WING MAIN PANELS

- W1 LEADING EDGE - 1/4 SQ. BALSA
- W2 LEADING EDGE SKIN - 1/16 SHEET BALSA
- W3 MAIN SPAR CAP - 1/8 x 1/4 SPRUCE
- W4 MAIN SPAR WEB - 1/32 PLYWOOD
- W5 REAR SPAR - 1/8 x 1/4 SPRUCE
- W6 TRAILING EDGE - 1/4 x 2-1/4 BALSA
- W7 ELEVATOR - 1/4 x 3-1/2 BALSA
- W8 GUSSET - 1/16 PLYWOOD (20 REQ.)
- W9 ELEVATOR INSERT - 1/4 PLYWOOD
- W10 PANEL JOINER - 5/32 DIA. WIRE 6° DIHEDRAL (2 REQ.)
- W11 JOINER SEAT - 5/32 I.D. ALUM. TUBE (4 REQ.)
- W12 RIB - 1/16 SHEET BALSA (30 REQ.)
- W13 RIB CAP - 1/16 x 1/4 BALSA
- W14 JOINER RIB - 1/16 PLYWOOD (6 REQ.)
- W15 ROOT RIB - 1/4 BALSA (2 REQ.)
- W16 ROOT RIB FACE - 1/32 PLYWOOD (2 REQ.)
- W17 TIP RIB - 1/4 BALSA (2 REQ.)

WING MAIN PANELS

- W18 TIP RIB FACE - 1/32 PLYWOOD (2 REQ.)
- W19 TIP JOINER SEAT - 1/4 I.D. ALUM. TUBE, EPOXY FILLET
- W20 TIP WEB - 1/16 HARD BALSA VERTICAL GRAIN
- W21 ELEVATOR HORN (2 REQ.)
- W22 ROOT SKIN - 1/16 SHEET BALSA, TOP & BOTTOM

REMOVEABLE WING TIP

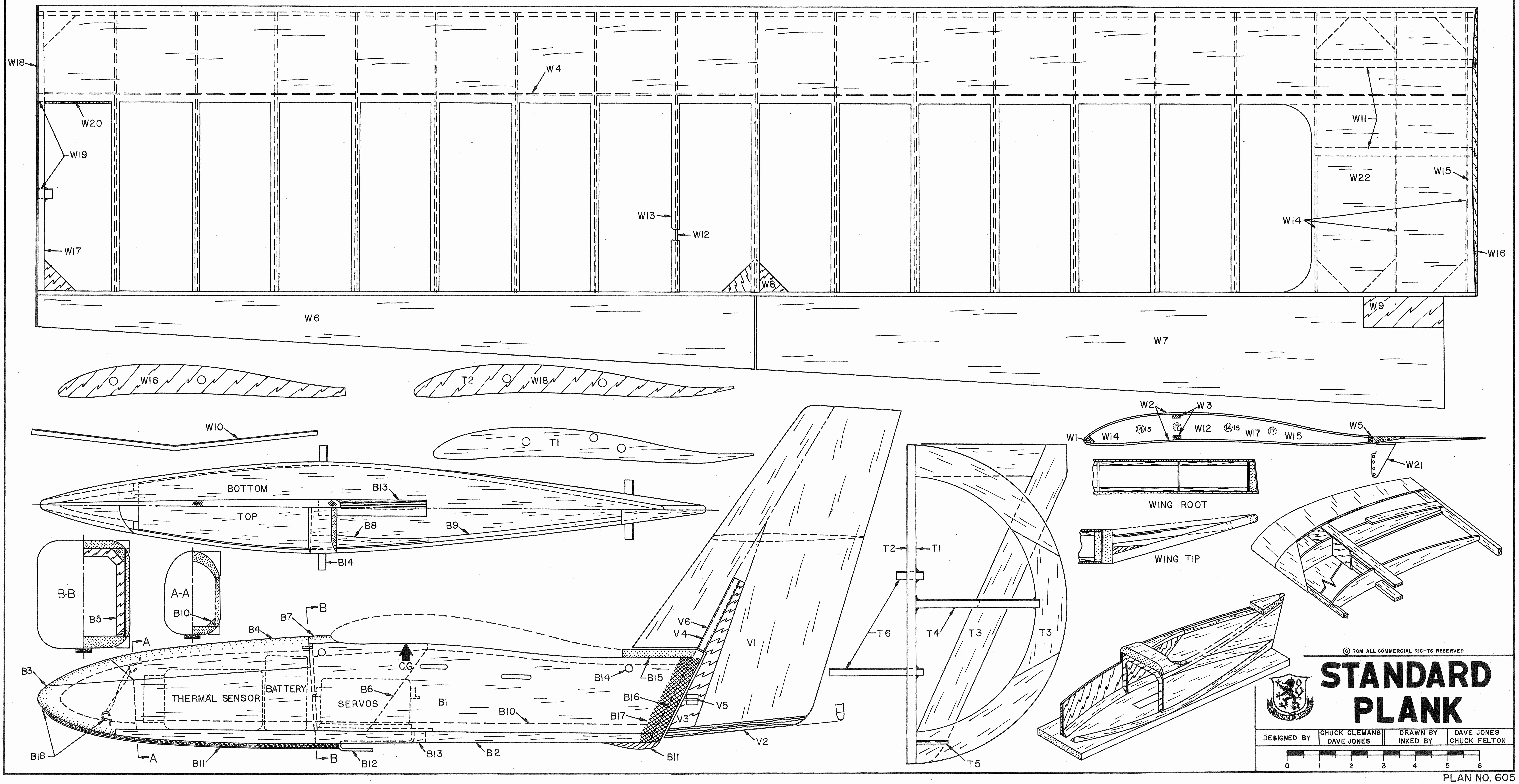
- T1 ROOT RIB - 1/4 BALSA (2 REQ.)
- T2 ROOT RIB FACE - 1/32 PLYWOOD (2 REQ.)
- T3 TIP OUTLINE - 1/4 SHEET BALSA
- T4 TIP SPAR - 1/4 O.D. ALUM. TUBE, EPOXY FILLET
- T5 DIHEDRAL BRACE - 1/8 PLYWOOD 15° DIHEDRAL (2 REQ.)
- T6 TIP JOINER - 1/4 O.D. ALUM. TUBE, EPOXY FILLET

