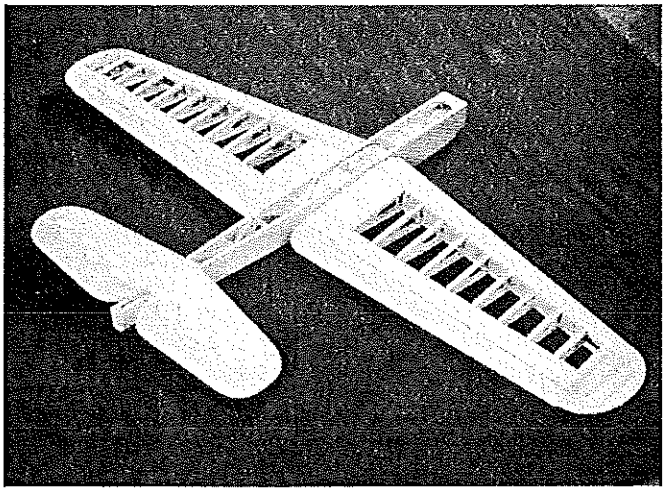
#774

SKY DANCER

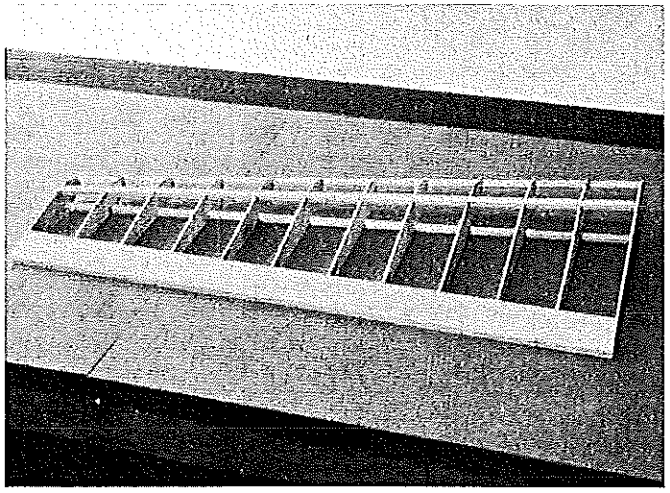
■ **Curtis Comer**

I have built and flown model airplanes most of my life. Since about 1947, my primary interest has been Control Line Stunt.

My early airplane projects were scratch-built versions of Steve Felker's Sabre Dancer in 1949, my own design in 1952, and Bob Elliott's P-40 Black Tiger in 1953. After limited modeling for several years, my need for a new airplane provided inspiration to create a new design. This was to become the Sky Dancer, which took to the air in 1960.



Top view of Sky Dancer's basic assembly. Target weight for finished model is 40-45 ounces.



Wing framework ready for leading edge sheeting and final assembly. Sky Dancer #2 uses an O.S. .35 FP engine.

A number of concepts from the earlier projects were utilized, with the Sky Dancer originally being finished in Black Tiger colors, minus the tiger teeth. Desiring a somewhat unusual design, I incorporated the idea of a swept wing, evolved from the shape of the Trixie, a profile Stunt kit I had built a few years before.

For many of the years 1960-1988, Sky Dancer wasn't actively campaigned in control line competition. Therefore, until recently it has been relatively unknown.

In 1988 I wanted to resume active flying, so I retrieved the original Sky Dancer from storage, made repairs, and returned it to service. Soon thereafter I found that the Sky Dancer qualified for the PAMPA (Precision Aerobatics Model Pilots Association) Classic Stunt competition event, and I have used it extensively in this activity. This is a rapidly growing event for vintage airplanes that were designed prior to 1969.

