



## COX CORPORATION

### “EP-380 ARF”

(An ARF Electric Trainer Aircraft)

By Bob Aberle



Speed-400 electric motors have been popular for many years. It was the primary choice for electric power when the first parking lot sized models hit our market about eight years ago. The Cox Corporation, makers of all those wonderful small size, glow-fueled engines and plastic, Ready-To-Fly (RTF) Control Line models has moved into the RC electric-powered Almost-ready-To-Fly (ARF) and RTF market in recent times.



Photo 1



Photo 2

The subject of this review is their new Cox “EP-380”, speed-400 powered “EP-380” Advanced Trainer. It is an ARF model that comes with a geared “380” size electric motor. This essentially ready-built and covered model and motor presently (June 2006) sells for \$114.95. The 400-Speed motor and gear box are included with the “kit”.



Photo 3A



Photo 3B

The basic framework is built-up balsa with a lot of plywood added in the critical areas. The entire airplane is covered with an iron-on covering material in red, with white trim. By the way, during shipping much of this covering material became very loose or wrinkled. I would advise you to carefully re-shrink this material with either a modeler's iron or heat gun. Don't apply too much heat or you might run the risk of melting the material.



Photo 4



Photo 5

As received the wing panels are separate and require joining using a plywood dihedral brace (photo 4) and 5 minute epoxy cement. Apply the epoxy inside the wing sockets and onto the brace itself. Slide the other wing half in place and remove any excess epoxy. Tape, or hold, the wing panels tightly together making sure both halves are aligned to prevent warps. Allow the epoxy to dry for at least 10 minutes.

The EP-380 is intended for full, four-channel control using ailerons, elevator, rudder and electric motor throttle via an Electronic Speed Controller (ESC) with a Battery Eliminator Circuit (BEC) that allows the motor battery to power the on-board radio system.



Photo 6

The ailerons, elevator and rudder come pre-hinged. But, as an ARF and not an RTF, the hinges are not glued in place. The first thing you must do is cement these plastic hinges in place. The instruction booklet recommends that you pin the hinges while applying the CA cement. Do not use accelerator

when gluing the hinges in place. I found it easier to first apply the cement to one side of the hinge (like on the actual control surface). After quickly curing, install the control surfaces to the wing, stab and vertical fin. Then again apply some thin CA while holding the control surfaces tightly in place. When installing the two ailerons, you will also have to apply some 5 minute epoxy into the two torque, or aileron, control arm holes in the wings.

*(Ed. Note: While Bob's method will work well for this and other similar electric-powered trainers, larger aircraft or those powered by glow engines require a stronger bond. Read how to do it in ["Installing Mylar Hinges"](#) in Sport Aviator's Flight-Tech Section.)*

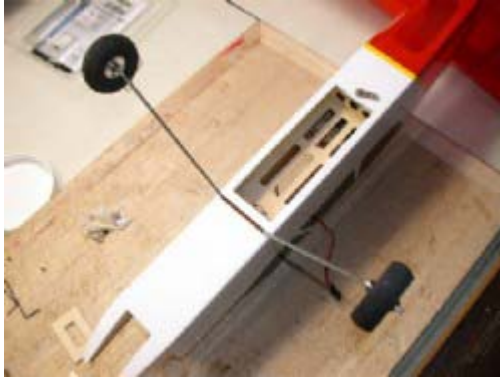


Photo 7



Photo 8

Once the hinges are taken care of you can install the wire landing gear with 5-minute epoxy cement. Put the epoxy into the landing gear mounting slots and then insert the gear legs.

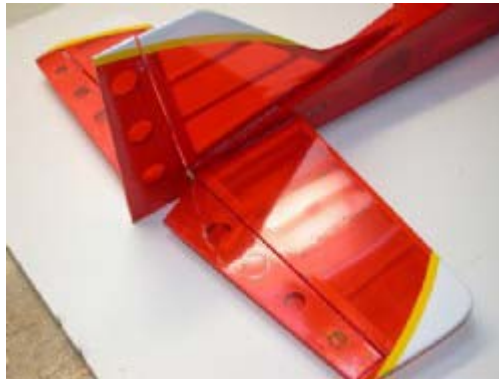


Photo 9

The stab and vertical fin are installed next. I spot cemented both of these surfaces first with thin CA to hold the correct position. Then I applied a liberal amount of 5 minute epoxy.



