TORKY

This simple-to-build Half-A Profile Proto ship has many years of experience behind its clean and functional lines. The article alone is like a textbook on 1/2A speed. **By Dale Kirn**

● It isn't often that the AMA will establish a special event just for Junior flyers only. But that is exactly the case with 1/2A Profile Proto. The idea behind this event is to encourage Juniors to enter a plane in the speed category at a minimum of expense and building time.

The rules were so written that the modeler has to build an airplane that will fly. That may sound a bit silly, but let's take a close look and see why we said it. Ever since 1/2A speed planes have been around, they have achieved the reputation of being the most difficult type of speed plane to fly. Only a few experts can make them fly right and go fast. The average modeler just is not aware of all the "little things" that are necessary to make a successful 12A speed plane.

The majority of 1/2A speed planes made are usually too small and improperly balanced. When flown in the slightest breeze, they either fly erratic or torque will roll 'em right in at the flyer. The logical solution to these problems is to make a larger plane that is easier to fly – even though it may be a bit slower. Thus, the reasoning behind 1/2A Proto.

The object of 1/2A Profile Proto is to cover a 1/2 mile (10 laps on 42 feet of .008 lines) from a standing start in the shortest amount of lapsed time. In order to do this, a relatively light (4-1/2 to 5-1/2 ounce) plane is needed. It must build up speed quickly and maintain that speed for at least 10 laps. The rules state that you must have your wrist in the pylon within the first lap. This feat can be quite a problem for the inexperienced flyer, especially if he flies his plane counterclockwise . . . as most modelers do. When the plane is released, the engine torque causes the plane to come in at the flyer. He must run back until centrifical force will keep the plane tight on the end of the lines. In the meantime, he must get his wrist into the pylon before the plane completes the first lap.

This torque problem has been plaguing 1/2A Proto flyers for quite some time, but there are at least three solutions to it:

1. Fly clockwise and let the torque hold the plane out.
2. Fly counterclockwise, but add an excessive amount of lead in the outboard wing tip and balance nose heavy.
3. Fly counterclockwise and use a left-handed shaft and propeller. Torque will keep the plane pulling away during takeoff.

With the solutions listed above, the modeler takes his plane off with his wrist in the pylon. This solves both problems. Solution number 3 was chosen for TORKY. All of the 1/2A Proto (Profile) records since 1969, have been set using this principle. The present record is 83.41 MPH, set by Harvey Dickinson of North Hollywood, California. In 1970, Jimmy Wade, Anaheim, California, set a record of 86.12 MPH. This record no longer stands, due to a rule change (age classification lowered for Junior flyers).

Availability of a large selection of left-handed propellers undoubtedly has discouraged many modelers from using this torque principle. Grish has made several left-handed 1/2A Props. His 6-4 and 4 1/2-4 props do a fair job, but they are a little too thick and flexible for speed use.

The author has been experimenting with left-handed props for several years and is currently producing a 1/2A Proto prop (4"D x 5"P). These props currently hold the records mentioned earlier.

The left-handed crankshafts have always been available from the L. M. Cox Manufacturing Company, Box 476, Santa Ana, California, 92701. They sell for $2.25 each, part number 1715. It takes about 10 minutes to disassemble the T.D. 049 and install the left-handed shaft.

All the basics of speed flying can be learned with a 1/2A Proto (profile) plane. It isn't any one item that makes an airplane go fast. Rather, it is a combination of many factors, such as the airplane design, balance, the engine, the fuel, the propeller, the fuel tank and the weather conditions.

Vibration is the most important thing to keep in mind when designing and building a 1/2A Proto. The three areas that must be watched very carefully are the engine mount, tail (stab/elevator) assembly, and the landing gear assembly. Not only can vibration rob R.P.M. from the engine, but it can also start a foaming condition in the tank and cause an erratic engine run during flight. Therefore, if these areas mentioned look a little "beefy" on the drawings, it was done so with this vibration factor in mind.

CONSTRUCTION

FUSELAGE: Cut fuselage outline to shape out of 1/2 inch balsa sheet. Saw 1/8 inch slot for stab. Shape beveled ends of hardwood engine mounts and cement hardwood spacer between them. When these have dried, cement this unit to the fuselage. Be sure there is a 3/16 slot under the top engine mount. This opening is for the wing.