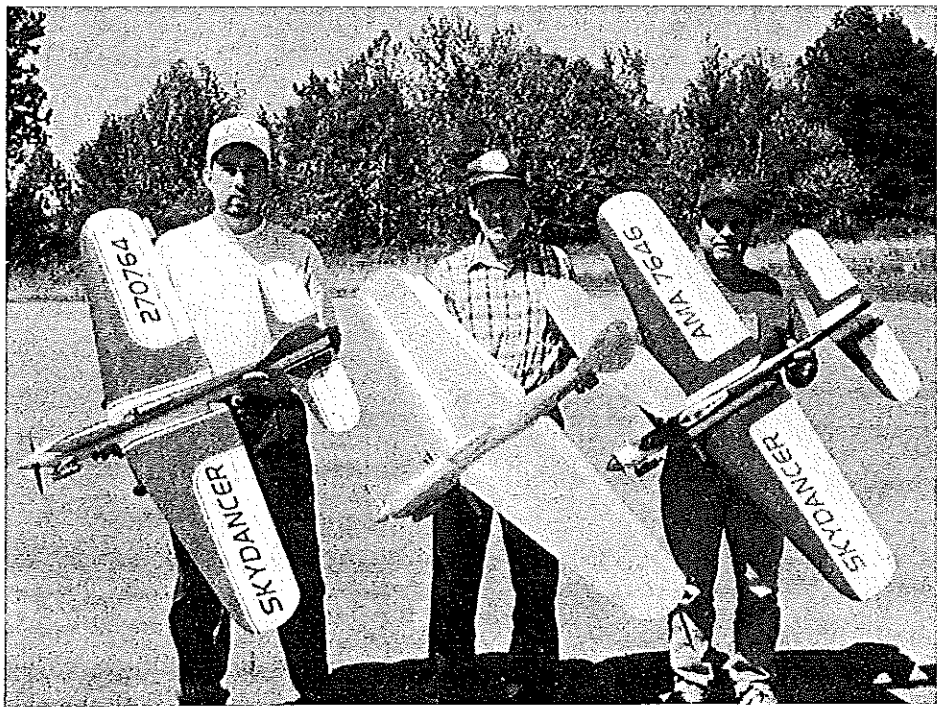
The flying history of the original Sky Dancer finally ended with a crash in late 1992. Sky Dancer No. 2 was hurriedly constructed in time for the 1993 Vintage Stunt Championships contest.

Sky Dancers have also been built by fellow club members William Davis and Larry Draughn. All of the Sky Dancers have flown in the Vintage Stunt Championships and many local contests with good results. The Sky Dancer has proven to be a versatile airplane for both the Classic Event and the AMA Skill Classes.

The Sky Dancer can provide you a unique airplane for this vintage event or, if preferred, just a fun to build and fly airplane.

CONSTRUCTION

Sky Dancer's basic construction is quite simple and straightforward. Most materials are readily available. However, for some unique parts, engines modified for good Stunt characteristics, etc., consider the several specialty sources who advertise in the monthly PAMPA publication *Stunt News* (see PAMPA's address at the end of this article). Quite often, there are two or more sources for a specific type of



Sky Dancer fleet (L-R): William Davis, Curtis Comer, and Larry Draughn. Design of the Sky Dancer dates to 1960.