VERTICAL TAIL

- V1 MAIN BODY - 1/4 SHEET BALSA
- V2 ROOT RIB - 1/4 SQ. SPRUCE
- V3 INSERT - 1/4 PLYWOOD
- V4 HINGE - 1/4 O.D. ALUM. TUBE
- V5 HORN (1 REQ.)
- V6 BEARING - 7/32 O.D. ALUM. TUBE

BODY

- B1 SIDE - 1/8 SHEET BALSA
- B2 BOTTOM - 3/8 SHEET BALSA
- B3 LOWER NOSE - PINE OR HARD BALSA
- B4 HATCH/UPPER NOSE - BALSA
- B5 FRAME - 3/32 PLYWOOD
- B6 FORWARD DOUBLER - 1/32 PLYWOOD
- B7 FORWARD WING STOP - 1/4 SHEET BALSA
- B8 FORWARD WING REST - 3/8 TRIANGULAR BALSA
- B9 AFT WING REST - 1/8 SHEET BALSA
- B10 LOWER LONGERON - 1/4 TRIANGULAR BALSA
- B11 SKID - SERVO TAPE AND STYRENE, REAR SKID - SPRUCE
- B12 TOW HOOK - 1/16 DIA. WIRE
- B13 TOW HOOK BLOCK - 1/2 x 3/8 MAPLE
- B14 WING HOLD DOWN - 1/4 O.D. ALUM. TUBE
- B15 UPPER TAIL - 1/4 SHEET BALSA
- B16 HINGE - 1/4 O.D. ALUM. TUBE
- B17 HINGE FAIRING - FG CLOTH AND EPOXY
- B18 MISCELLANEOUS



