Taperwing

For several years now the ½A Pylon Racing circuit has been dominated by one or two designs. Now there's a new name to add to the list, and it's already consistently whipping the planes that have led the pack for so long.

■ **John Hunton**

FOR THE PYLON RACER who wants the best, for the RC flier who wants to get into Pylon Racing, or for anyone who wants to see what a Cox Tee Dee can really do, the Taperwing is an exciting possibility.

Designed in collaboration with J. E. Albritton, this ½A racer is faster than the GLH and smoother than the Undertaker. Thanks to its minimal frontal area and a tapered wing and fuselage, this single-aileron model achieves 90-plus mph speeds that stretch the limits of standard performance—yet it still complies with the AMA rules.

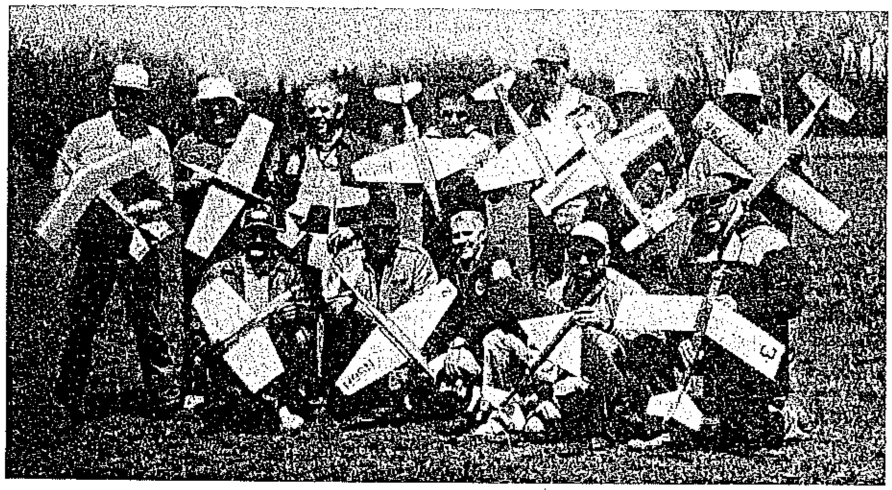
RC Pylon Racing is a good test of several key facets of RC modeling: airframe, propulsion, piloting, and organization. The value of the ½A subcategory is that it simplifies the event and makes it possible for anyone to compete. The Taperwing extends the advantage further by incorporating concepts that sharpen your competitive edge. Here's how:

• **Airframe** features the lowest possible frontal area within the rules. Not only is the wing tapered, but the fuselage is as well. The single aileron helps to hold up the nose when the airplane is entering a turn. The tapered wing planform improves efficiency in turns. Incidence, twists, and offsets are used for greatest aerodynamic efficiency.

• **Propulsion,** or getting the most out of an engine, is enhanced. See the discussion on fuels and propellers later in this article.

• **Piloting** on a tight ½A Pylon Race course is far easier with this airplane than with a twitchier, jumpier model. The Taperwing's elongated configuration gives it steady, stable flight. It also makes the airplane easy to launch and a good racing trainer.

• **Organization:** Notes from world-class CL Team Race competitor J. R. Albritton later in this article cover how to maximize



Contestants at the Northern Virginal RC Club's spring 1987 ½A Pylon Race. Four Taperwing planforms are visible, and they belong to Dave Beazel, J.E. Albritton, Clay Hunton (an earlier version), and the author. At the club's race in August, Taperwings won the top three places.

Designer John Hunton and his Taperwing model. This model meets all requirements for the AMA ½A Pylon Racing event. Clubs in John's area permit crankcase pressure to be used.

your pit operations and increase your overall reliability.

The taperwing design has gone through an iterative development process and has two seasons of racing behind it. Although they're engineered to the AMA rules, the shapes and proportions of the model are nevertheless unique.

Evidence of the design's inherent stability came during a race in Reston, VA. In the first heat the Taperwing was lapping a slower model, and the two collided. One complete side of the horizontal stabilizer and elevator on the Taperwing sheared off flush with the fuselage. Even with half a stabilizer, the model not only continued to fly (as did the other airplane), but won that race *and* all four of the remaining races.