Sky Dancer

Type: CL Classic Stunt

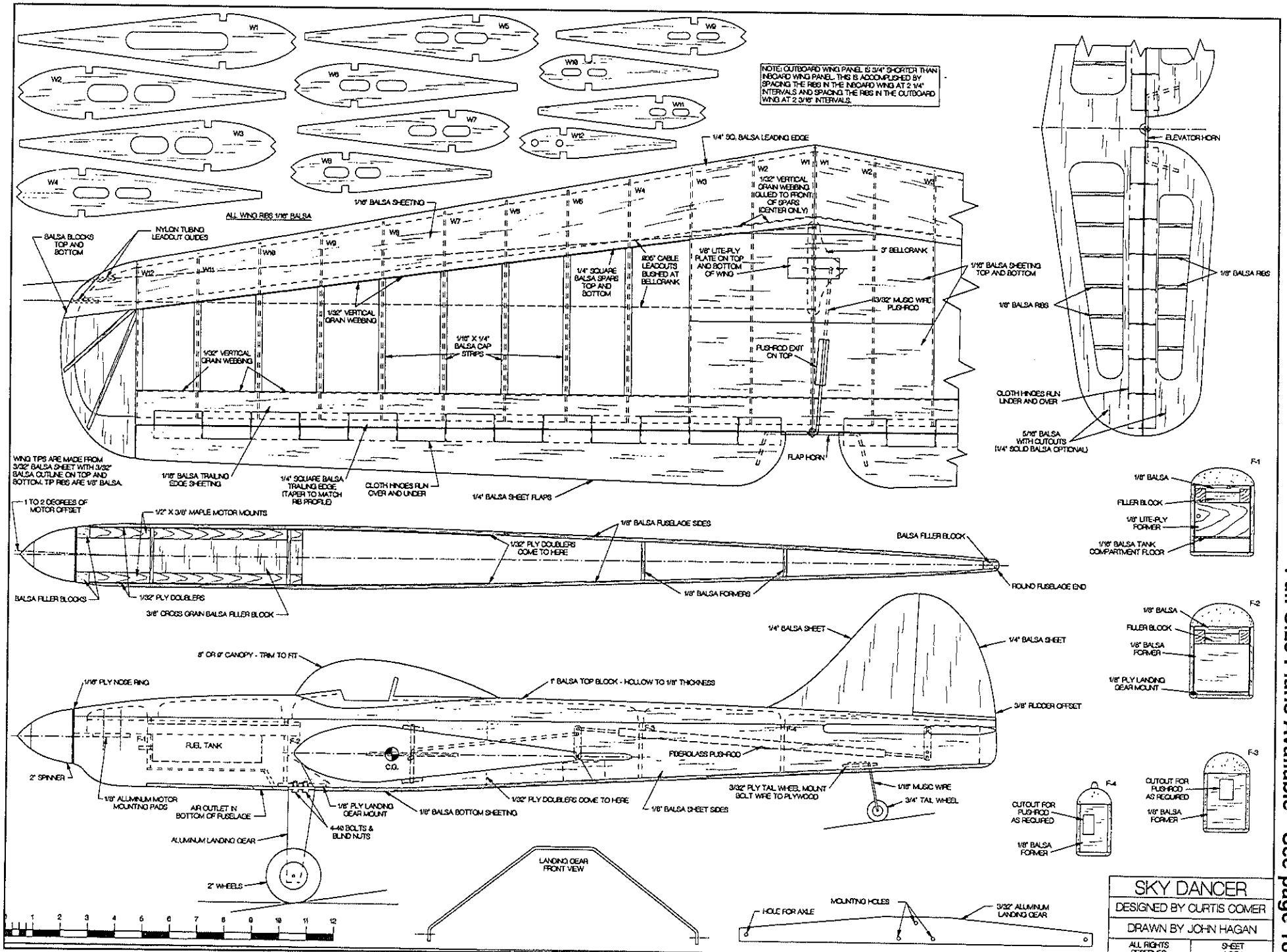
Wingspan: 54.25 inches

Engine size/stype: .35-.40

Flying weight :40-45 ounces

Type of construction: Built-up

Covering/finish :Silkspan over nylon (open areas); clear dope



SKY DANCER

DESIGNED BY CURTIS COMER

DRAWN BY JOHN HAGAN

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Full-Size Plans Available—See page 184

item. Inquire for information and pick the source of your choice.

For the most competitive performance, aim for a final weight in the 40- to 45-ounce range. However, the airplane still performs well if slightly overweight. If light weight wood isn't available, try substituting a thinner wood of medium density in some locations.

For adhesives, use the traditional solvent-type glue in most external locations, for ease in sanding and finishing. Cyanoacrylate (CyA) adhesive can speed the process on many internal assembly tasks. Use a slow-curing epoxy where specified, and anywhere else you desire maximum strength.

Wing: The wing is probably the most complex part of Sky Dancer, but it isn't as difficult as it may first appear. I prefer to assemble the wing on a flat building board. If you normally build on a wing jig, you should encounter no problems.

The wing may either be assembled in one piece or built in two pieces and then joined; I used the two-piece process. When laying out the wing, note that the inboard half has 3/4 inch greater span, and space the ribs accordingly.

Trim the square trailing-edge strip to match the taper of the ribs and then glue it to the trailing edge bottom sheet. Place a 1/16 sheet spacer on the building board a short distance in front of the trailing edge so the ribs will be correctly elevated. Glue the ribs to the trailing edge strip and bottom sheet.

Pin both spars and the leading-edge strip in position, align everything, and support as needed before gluing. Glue the trailing edge top sheet in position and add the shear webs between the trailing edge sheets.

Glue the leading edge top sheet to the top spar. Dampen the outer surface of the sheet to help it curl around the ribs and leading edge. Remove the wing from the building board, turn it over, and secure to the building board. Finish gluing the sheet to the ribs and leading edge strip. Repeat the process to install the leading edge bottom sheet. Add the top and bottom rib capstrips.

Test-fit the wing halves and adjust as needed for good alignment. Apply epoxy, join the two center ribs, and secure the trailing edge to the building board. Before the epoxy cures, be sure that the trailing edge is straight and the leading edge is the same distance above the building board at each wingtip.