STANDARD PLANK

DESIGNED BY	CHUCK CLEMANS DAVE JONES	DRAWN BY INKED BY	DAVE JONES CHUCK FELTON

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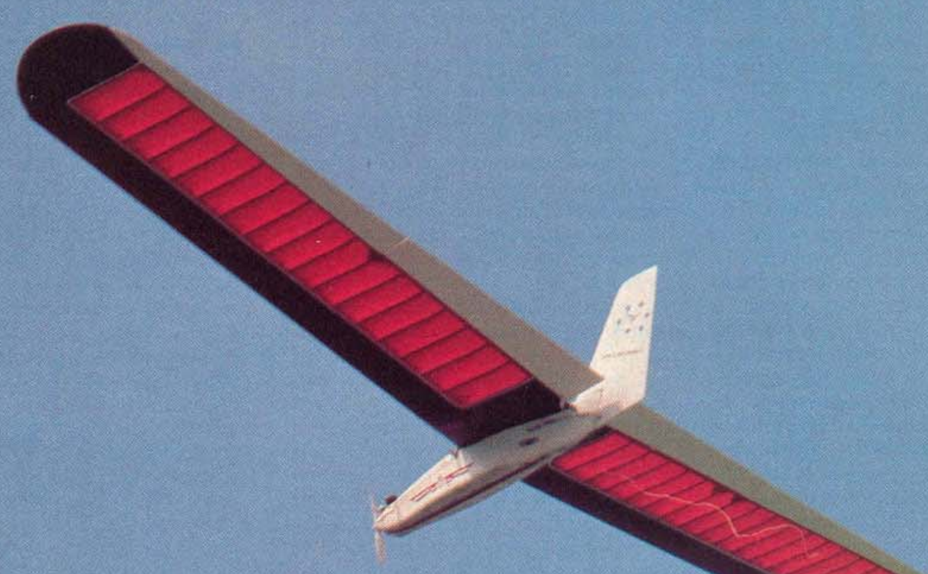
PLAN NO. 605

STANDARD PLANK



BY CHUCK CLEMANS AND DAVE JONES

PHOTOS BY JOHN C. CLOSSON

The Standard Plank is the continuation of a design series on flying wings and is the second design from the series to be published. The Little Plank was featured in the May 1972 RCM and, judging from the correspondence received, was well accepted both here and abroad. The current design is an attempt to improve performance for thermal soaring while retaining the simplicity and ease of construction inherent with the Plank configuration. A new wing section was developed based on the NACA 6409 and the aspect ratio was increased to ten. Control installation was simplified through the use of elevator and rudder.

Design Summary

Configuration: Flying wing with no sweep and a constant wing section allowing the use of a single rib size.
Fuselage: Minimum cross section with a single internal bulkhead.
Rudder: Flying rudder utilizing an aluminum tube hinge.
Power: .049 to .051 in a power pod, easily removed for slope or tow launch. Prototype used a Cox TD .051.
Controls: Elevator and rudder.
Wing Section: CJ-2, a section developed by the authors for use on flying wings and based on the NACA 6409 used on the Olympic 99 and other R/C gliders.
Wing: Two piece with integral or plug in tips. Basic span of 100 inches may be extended with alternate tips.
Equipment: The prototype utilized a Kraft two channel and Soaring Products thermal sensor.
Construction: Balsa with spruce spars.
Finish: Solarfilm and MonoKote on wings, Hobbypoxy finishing resin and acrylic lacquer on the fuselage.
Weight: 36-46 ounces, using a Kraft two channel and Soaring Products thermal sensor.
Performance: An unusual and versatile sailplane with a large range of flight speeds.

STANDARD PLANK
Designed By: Chuck Clemans & Dave Jones

TYPE AIRCRAFT
Thermal Soaring, Tailless
WINGSPAN
100 Inches
WING CHORD
11.25" (Average)
TOTAL WING AREA
1090 Square Inches
WING LOCATION
Top of Fuselage
AIRFOIL
Reflexed NACA 6409 (CJ-2)
WING PLANFORM
Swept T.E.
DIHEDRAL, EACH TIP
6 Degrees
O.A. FUSELAGE LENGTH
20¾ Inches
RADIO COMPARTMENT AREA
(L) 9" (W) 2" (H) 2½"
FLYING RUDDER HEIGHT
11¾ Inches
FLYING RUDDER WIDTH
4½ Inches (Average)
REC. ENGINE SIZE
.049-.09 Power Pod or Nose Mounted
LANDING GEAR
Skid
REC. NO. OF CHANNELS
Two
CONTROL FUNCTIONS
Elevons & Rudder
BASIC MATERIALS USED IN CONSTRUCTION

Fuselage	Balsa and Ply
Wing	Balsa, Ply and Spruce
Empennage	Balsa, Ply and Spruce
Weight Ready-To-Fly	36-46 Ounces
Wing Loading	4.75-6.07 Oz./Sq. Ft.