Cut two .050 thick aluminum engine spacers to size and drill clearance holes for engine. Wipe bottom side of engine mounting lugs with alcohol or lacquer thinner to remove any oil film. Temporarily spot glue the two spacers to bottom side of engine mounts. Purpose of aluminum spacers is to provide a hard surface for the engine to seat against and also helps to keep the engine from cutting into the wooden mounts and allowing the screws to work loose.

Bevel the inner sides of the engine mounts with a sharp knife to receive the T.D. 049 crankcase. Use 3-48 screws and 3-48 blind mounting nuts to hold the engine in place.

Saw or file two 1/16 deep grooves on the bottom side of the lower engine mount. These slots receive the two landing gear wires.

Cut rudder/fin to shape and cement to fuselage. Cement tail skid and canopy (both cut from 1/16 inch thick sheet clear plexiglas) to fuselage.

When fuselage parts have completely dried, carve and sand fuselage to cross sections shown on plans.

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STAB/ELEVATOR: Cut stab/elevator to shape out of 1/8 inch medium hard balsa. Sand top and bottom surfaces to a symmetrical airfoil section. Cut elevator off from stab and bevel both mating edges. Cement linen hinges in place on both elevator and stab. Form elevator horn out of .060 aluminum and secure to elevator with a 3-48 screw/nut and epoxy glue. Stab can now be cemented to fuselage.

WING: Select a firm, but light sheet of 3/16 balsa. Saw (or cut with knife) to outline shape. Use a sharp knife and cut out opening in center to receive the hardwood bell crack mount. Cement this hardwood piece in place. When dry, carve and sand airfoil to shape. It is suggested that you draw a reference line on both the leading and trailing edge *before* you start carving the airfoil. The type of airfoils used give a lifting section in the center portion of the wing and tapers to a symmetrical section at the wing tips. Cement 1/16 inch thick plexiglas line guide to underside of inboard wing tip. If you are going to use a regular Tee Dee with a conventional shaft and prop, add weight to outboard wing tip. The weight should be inlaid (and cemented) on underside of the outboard wing tip. Wing can now be cemented to fuselage. Fill in gap on top of wing (where it goes through the fuselage) with scrap balsa or plastic wood.

LANDING GEAR ASSEMBLY: Bend the two landing gear wires to shape and solder together as shown. Solder washer on both sides of 1 inch K & B speed wheels. Cut landing gear retainer plate (.050 alum) to shape and drill the three holes as shown. Lay plate over bottom of lower mount and mark the hole locations. Use a 1/16 inch diameter drill and start these 3 holes in the wood. Insert landing gear assembly into the two slots and secure aluminum plate with No. 3 wood screws. This assembly can be removed before painting if desired.

TANK: A suction type tank is used to keep things simple and troublefree. Cut tank pieces out of .005 steel (or brass) shim stock. Solder main seam first, using acid core solder. Add front end cover and solder into place. Anneal a piece of 3/32 inch O.D. brass tubing by passing it through a flame and allowing it to get white hot. Let cool. Now it can be bent easily to form the air vent pipe configuration.

Solder the fuel pick-up tube and air-vent tubes into tank. Press tank back cover into place and solder. Flush tank with a solution of hot water and baking soda to remove any acid that is inside the tank. Tank can now be cemented to fuselage. Add balsa fairing behind tank.

NOTE: In order to fill the tank, point the nose of the aircraft down so that the fuel pick-up tube will be at the "top" of the tank. Open needle valve four turns. Fill through the air vent. When the tank is full, fuel will drip out of the venturi.

CONTROL SYSTEM: A Sterling bellcrank was modified to eliminate the need for leadouts. Two Mono-Line type brass "buttons" were riveted onto the bellcrank. These buttons are available from Kirn-Kraft, P.O. Box 224, Anaheim, California, 92805. The modified bellcrank with a brass bearing is also available from Kirn-Kraft. A double Mono-Line end loop is soldered to the end of each .008 line, per sketch "A". Use a 3-48 flathead screw/nut to hold bellcrank in place. Head of screw should be on top-side of wing.

Cut pushrod to length and bend a right angle on each end. Do not solder nut on bellcrank anchor screw or washers on ends of pushrod until plane is painted. This will allow you to remove the bellcrank/pushrod assembly before the painting process.

A Cox plastic control handle was modified to allow for adjusting the line lengths. Two brass Mono-Line type buttons were riveted to an aluminum strip that pivots. Loop fittings are also fabricated to "handle end" of control lines. This handle is available from Kirn-Kraft.