Install the bellcrank and leadout wires, using either flexible cable or 1/32 music wire. A Sig three-inch bellcrank and Sullivan C-D size flexible cable works well. To prevent the cable from wearing the nylon bellcrank, attach short pieces of 1/32 or 3/64 music wire to the bellcrank and connect them to the cable.

I fabricated flap and elevator control horns to the length shown, which gives the desired geometry. This provides a system with reasonable leadout travel and control sensitivity, and should be approximated if purchased components are used. Control horns of 3/32 wire have proven adequate for the airplane.

It is a good idea to lay out and verify the control motions on paper before making final installation. I install stops to limit the bellcrank motion to about +-50°. Some type of adjustable-length flap pushrod should be used. A two piece pushrod soldered together with brass tubing has worked well.

Verify complete wing alignment one last time and then add the shear webs between the spars. Prepare a large piece of center sheeting by gluing several sheets together. Cut to fit in the top and bottom center areas, and glue in place. Apply fiberglass cloth and epoxy to strengthen the center joint.

The wing is now resistant to any twist and will maintain alignment well during covering and painting. Prepare a weight box in the outboard wingtip for securing individual weights in place during flight trimming.

Prepare the flaps and flap horn assembly. Use medium-weight balsa that is stiff and straight. Use your favorite method of horn installation and bond with epoxy. I put basswood strips in the flaps and inserted the flap horn into the strips.

Hinge the flaps to the wing using your

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Sky Dancer/Comer

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favorite method. I used full-span fabric hinges of .005 polyester taffeta. This gives the benefit of a sealed hinge line.

Make the initial hinges at the fuselage about an inch wide and about 2 inches wide on all subsequent hinges. Apply masking tape on the trailing edge and on the flaps about 1/2 inch from the hinge line to give a straight edge for installing the hinges with uniform overlap.

Connect the pushrod to the flap horn and adjust the length so that the bellcrank and flaps are centered, have equal motion, and free movement throughout full travel. Trim the flaps to the correct length, and then attach the wingtips.

Fuselage: If possible, determine what motor and muffler combination you will use before beginning construction. The nose length is about right for a lightweight system, such as a Fox .35 or O.S. Max .35 and using a tongue-type muffler.

With a heavier engine, such as an O.S. FP .35 and stock muffler, it is best to shorten the nose at least 1/2 inch. A Fox 1/2-inch prop shaft extension is a good way to move the engine weight toward the rear.

Verify that adequate room remains for the fuel tank; a four- ounce tank should be adequate. Be sure you have a proven engine that gives a good "Stunt run," especially if you are using a Schnuerle-ported engine.

Use epoxy to assemble the engine crutch. If needed, increase the width slightly to accept the engine and fuel tank (most stock fuel tanks are two inches wide). Locate F-1 to match the position of the engine. Note that the crutch is spaced so that the mounts are 1/8 inch below the top edge of the fuselage sides.

Drill the engine mount holes to provide approximately 1° of offset. Add 4-40 blind nuts and test-fit the engine.

Make the fuselage sides with a little extra length at the nose and use epoxy to laminate the plywood doublers to them. Position the crutch and fuselage sides upside down on the building board, align everything, and bond together with epoxy.Prepare Formers F-3, F-4, and the rear filler block. Position these, align the fuselage with a jig and/or templates, and glue everything in place. Adding some diagonal braces between the fuselages sides, both top and bottom, will make a more twist-resistant structure.

Use lightweight balsa for the top block. Tack-glue it in place and carve to approximately the final shape.

While the top block is still temporarily in place, install the wing. Cut the fuselage sides below the wing. Carefully align the wing in the fuselage and secure with epoxy. Use epoxy to put the fuselage cutouts back into place and add 1/32 plywood doublers over the joints.

Remove the top block and hollow to approximately 1/8 wall thickness. Add the bellcrank shaft top and bottom supports. Bolt the landing gear to the mounting plate, position in the fuselage, and secure with epoxy.

Empennage: Make the stabilizer and elevator from light- to medium-weight balsa that is stiff and straight. Make the cutouts for lightness and add the ribs. Substitute built-up or solid construction if you don't want the open bays. Add the elevator horn and hinges with the same method used for the flaps. Cut the fin and rudder from lightweight balsa.