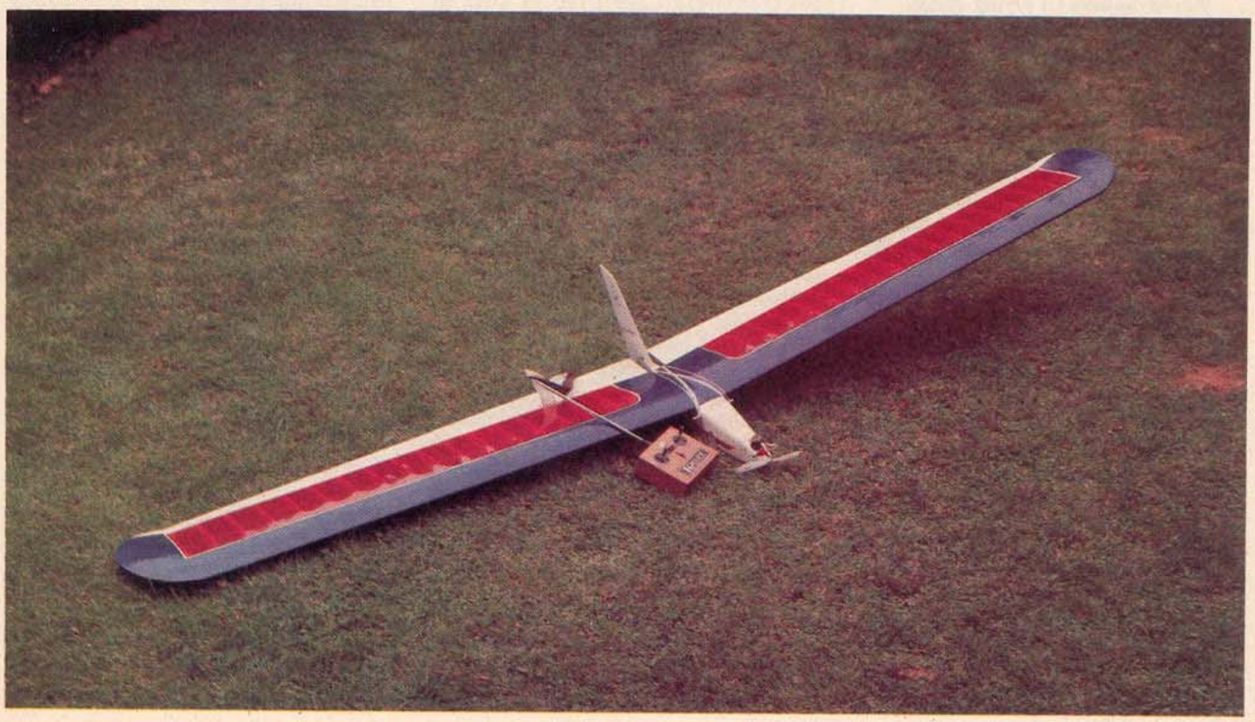
Historical

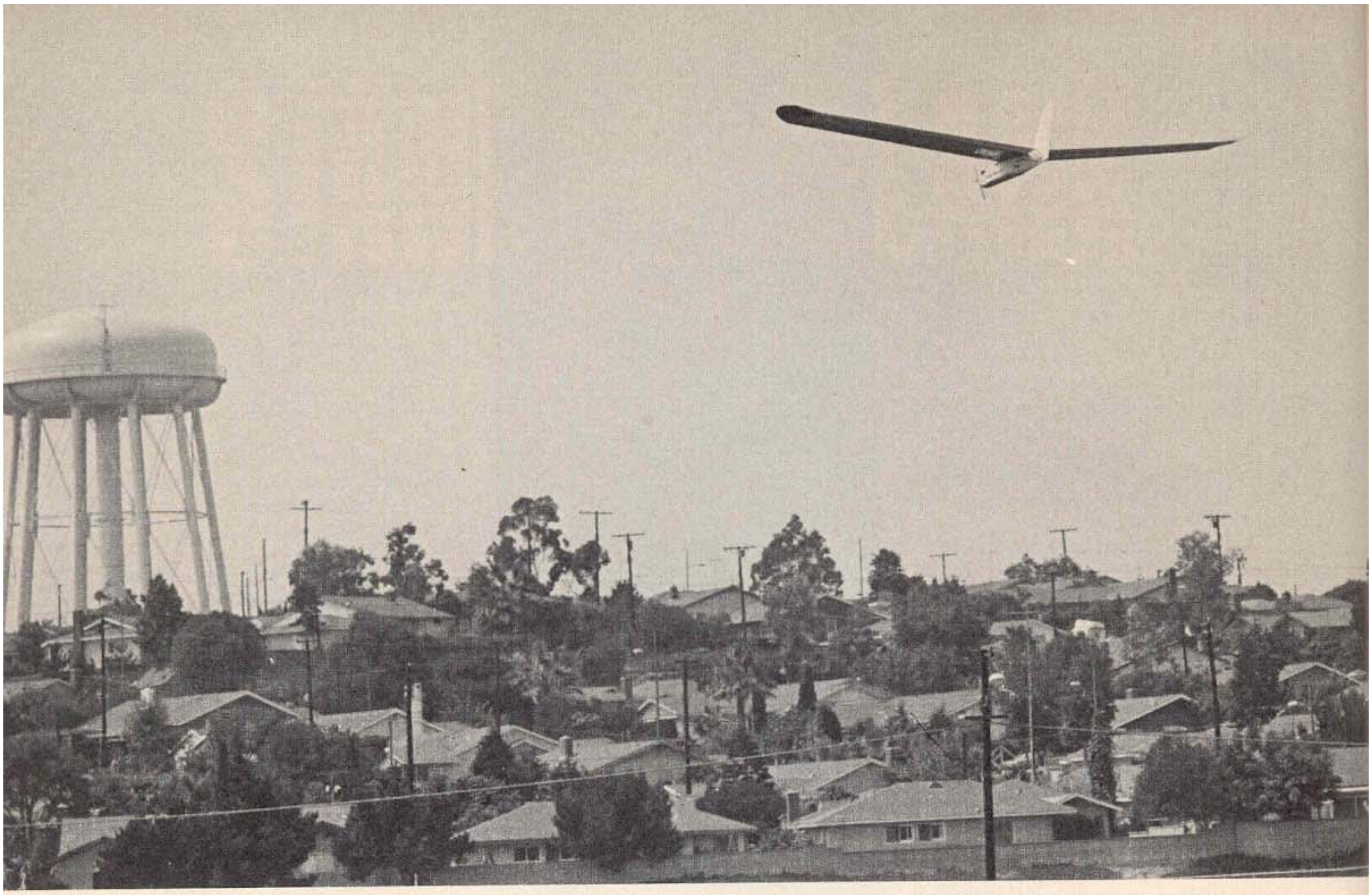
The lineage of this model dates back to the late 1940's when we built our first Plank. A typical model of that time is shown on page 26 of the 1950 Aeromodeller Annual. The data by T. van Teunenbroeic of Holland, in addition to the model two views, included ordinates for the airfoil. After a hitch in the Air Force and college, more Plank models were built. All exhibited similar flight characteristics which led us to believe better performance necessitated an improved wing section.

Little Plank (RCM, May 1972) had a modified wing section based on earlier models. However, the changes were toward stability and construction simplicity, not performance improvements. Although the Little Plank has its place, we felt we wanted a plane oriented more toward the thermal side of the sport. With this in mind, configuration changes aimed toward higher performance were considered. The final changes were these; increase in aspect ratio and area; rudder/elevator control; and a new wing section.

The first modifications, area and aspect ratio increase, produce a higher performance wing. The control system of rudder and elevator allowed us to use plenty of dihedral (6 degrees) which, in turn, made the plane easier to fly. The big jump in performance, however, came from the new

Photo to the left, and below, show Frank Nauman's Standard Plank. Optional nose mounted engine used on this prototype.





Telephoto lens compresses the distance as the Standard Plank flies over the West High School field in Torrance, California.

wing section. It has more camber and less reflex than any section we have used in the past.

Aerodynamics Of Flying Wings

The fear many modelers have of tailless airplanes is based on the unknown. The basic forces on a tailless are the same as on a conventional or canard configuration. These are lift, drag, weight and pitching moment. Lift, drag, and weight are probably familiar terms but pitching moment may not be. Pitching moment is a force produced by the wing as it is moved through the air. This force tends to pull the leading edge of the wing down. In order to prevent that from happening a trimming device is needed.

