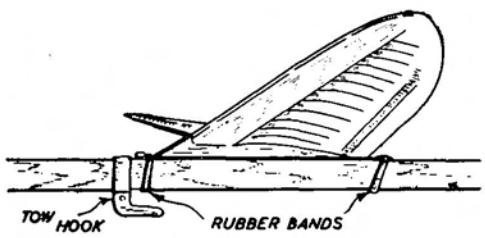
M.A. Presents The Glider of the Year





TOOTHPICK

Span ... ... 67 in. Overall length 78.5 in.

	Area	Projected area
Wing ...	465 sq. in.	458 sq. in.
Tailplane ...	71 sq in.	67 sq. in.
Total ...		525 sq. in.

Total weight ... ... 14 oz.
Wing loading ... ... 3.12 oz./100 sq. in.
Sinking speed ... ... 1 ft./sec.

From 'Model Aircraft' December 1951

TOOTHPICK

The Winner of

THE WORLD A2 GLIDER CHAMPIONSHIP

By Oscar Czepa

UNORTHODOX to British eyes, the *Toothpick* is the latest model in a long series of designs based on practical experiment and a study of the theory of low speed aerodynamics. It is typical of what is known in Austria as the " Vienna School " of design.

Basically the main requirements of a good towline glider are :—

(i) It must have good line stability.
(ii) Adequate lateral stability.
(iii) Design proportioned to the best advantage for that particular class, with the emphasis on minimum sinking speed.

Line stability is achieved by virtually eliminating all side area in front of the wings, so that all the surfaces offering " keel " area are grouped at the tail end. Even the small nacelle giving the required fuselage cross-section is grouped around the tail, again with a certain fin effect.

Lateral stability is taken care of by using straight dihedral of 10 deg., which has been found quite adequate under all conditions. With the first two conditions satisfied the remainder of the design is based on arriving at the best possible arrangement to meet condition (iii).

Broadly speaking, the main requirements for a low sinking speed are high lift and low drag. The fuselage serves only as a bearer or supporting member for the wing and tail unit. Aerodynamically it is a nuisance and so to minimise this nuisance its wetted area and cross-section are reduced to the smallest possible figure. It could be argued that by using a very long fuselage we are defeating our own end (i.e., trying to reduce wetted area), but we need a long fuselage for two very important reasons. In the first place we have a fixed total area for the A/2 specification. On any conventional model the wing flies at its optimum attitude for best lift. The tailplane operates at a lower lift, or no lift at all if it is used as a pure stabiliser. Hence, with a fixed *total* area the best arrangement is to allocate as much as possible of this area to the wings.

We have found it possible to reduce tailplane area to between one-eighth and one-seventh of the wing area, and still retain adequate longitudinal stability, provided we use a moment arm of between five and seven times the wing chord. Still keeping our fuselage cross-section small, we simply extended it aft of the wings for the required distance.

This long stick fuselage had to be made of ply. Balsa is very difficult to obtain in Austria and it is doubtful that a balsa fuselage of similar cross-section would be strong enough, in any case. But ply is relatively heavy and so to balance out the model within the permitted 14½ oz. minimum total weight we simply extend the front part of the fuselage forward until we can get the required balance with only a small amount of ballast.

We thus have a very efficient set-up, with low drag and high lift already partially assured by the large wing area. The final factor is the aerofoil section. The particular section used was evolved after a long series of experiments and is one which we believe gives very nearly optimum performance for glider wings of all sizes. It has very high lift values with correspondingly low drag.

Construction of the model should not present undue difficulties to an experienced builder, although the materials used are somewhat different from standard

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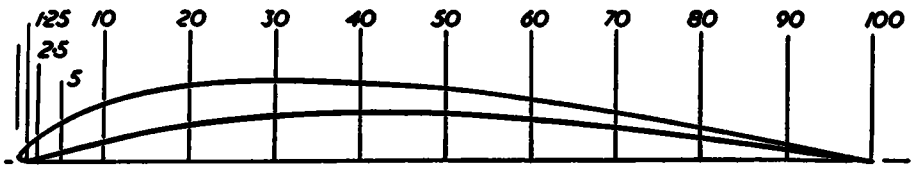

STATION	0	1·25	2·5	5	10	20	30	40	50	60	70	80	90	100
UPPER	0·5	2·3	3·1	4·75	6·9	8·9	9·5	9·1	8·45	7·2	5·75	4·0	2·1	0
LOWER	0·5	-	0·5	1·2	2·3	4·5	5·55	5·75	5·55	4·8	3·8	2·5	1·15	0

British practice. Supplies of ply in suitable thicknesses and length may be difficult to come by and here possibly alternative methods of construction may suggest themselves. 0.8 mm. ply is rather too heavy, if used in place of the 0.6 mm. ply specified, making it difficult to duplicate the model at 14½ oz. total weight, if the same construction is followed. For the fuselage it should be possible to use 3/32 in. sheet balsa, perhaps, strengthened by binding with silk.

The fuselage stick is made by cementing three strips of wood together, with light ¼ in. balsa triangular formers, spaced as indicated on the plan. A light balsa sleeve is made to fit over the fuselage stick. On this sleeve the nacelle is built up from balsa formers and stringers. The tailplane and fin also attach to this nacelle, the whole being free to slide on and off the rear of the fuselage stick. Do not cement the nacelle in place.

The tailplane is built flat in one piece from balsa sheet and strip. Slot and "fan" the leading and trailing edges to bend round to form the elliptic tips, cementing well. When the tailplane structure is completed it is cut in half and re-cemented to the nacelle at 20 deg. dihedral angle.

The wing panels are built separately. A simple jig is necessary to block the ribs and leading edge up and hold the 0.6 mm. ply trailing edge at the required angle. The leading edge is of light balsa, slotted to take the ribs. The upper and lower mainspars are stripped from 0.4 or 0.6 mm. ply, no thicker. Finally, the two panels are joined with the aid of the dihedral braces, each panel to have exactly 10 deg. dihedral. The centre section platform can then be built up and completed.

When all the components are completed and covered and doped, find their total weight. Then add ballast weight as required to the nose compartment of the fuselage to bring the total weight up to the 14½ oz. minimum required. Assemble the model and adjust the wing position until it balances at the c.g. position specified—40 per cent. chord. You can check this position by hand launch trimming flights. This will give you a rough trim. The best trim can only be arrived at by tow launched tests, adjusting the wing fore and aft slightly, as necessary. From a 20 metre towline the flight time in still air should be between 58 to 60 sec.

The towhook should come directly in front of the leading edge of the wing. Check carefully for warps for a warped wing, or other misalignment will almost certainly mean that your model will veer off to one side on tow. Tow slowly and do not hurry the launch.

For thermal flying a flat left circle is best, which can be achieved by offsetting the small balsa fin to the left. Even flying straight, however, *Toothpick* will find and hold thermals.

A dethermaliser is essential, but the normal tip-tail type is not effective on models of this type. A parachute is best, strapped to the side of the fuselage and released by the usual burning fuse. The parachute used is approximately 5 sq. dm. in area (77.5 sq. in.). The chute line is roughly 5 ft. long and is attached to the fuselage 4 in. behind the wing.

Plans prepared from authentic original drawings, supplied by Oskar Czepa. Where possible dimensions have been reduced to inches. True metric dimensions are given in the case of some of the more important measurements.