FINISH: Sand all surfaces carefully before painting. Use No. 320 wet-or-dry sandpaper for final sanding. Then choose one of the following methods for painting:

1. Brush on 2 to 3 coats of clear butyrate dope, sanding lightly between coats. Spray on 2 to 3 coats of colored dope.
2. Brush on a coat of colored epoxy paint – such as Hobbypoxy or K & B Super Poxy. When dry, sand with No. 320 wet or dry sandpaper. Spray on two thin finish coats.

After paint has completely dried, bend elevators up and down several times until the hinges loosen up. Attach engine, landing gear assembly and controls and you're ready to go flying.

ENGINE: The Cox Tee Dee .049 puts out a fantastic amount of power for its size. But, like any precision piece of equipment, it requires a certain amount of attention and maintenance to keep it in top condition. The majority of these things just require a little common sense to locate and fix. For example, anything that is loose on the engine is not right. The most common parts coming loose on this engine are the back cover, the glow head, and the front retaining ring that holds the plastic carburetor housing firmly onto the engine. This plastic housing retainer ring should be checked often as the plastic housing will shrink slightly when cold.

There is one point that should be stressed. Do not attempt to rework this engine until you can turn consistent speeds. Should you decide to rework it, only do *one* thing at a time. It isn't often that a reworked engine wins consistently. Both the Junior 1/2A Proto AMA records (22a and 22b) were set with virtually stock engines. The only modifications were to run on a pressurized fuel tank (pressure fitting off center of backplate with a .006 hole) and the venturi was opened from .106 I.D. to .128 I.D. These two modifications gave an honest 3 to 4 mph increase in proto speed. There is another area that shows promise, and that is an exhaust extractor. Suggest you spend your "rework the engine" effort in this area.

Now for some specific maintenance items. Many a Tee Dee .049 cylinder has been ruined by improperly inserting the wrench into the exhaust ports to remove the cylinder from the crankcase. One little slip, and the wrench will put a burr in the cylinder and possibly ruin it. To avoid this situation, it is recommended that you file two parallel "flats" on the top fin of the cylinder (see photo). This will allow you to use a Cox wrench (No. 1230) which was designed to remove the cylinder from the .049 throttle control engines. The newer Cox Tee Dee .049 has these "flats" on the top fin.

After several good runs, you may notice a clicking noise when the prop is flipped. This is something to get concerned about. It is an indication that the ball socket area in the piston is coming loose. When it gets too loose, it will actually snap the crankpin off of the crankshaft. The faster the engine is running, the quicker it will break. A special hardened tool is now available to correct this condition. Cost is $2.95 and it can be ordered from Kirn-Kraft. You merely insert the piston/rod assembly into the tool, turn complete assembly over and place on hard flat surface and strike tool on top . . . until play is removed. The clearance in the ball-

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socket area should be from .001 to .002. This tool will enable you to save many piston/rod assemblies . . . as well as crankshafts. No need to break in a new piston every time the old one gets a sloppy ball-socket, and a good piston/cylinder fit will last considerably longer if given this maintenance.

Piston and cylinder fit is quite critical for maximum performance. The ideal fit (to accept highly nitrated fuel) occurs when the piston can be pushed up the liner until it is about 1/16 to 3/32 inch above the glow head gasket "shelf" without sticking. This is best checked with both the piston and liner *dry*. If it sticks before reaching this height, it is possible that either some varnish has been deposited on the liner walls or that the engine needs additional running.

Varnishing can easily be identified by first wiping the cylinder dry and then holding it up to the light. A light brown color on the walls indicates varnish (caused by castor oil in fuel). To remove varnish, wrap some fine steel wool around a wooden dowel and wipe the liner walls lightly until the varnish is removed. Wash the fine steel wool particles away with alcohol, and dry. Check to see if fit has improved. It it still sticks before reaching the recommended height, check the liner walls for any scratches or grooves. A small magnifying glass is a necessity when checking for these conditions.

Another thing to watch for is aluminum particles coming out of the exhaust. Naturally, this indicates something is wrong. It can be caused by two things. Either the connecting rod is gouging into the crankcase rear cover or some fine sand has been taken into the venturi and is gouging the aluminum crankshaft bearing area.

Check back cover first. If it is obvious that metal is coming from here, check for these two conditions: Either the crankpin (on the crankshaft) has a taper (smaller O.D. on the outer end) or the connecting rod hole has a taper in it – with a larger I.D. to the front of the crankpin area. At high RPMs this would allow the connecting rod to slide off the crankpin and dig into the rear cover.