On a conventional configuration the trimming device is the horizontal tail. On a tailless it is the sweep and/or the wing section. On the Plank it is the wing section which is self-trimming. In other words, the wing section does two jobs, lifting and trimming. A wide variety of sections are capable of doing the job. Although none can, at this time, compete as a lift producing device with the conventional configuration, other advantages are inherent. Low drag, high maneuverability, wide speed capability and structural simplicity are some of them.

If you now have the urge to try something on your own, a set of six wing section ordinates are available. Also available is a newsletter Tailless Topics[2]. It is intended to put experimenters and flyers in touch to further the advancement of tailless airplanes.

CJ-2 Development

The NACA 6409 has long been a favorite of modelers, and even in these days of the Eppler series, finds success on models such as the Airtronics' Olympic 99. We were curious to see if a reflexed version of the 6409 would, if stable enough for flying wing applications, retain good soaring capability.

How does one reflex an airfoil? Fortunately, the work of Jim Marske, a designer of man-carrying flying wing sailplanes, suggests a method for accomplishing this[3]. According to Marske, the stability of an airfoil is determined by the point at which the mean camber line intersects the chord line. The further forward this point of intersection, the more stable the airfoil. An intersection at about 85% of the chord line back from the leading edge will produce an airfoil with more or less neutral pitch stability.

To produce the CJ-2, the mean camber line of the NACA 6409 was first plotted and then redrawn so that the intersection with the chord line occurred at 75%. This was deemed to be as close to neutrally stable as we wanted without an autopilot. From 75% to 100% the mean camber line is gently returned to the chord line. Using the new mean camber line as a reference, the NACA 6409 thickness distribution about the original mean camber line was plotted. The result, a reflexed NACA 6409 (CJ-2), with many of the characteristics of the original airfoil plus the added self-trimming capability required for flying wing applications.

FLYING

Test flying the Standard Plank will present few problems if the following points are kept in mind:

(A)Begin tests with the Center of Gravity and elevator settings as shown on the plans.

(B)It is impossible to have too much rudder throw.

(C)While too much up will rarely cause a problem, a little down can be quite dramatic.

Hand gliding is definitely advised. Begin with full up trim and adjust for a relatively fast glide. Fine tune the glide after the proper elevator/CG relationship has been established. The idea here is to move the CG as far to the rear as possible, thus reducing

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the amount of up-elevator required for a floating glide. All this, of course, tends to reduce pitch stability. A satisfactory balance will be reached with the CG at 20% to 23% of the basic chord width back from the leading edge. The prototype seems to fly best with a slight lope or instability in straight flight which disappears when turning in a thermal.

When flying on the slope, attempt to stay ahead of the airplane and anticipate turns. If at any time the Standard Plank is not responding fast enough to a turn command, simply increase the flying speed by feeding in a bit of down elevator until it responds. This is good advice for any model, of course, depending on altitude remaining.

Winch tows with the Standard Plank present no special problem. Just keep the switch closed and the Standard Plank will climb like a conventional design. If there is little wind to launch into, expect a stall about two feet after the launch. This initial stall results from the position of the

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towhook and the short tail moment which combine to produce an initial pitch-up and resultant stall.

Do not attempt to fly the Standard Plank under power without first achieving a satisfactory glide. If you are not an experienced flyer, find someone to help with those first flights. With the engine mounted in a pod high above the CG, it is easy to develop pitch oscillations under power which will become magnified if the operator gets behind. If this should happen to you, let the elevator return to neutral and put the plane into a climbing turn until you get things sorted out. This method was used to control stalls on rudder-only models and applies here as well. Pitch stability under power is improved by mounting the engine in the nose. This approach precludes removing the engine for slope or tow launch, however.

For those modelers wishing a permanent nose installation of their engine, several small problems must be solved. Our friend, Frank Nauman, has built a 105 inch span Standard Plank with an engine (.09) in the nose. Flight tests have indicated elevator sensitivity during the powered portion of the flight. This can be handled by flying with the elevator trim only, but probably the best solution is to fix the inboard end of the elevators. The fixed portion need only extend outboard of the propeller tip. A skid to protect the propeller can be added. Frank reports that two ounces of fuel is too much and suggests a one ounce tank. The nose must be shortened so the propeller center line is about 9 inches in front of the wing. Frank's trim is 3 degrees down on the engine with enough elevator up trim to hold a constant 15-20 degree climb.

constant 15-20 degree climb.