The AMA rules for ½A racing planes are summarized as follows:

- Minimum weight—20 oz. (The Taperwing can be built at under 16 oz.) 20 oz. = 1.25 lb. = W
- Minimum wing area—200 si = 1.39 sf = S
- Wing root depth—⅞ in.
- Fuselage width—2.25 in.
- Fuselage depth—3.50 in.

The following assumptions are made for calculations:

- Weight = 20 oz. = 1.25 lb. = W
- Air density = 0.00238 = σ
- Velocity of Taperwing = 90 mph = 132 fps = Vt
- Frontal area of Taperwing = 22.6 si = 0.157 sf = St
- Frontal area of GLH = Sg = 33.5 = 0.233 sf = S
- Horsepower output of Tee Dee = 0.1 = HPR

A series of calculations can be made with the above information to derive a gross approximation of the difference in performance between the GLH and the Taperwing. Calculating coefficient of drag (Cd) for the Taperwing:

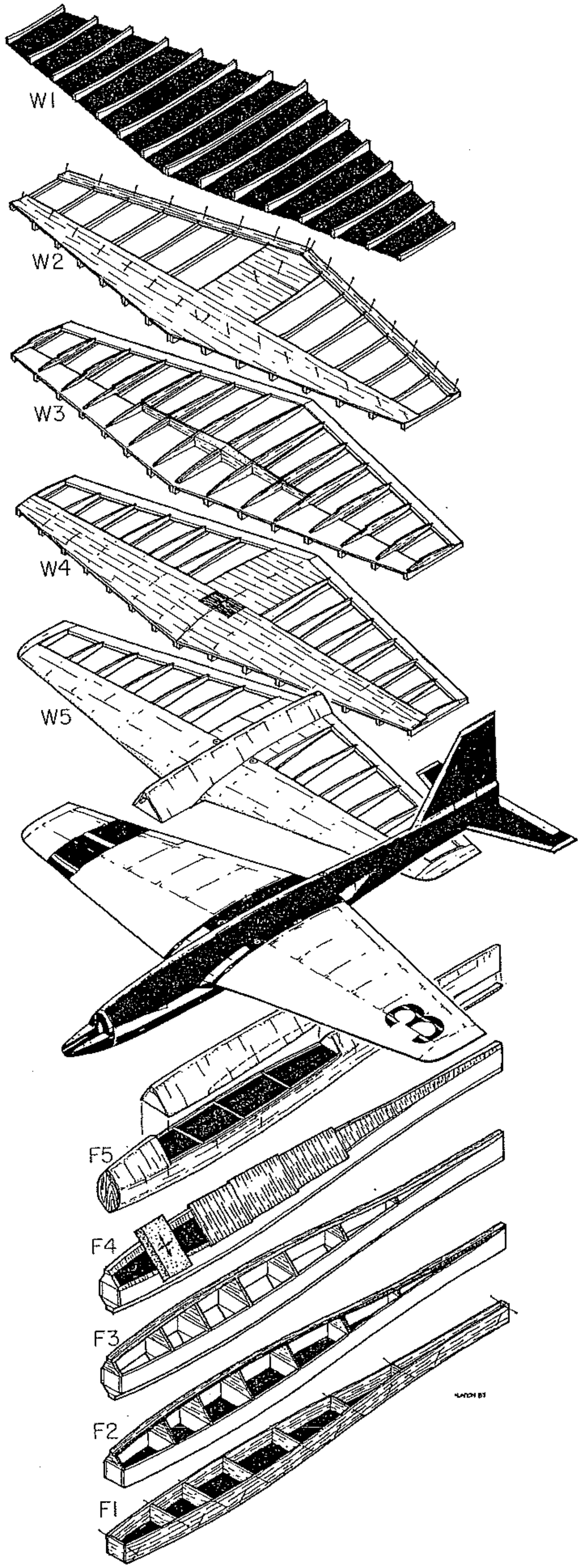
HPR = DV/375
0.1 = Dt x 132/375
Drag (T) = 0.284 lb.