Final Assembly: Prepare the elevator pushrod. Trial-fit the stabilizer, elevator, and pushrod into the fuselage. The elevator and flaps should simultaneously be in the neutral position, and have full motion with no binding.

I set up the elevator horn and pushrod with almost no built-in looseness and have found the airplane will still track well in level flight. Carefully align the stabilizer and elevator to the fuselage, wing, and flap hinge line before gluing. Lubricate all metal-to-metal contact points in the control linkage.

Glue the top block in place. Prepare the tail wheel mounting assembly and attach with epoxy. Add the fuselage bottom sheeting.

Mount the motor engine 1/8 aluminum spacers and adjust for about 1° offset. The engine is semi-enclosed, with a fixed

cowling. Cut the sides and top block to allow for the plywood nose ring and to give the desired gap for the spinner.

Attach the nose ring, add filler blocks as needed, and shape the nose and top block to final configuration. Apply 1/2-ounce fiberglass cloth and epoxy finishing resin on the nose area from the wing forward, and sand to a smooth finish. Cut openings for the muffler and needle valve.

Cut a bubble canopy to fit; a Sig eight- or nine-inch canopy works well. Add cockpit detail as desired and glue the canopy in place with epoxy.

Set the rudder for about 3/8 offset. Epoxy it to the fin and epoxy the assembly to the fuselage. Apply fillet material (such as Sig Epoxolite) around the wing, stabilizer, fin, and cockpit.

A removable and adjustable fuel tank is recommended. There are several good methods to use. I used a 4-40 bolt through the tank center into a blind nut secured between the engine mounts. This is easiest if the tank is built from scratch or from a kit.The center hole in the tank is fabricated by soldering 5/32 brass eyelets in the top and bottom surfaces. A piece of 1/8 brass tubing is soldered within the eyelets to seal the structure and prevent crushing the tank when the mounting screw is tightened. The fuselage area below the tank may be left open or covered with a removable hatch as desired.

Covering and Finish: Use your favorite method of final covering and finish to achieve the result desired. I used Sig dope, with the goal of applying a reasonably nice but lightweight finish.
I use the following steps, which may be somewhat unusual:

Apply a thin coat of clear epoxy paint (such as K&B Superpoxy) to seal the wood, glue joints, fabric hinges, etc. Sand well and then apply clear dope. Apply Dave Brown Skyloft spun nylon over the open areas to give good puncture resistance. Follow with lightweight (00) silkspan over the Skyloft and the remainder of the airplane. From here on, it is the usual process for dope finishes.

Power System: The original Sky Dancer was powered by a Fox .35 and tongue-type muffler. Sky Dancer #2 uses an O.S. FP .35 and a modified stock muffler.

The two Sky Dancers built by others use O.S. Max .35s with tongue-type mufflers. Although the Max .35s are no longer available new, used or rebuilt engines can still be found from individuals or specialty suppliers. I modify the FP .35 to provide the type of engine run that I prefer: consistent and fairly fast.

All of these power systems have worked well. Choose a system that you prefer and tune it for the best possible performance.

Flying and Trimming: As with many Stunt airplanes of 1960 vintage, there is somewhat limited adjustability. However, a considerable amount of tuning and refining can still be done to the airplane, power system, control system, etc. Read everything you can find on the subject.

Trimming is a never-ending process, and you should find that over time your Sky Dancer is continually improving. Without going into extensive detail, the following basic steps have worked for me:

1) I have found the following settings to be about right, and they should be a good starting point for a new Sky Dancer: Center of gravity (CG) 6 3/4 inches in front of flap hinge line; 3/8 rudder offset; 1° engine offset; one ounce tip weight; 62- to 64-foot lines; and 3 7/8 inch handle spacing.

2) I use as low a prop pitch as possible that will still deliver the desired lap times. This is usually five pitch or slightly less.

3) During initial flights, verify that the wing is level to the same position both upright and inverted. If necessary, tweak the flap horn to correct any variation.

4) Adjust the fuel tank height to obtain the same engine speed upright and inverted.

5) Experiment as needed with the above variables, plus engine settings, glow plugs, fuel, lap speed, sealed hinge lines, trim tabs, etc. until you are satisfied with the overall handling.

Over the years, the Sky Dancer has been an interesting and enjoyable airplane for me. I hope it can be the same for you. For more information on Classic Stunt, contact PAMPA at 327 Pueblo Pass, Anniston AL 36206. ✈