Flying the engine in the nose version of the Standard Plank requires no more than the normal care. Trimming can probably be accomplished in two short flights. You can take advantage of Frank's final trim for a beginning. He states, "I put three degrees of down in the motor and that caused the need of a bit, just a wee bit, of up trim to maintain a 15-20 degree climb." The next flight had three turns of up and a reduced rudder throw to ± 20 degrees. The following flight used a click or two of left rudder trim. Fuel used on these flights was 1/2 ounce of Blue Label. As Frank reports, "It climbed to maybe three hundred (feet) and the fuel ran out, the nose came down to level flight, but it kept right on going up. I had hit smack dab in the center of a thermal. With almost zero wind the drift was so slow it was hardly noticeable, however, that red, white and blue 105 inch wing was sure getting smaller. I eased some down in, as I just chickened out at the distance that thing was, and straight up, (my poor neck) anyway I couldn't tell if it was still going up, or what, so I put in full down trim, thats when I lost it, not the control, but the sight. Course, as

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you know, it was diving directly at me, from what my number two grandson (the one with the very good eyes) said, it must have come straight down for better than 800 feet before I had sense enough to put her into neutral. Soon it started to reappear, going like it had a hot tail. I could just see the wings folding, coming apart, uncovering themselves, the elevators flapping off, or whatever, but nothing happened. I made the most beautiful 150 foot loop you ever did see." Eight more flights were made with this trim set-up and Frank thinks it is good.

CONSTRUCTION

The Standard Plank is not intended for the beginner and the plans, together with the parts list, should be complete enough to point the way for the more experienced builder. A few points will be discussed however to avoid possible confusion.

Fuselage: The plans show a split top and bottom view along with a side view of the fuselage. When cutting out the fuselage sides be sure and allow approximately 1/4" for curvature. Take care when assembling the fuselage to ensure that the sides are vertical since any error will be evident when the rudder is mounted. The rudder hinge assembly has proven easy to make and trouble free. 1/4" OD aluminum tubes are inset in the rudder and the aft end of the fuselage respectively. The next smaller size aluminum tube is then inserted through both larger tubes to act as a bearing.

Wing: Before beginning construction, determine whether the wing is to be built in one, two, or four pieces. The prototype was built with removable tips to permit experimentation with different sizes and shapes of tips. If fixed tips are used, the wing construction may be simplified accordingly. Round and swept tips are shown on the plans. Both were used on the prototype with no apparent change in performance. The round shape was preferred from an appearance standpoint, however. If a one piece wing is built, replace the tubes and wires with dihedral keepers. Except for the tip and root plates, the wing ribs are all of a single size and shape. They do differ, however, in the placement of holes and in the material from which they are cut. Study the wing layout and composite drawing of the ribs carefully before committing wood to saw. Notice the small upsweep of the tips. This shape not only increases the effective dihedral but dramatically effects the appearance of the aircraft.

Finish: The prototype was covered with a mixture of Solarfilm and MonoKote. The wing tips and trailing edge were white Solarfilm with open areas transparent yellow. The wing leading edge and center were covered with opaque red Super MonoKote. White and blue stripes were cut from trim MonoKote. Elevator hinges were made from Solarfilm. The fuselage and rudder may be finished in any of several ways depending on your local terrain. The prototype utilized Hobbypoxy Quick-Prep finishing resin and blue acrylic auto lacquer.

CONCLUSION

Test flying the Standard Plank was described earlier in the article so there is little left to say but "Happy Flying." The authors invite your comments or questions. Send SAE c/o this magazine.

1. **"Six Self Trimming Wing Sections", $1.00 Postpaid, Western Plan Service, 5621 Michelle Drive, Torrance, California 90503.**
2. **"Tailless Topics", $.25 and self-addressed, stamped envelope, Western Plan Service, 5621 Michelle Drive, Torrance, California 90503.**
3. **"Experiments In Flying Wing Sailplanes", $2.50 Postpaid, Jim Marske, 130 Crestwood Drive, Michigan City, Indiana 46360.**

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