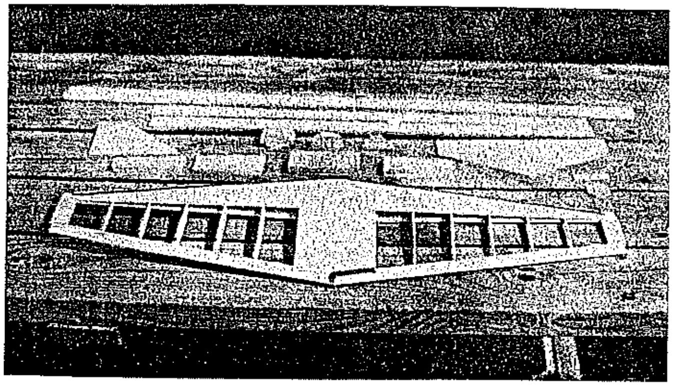
Dt = 0.5 σ V Cd S
.284 = 0.5 x 0.00238 x 132 x Cd x .157
Cd (T) = 0.0872

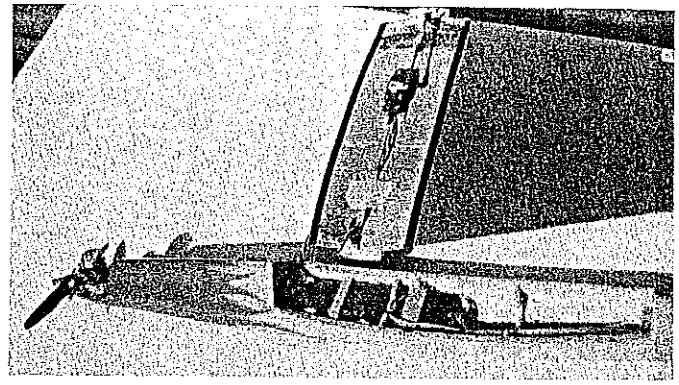
Using this Cd value for the GLH (g) and working back to drag:
Dg = 0.5 x 0.00238 x V^2 x 0.0872 x 0.233
Dg = 0.000241 V

And now for velocity:
HPR = DV/375
0.1 = 0.0000241V^2 V/375
V (GLH) = 115.9 fps or 79 mph

The calculation shows that with an engine of the same horsepower output the Taperwing will do 90 mph, while the GLH will







Left: The roughed-out wing and fuselage components. Right: The plans show the wing attachment as it is here and also another method that allows easier access to the fuel tank. Radio installation is easy with only two servos. Note the foam tape over the receiver to protect it.

do 79 mph. These are simplified calculations that do not consider many variables, and thus are essentially approximations. However, in actual racing against GLHs the Taperwing does seem to be considerably faster.

Construction of the Taperwing is not as simple as with the GLH, but the results are worth the trouble if you want to be competitive. The following notes are keyed to the construction sketches:

F1: Build the fuselage crutch directly over the plan on wax paper. Use firm ⅛ x 1-in. balsa for the crutch and crossmembers.

F2: Cut the formers from ⅛-in. balsa. Note that there are doubled formers on the top where the fuselage halves part to accommodate the wing. How far forward the fuselage divides is somewhat discretionary, and an alternate location is shown on the plan. However, separating the fuselage forward of the leading edge of the wing will weaken it, while parting it at the leading edge hampers access to the fuel tank. The choice is yours.

It is suggested that you plan your radio system and fuel tank installations, then precut the formers that will have to be trimmed out. The top stringer is either very soft ½ x ¼-in. balsa, or two strips of ½ x ⅛-in. balsa laminated together.

F-3: Remove the assembly from the plan, and assemble the bottom formers and stringers to the crutch.

F-4: Using a sanding block, sand the areas for the side sheet parts flat, except for the rearmost six to eight inches of the fuselage. Use 1/16 medium-soft balsa for the sides.

F-5: Prepare the ⅛-in. plywood firewall with blind nuts for the Fourmost engine mount, and glue it to the fuselage. Trim and sand the fuselage, then prime and resand before making the wing joint and stabilizer mount cutouts. After the wing cutout is made, install the ⅛-in. firm balsa doublers inside the lower cutout area. These doublers are very important for continuity of strength throughout the wing mount area.