Photo 10A



Photo 10B

There is also a plywood tailskid mount that gets epoxied underneath. The photos will show how the tailskid and bracket are assembled at the same time that the vertical fin/rudder is installed. If you wish, you can make a tail wheel wire bracket from some 1/16 in music wire available at any hobby shop.

You will also need a small tail wheel and 1/16 in. wheel collar. This provides a steerable tail wheel that enhances ground handling, especially on paved runways. This is a nice touch but not critical since most takeoffs will probably be via hand launching anyway.



Photo 11

Two plastic sleeves for the trail control rods are already factory installed. They will guide the two supplied wire control rods; each going from a forward mounted servo back to the rudder and elevator. You will have to install the provided control horns to the elevator and rudder. Be careful when locating the rudder control horn because there is a chance that it might interfere with the movement of the elevator. (*Ed. Note: Make sure you put the screws that hold the servo output arms back onto the servo back into place before flying.*)

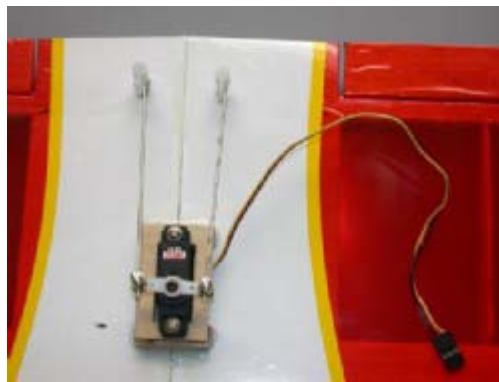


Photo 12A

Photo 12B

Make sure you have the proper clearance so that both rudder and elevators can move freely. The aileron servo mounts on the bottom of the wing at the center section. Epoxy the aileron servo tray into position and install the servo. All the hardware necessary to do this job is provided.



Photo 13

The ailerons are held to the mini-servo using adjustable links. Center the servo and then adjust the linkages until both ailerons are neutral when the transmitter aileron stick and trim tab are centered.

After the purchase of your EP-380, you will need to supply a four-channel RC system (transmitter and receiver and three servos). Also needed is an electric motor Speed controller (ESC), with a BEC that will let you share the one battery pack with both the motor and RC system. The final item needed is a battery pack and a charger for that pack. I'll have more on the battery later!



Photo 14A



Photo 14B

Mounting provisions have been made for installing the 380 (Speed-400) electric motor. Basically, two metal clamshells surround the motor with screws holding these brackets to the plywood beam mounts.



Photo 15



Photo 16

A gearbox is provided for the motor (photo 15), which will allow the motor to work more effectively and efficiently. Three different pinion gears are provided. The pinion gear is the one that is placed on the output shaft of the motor. Then the gear drive is bolted to the front of the motor, with the pinion gear meshing with the gear train. The instructions recommend that you start with the highest gear ratio 3/1 which requires the pinion gear with 10 teeth. The other ratios provided (but not used by me) are 2.14/1 and 2.5/1. The other brass pinion gears can be seen on the lower right side of photo 16.



Photo 17



Photo 18

Before installing the motor you would be wise to solder the two output wires of your ESC to the wires attached to the 380 motor. The red motor wire is positive (+), while the black wire is negative (-). Insert the ESC first through the clearance hole in the firewall, followed by the motor. The ESC can remain in

the compartment behind the firewall (photo 17) and in front of the bulkhead located by the wing leading edge. The two battery wires exiting from the ESC are passed down into the lower battery compartment while the servo-type cable exiting from the ESC gets routed up to the RC receiver where it is plugged into the throttle port. The battery is located in that lower compartment which has a hatch cover (photo 18). Removing that cover allows you to easily remove the battery pack for charging purposes or to substitute a freshly charged pack.