Use a 1 inch micrometer and check the O.D. of the crankpin right next to the counter balance area and at the outer end. If the outer end has a smaller O.D., this indicates a defective part (by the manufacturer) and it will have to be replaced. If both ends of the crankpin check out the same, try turning the connecting rod hole around 180 degrees.

To check the crankshaft bearing, it is necessary to remove the crankshaft from the case. To accomplish this, first remove the back cover, cylinder and piston/rod assembly. Lay rear portion of crankcase on flat surface, thread a short 5-40 screw into front of shaft and hit with hammer until the shaft is pushed away from the pressed-on drive washer. Wipe the bearing surface clean and check with a magnifying glass for any deep scratches. If deep scratches are visible in the bearing area, it is best to replace the crankcase. Also check the crankshaft finish grind to see if it has been damaged.

When running this engine on a suction fuel tank, the needle valve can be another source of trouble. Since it normally runs with a setting of about 4 to 5 turns open, the weight of the steel needle valve causes the threads in the needle valve body to wear excessively. They can get so loose that they will allow air to seep in through the thread area and cause the peak adjustment to be quite critical. To correct this condition, cut a short piece of neophrene tubing (about 1/8 inch long) and slip it over the threaded area on the needle valve. When the needle is placed back into the threaded area of the needle valve body, the tubing will completely seal the area off.

Kirn-Kraft also produces a front needle valve assembly for the Tee Dee .049 that eliminates the above problem. It has a needle valve with 128 threads per inch and the needle thread area is sealed (with nylon cap) to prevent air from getting into thread area.

It is a known fact that some Tee Dee .049's are better than standard. Actual flight tests have shown that there can be as much as 10 MPH difference between two "stock" engines (placed in the same plane) using the same fuel and prop combination! The difference can usually be traced to the cylinder by-pass timing. The critical areas are the heights of the grooves and how "deep" they are into the cylinder wall. Each by-pass consists of 3 grooves; one large groove with a smaller one on each side. The distance from the top of the cylinder (glow plug shelf) to the two smaller grooves should be .315 (and .325 to the top of the big groove). The depth of the grooves should be .480-.485 for the two small grooves (measured diagonally) and .470-.472 for the large groove.

The majority of the cylinders checked had these grooves on the "shallow" side. Also, many had the side grooves even with the center groove. A steady hand and a motor tool can make the necessary corrections. However, if you know a machinist, it is better to have him make the alterations.

FUEL: There are several good fuels that you can buy at your local hobby shop that will turn good speeds. Normally, 1/2A engines require a little more nitro than the larger engines. Fuels such as Cox Racing Fuel and K & B Speed Fuel usually work in a variety of weather conditions. It is suggested that you stay with a commercially available fuel until you achieve consistent results. Then, try mixing your own fuel to see if you can better your speeds. Here is the formula that has set several 1/2A proto records: 60% Nitro, 15% Klotz (polyoxide oil), 2% lubricin, and 23% propolyene oxide. This formula works well in hot (90^{o}-100^{o}) weather that has low (20%-30%) humidity.

FLYING: A hard surface such as smooth asphalt or concrete is recommended for a flying site. Sweep the area where you will be starting the engine and releasing the plane. THIS IS VERY IMPORTANT!! Otherwise, fine sand will be picked up by the propeller blast/suction and ruin the engine in a very short time.

Always check the controls before each flight. It is almost unbelievable the number of times a two-line flyer picks up the handle and has the controls reversed. Usually the only damage is a broken prop and frayed nerves.

All test flights with this plane were conducted with left-handed props. A 5-1/2 x 4 Grish prop (cut to 5 inch diameter) would give a proto speed of 63 to 68 miles per hour, depending on fuel and weather conditions. Best speeds were obtained using a left-handed Kirn 5-5 cut to 4-7/8 diameter. Proto speeds of 73 - 78 miles per hour were obtained with this prop.

Experiments with props (altering the diameter, blade shape, thickness and pitch) and fuels produced more gain in speed than any rework done on the engine. This statement would also apply to conventional "right-hand" props should you decide to fly clockwise. If you fly counterclockwise and do not wish to use the left-handed crankshaft/props be sure to add at least a 1/4 ounce of lead to the outboard wing tip and move the balance point about 3/8 inch forward. This will help to keep the plane from coming in at you during the take-off period.

It is hoped that the information contained in this article will help you achieve faster speeds with your 1/2A proto. If you haven't made one yet, TORKY is an ideal plane with which to start. ●

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