The Fourmost engine mount can now be trimmed down and fitted to match the fuselage profile. Drill hidden holes in the mount if necessary to lighten it for balance; the mount, as delivered from the factory, is a little heavy for this kind of model.

W-1: Glue the wing plan to a straight and level work surface. Cut the wing jig parts from ¼-in. balsa, and glue them over the plan. Coat the jig surfaces with soap to prevent adhesion of the assembled wings. This jig can be reused for future wing assemblies.

W-2: Cut the top sheet pieces from 1/16 balsa, noting that the top sheet is continuous. The wing is built from the top down for proper dihedral. Cut the trailing edge pieces to length, and notch them. Pin these parts into the jig.

W-3: Cut the wing ribs from 1/16 balsa, and glue them in place. Cut out and install the four spar gussets. Install a continuous ½ x ½-in. tapered block (using firm wood) across the center section. Sand this assembly with a sandpaper board to smooth and even out all parts.

W-4: Cut out and install the 1/16 balsa bottom sheet parts. After sanding the exposed surfaces smooth, apply filament tape as shown to span the sheet joint.

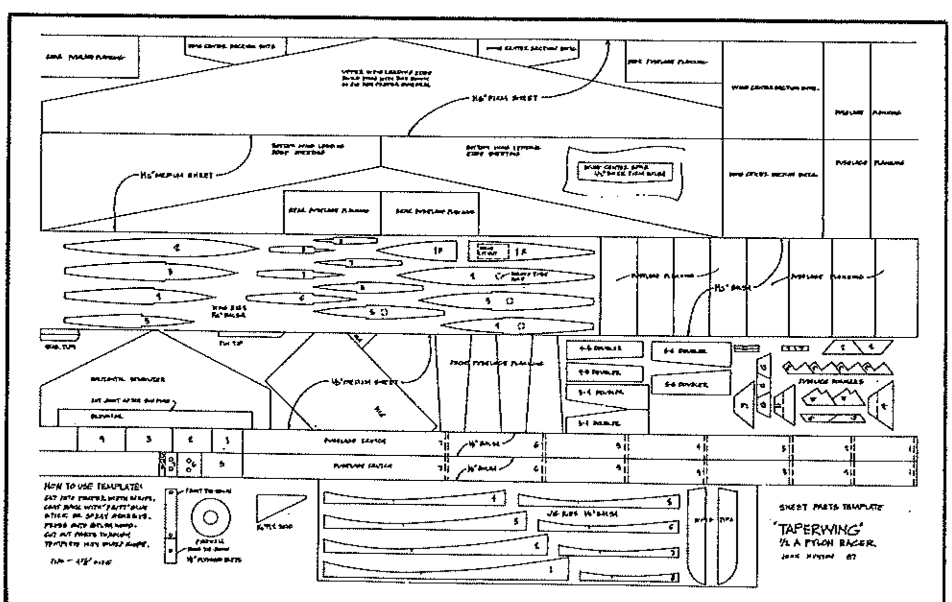
W-5: Remove the wing from the jig, and sand all surfaces. Prime the wing center section. Prepare the wing with the desired aileron control system. A continuous aileron will be easier, but the notched type is more efficient.

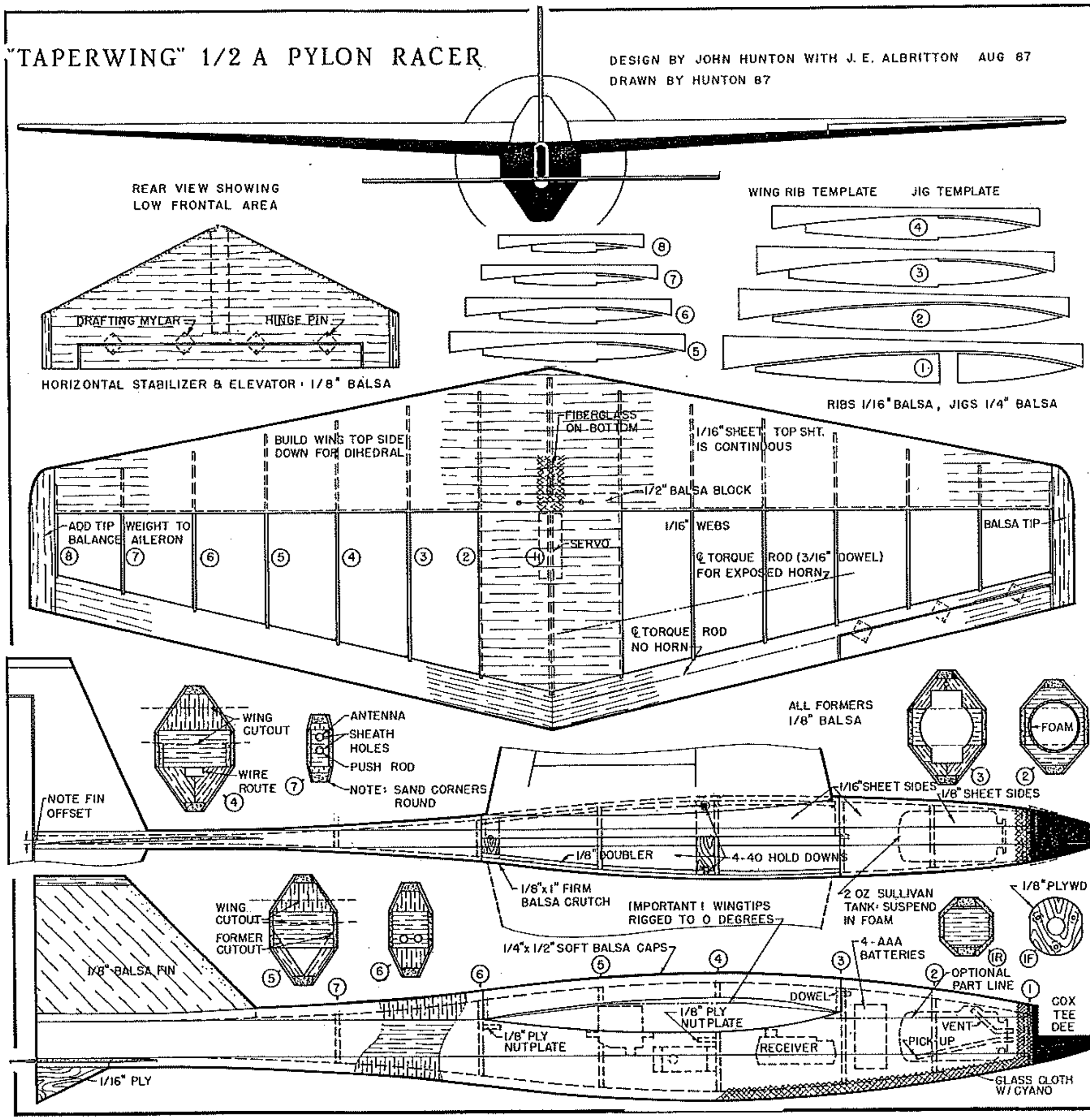
The plan shows alternate torque rod locations. A 3/16-in. dowel can be used to make the exposed horn type rod sufficiently rigid, but it will be difficult to achieve comparable rigidity with the hidden horn type. Be sure to weight the opposite wing for good lateral balance.

After mating the wing to the bottom shell of the fuselage, paying very close attention to the positive incidence setting, the fuselage top fairing can be joined to the wing. These two steps are the most tedious of the entire assembly. Be careful to perform them accurately.

Cut out the tailpieces, and sand them to the smooth airfoil shapes shown. Note that cross-grained pieces are installed at the tailplane tips. Cut out the elevator. Assemble the horizontal and vertical tailpieces to the fuselage. Note the incidence of the horizontal stabilizer and the offset of the vertical stabilizer; this counteracts torque.

On the prototypes, exposed balsa parts were primed with nitrate clear dope, then coated with several layers of Black Baron





Bernie Stuecker launches Dave Beazely's Taperwing during a race sponsored by the Prince Georges RC Club. Dave, in the background, gets ready to rip around the course.

J.E. Albritton shows off the very small frontal area of the Taperwing design. Minimal drag is the key to going fast. Next most important is high-speed stability. This model excells at both.

epoxy clear. Use heat shrink covering for the wing panels. It is strongly advised to select colors for your model which are very light on top and equally dark on the bottom. In racing, where the perspective is constantly changing, you must be able to discern immediately whether the model is upright or inverted. In addition, use a distinctive scheme on top for easy recognition by the judges.

Suspend the fuel tank in foam to prevent fuel frothing. See the plan for diagrammatic fuel tank rigging. One of the AMA rules for this event mandates that a fuel shutoff be provided. Locating the fuel pickup near the bottom of the tank allows the model to be inverted in flight to starve the engine of fuel.

Many good hinging systems are available. One of the simplest approaches is to cut the hinges from Mylar drafting sheets. Install the hinges with cyanoacrylate glue (CyA), and be sure you insert pins to secure them.

Finish installing the controls and servos. A goldenrod-type pushrod system is recommended for elevator actuation. Install a piece of pushrod inner sheath to run the antenna through to the tail. Install the radio gear.

Check the balance point carefully. Don't hesitate to add ballast if necessary to obtain the good control response that comes with a correctly balanced model. Check the lateral balance as well. If one wing is heavy, the result will be a tendency for the airplane to roll into or out of the pylon turn.

The following notes on engines, propellers, and fuels were provided by co-designer J. E. Albritton.

Engines

Stock: If AMA rules are followed closely, the use of stock engines is required. However, because of the variances in dimensions due to manufacturing tolerances, it is possible to get a higher-performance engine by trying different combinations of pistons and cylinders from several engines and testing to see which combination produces the best results. Work with the glow plug to find the highest practical compression ratio (by removing the washers to increase compression) which still maintains good needle valve insensitivity and ease of starting.

Semistock: Kustom Kraftsmanship (KK) sells a fine, powerful example at a reasonable price. The engine has been dimensionally improved, comes with a fine-thread needle valve, and can be purchased with a drilled venturi and a pressure-tapped backplate. The KK engine and the Taperwing make a fine team.

Modified engines:

Mild: Some clubs allow mild modifications which will increase engine reliability. These mods consist of using a 72-turn needle valve from Kustom Kraftsmanship (KK) and a pressure fuel system which employs a pressure-tapped backplate, also from KK.

Wild: An appreciable power increase can be achieved by drilling the venturi to 5/32 in. This mod requires the use of a pressure fuel system. Another significant change, which requires special machining, is to modify the transfer ports to a tapered configuration. I have limited capability to perform some of these mods. Write to get details. *(J. E. Albritton's address appears at the end of this article.)*

Propellers

Stock: The Cox 5 x 3 propeller works best. This prop has actual pitch of over 4 in.

Semistock: 4¾ x 3 from Kustom Kraftsmanship.

Sorta-stock: An Albritton carbon fiber special prop for ½A is available in limited quantities. Write for details. This is the best prop known to us at the time of writing.

Nonstock: Remove ⅛ in. from the entire leading edge of a Cox 5 x 3, sand the airfoil back onto the top, and shorten it to 4¾ in.

Note: For optimal engine performance in the air, the propeller should be one that allows the engine to exceed 23,000 rpm on the ground.

Fuels

Cox racing fuel is very hard to beat, and Cox engines in particular run well on it. No other brand of fuel with under-30% nitro is recommended.

Reliability and organization

Follow the acronym KISS (Keep It Simple, Stupid). Plan what equipment you need, and use the same equipment every time you fly. Repetition is reliability.

Flying: The Taperwing is designed and built for Pylon Racing. When flying an official pylon course, the model is close in to you and turns very tight. With other kinds of flying, don't let the Taperwing get too far away, as the model's very low frontal profile makes it difficult to see at a distance.

If the nose tends to rise or dip at the completion of a turn, check the position of the transmitter stick—chances are it is not pulled straight back. For smoother and faster performance in flying the pylon course, set control throws to the minimum.

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