Photo 19



Photo 20

A neat molded fiberglass cowl covers the electric motor and provides for a certain amount of streamlining (photo 19). A propeller adapter is supplied along with the propeller and a spinner. The front of the cowl has an air intake opening to allow air to cool the motor. That air can pass on through to the ESC compartment and even down into the battery compartment. Unfortunately there is no mention of an air exit hole, which is equally important to the cooling process. So I simply cut open the first lightning hole on the lower portion of the fuselage, just aft of the wing trailing edge (photo 20)



Photo 21

I used several different brands of RC equipment simply to use up what I had on hand. The transmitter is a Polk's TRACKER-III synthesized computer driven type with its companion synthesized SEEKER-6 dual conversion receiver (photo 21). The neat thing about this system is that it can be set to any of the 50 RC flight channels; no crystals required. The rudder and elevator servos are the JR S75 sub-micro type, while the aileron servo is a Hitec RCD HS-81



Photo 22      Photo 23

For an ESC, I used an older style Castle Creation Pixie-14 intended for brushed Motor operation and Ni-CD or NiMH type batteries (photo 22). This ESC has a preset low voltage cut-off that can't be adjusted for operation with Li-Poly batteries. It also is no longer available. More modern choices for an ESC would be either the Castle Creations Pixie 20P (photo 23) or the FMA Direct SUPER-20 ESC. Both of these ESC's can be programmed or can auto-detect the proper low voltage cut off suitable for use with any type battery (Ni-CD, NiMH or Li-Poly).



Photo 25

Cox recommends a battery pack consisting of 6 or 7 cells (NiMH) with a minimum capacity of 1050 mAh. Probably the best choice if you were to follow this recommendation is the Kan type 1050 cells or the GP-1100 NiMH cells (both available from Overlander Batteries at [www.overlander.co.uk](http://www.overlander.co.uk) or Diversity Model Aircraft at <http://66.241.195.91/batteries/batteries.asp?path1=batteries> (photo 25)



Photo 26

My initial impression using both of these batteries was that the motor really needed 8 cells. Using the APC 10 X 4.7 in. propeller on 8 cells, I measured 8.9 amps and 84 watts. On an APC 9 X 6 prop I measured 8.0 amps and 75 watts. Neither was quite as high as I would like. The alternative right at this point would have been to try one of the other gear reduction ratios and a different prop size. But quite honestly, I wanted to get right into the use of Li-Poly batteries for this application and even before my first flight went to a three cell FMA pack consisting of three 1250 mAh rated cells at 20C load capable (photo 26).

Using the supplied APC 10 X 4.7 Slo-fly propeller and this three-cell Li-Poly battery, I measured 11.32 amps, 11.14 volts under load and 124 watts. I considered this a little high (current/power wise) for a Speed-400 motor and therefore went to a slightly smaller diameter propeller, but with a little more pitch. My final choice was the APC 9 X 6 Slo-Fly propeller which, on the three Li-Poly cells, gave me: 10.5 amps, 11.24 volts, 116 watts and an rpm of 6000.



Photo 27

I think this is about the best choice. If you go the Li-Poly route make sure you use one of the two ESC's I recommended. If you use an older ESC without a suitable Li-Poly cut-off point then I would suggest you add the FMA Direct Automatic Cell Detect, Low Voltage Cut-off Device (P/N AVC1AIR) (photo 27). If you allow your Li-Poly pack to go below approx. 2.7 volts per cell, it will quickly lose capacity and deteriorate beyond help in a short time.



Photo 29

The final weight of my EP-380, with the three-cell 1250 Li-Poly battery pack was 26.2 ounces (photo 29). The battery pack itself weighed 4.2 ounces. At that total weight and a power level of 116 watts, the power loading figures worked out to 4.42 watts/ounce or 70.7 watts/pound. That clearly puts this aircraft in the fully aerobatic category.



Photo 30

But that is, of course, when flying at full throttle settings. For the most part you will want to fly at reduced throttle settings for more comfortable flying and training. Flying at reduced throttle will consume less current allowing the motor to run longer on a charge. At full throttle settings you can count on 7-minute duration flights. With reduced throttle settings you can plan on over 10 minute flight times.

Control throws ended up essentially the same as that recommended by Cox. The ailerons operated 7/16 inch either side of the neutral position. The elevators are 1/2 inch either side and the rudder 1 inch either side of neutral. I did feel that the aileron control throw might be just a little too much for a relatively new RC flyer. If you fall into that category you might want to reduce the aileron throw to 3/8 inch either side of neutral. If you have dual rate control available on your transmitter, you can set the aileron throw so that you have a choice of 7/16 or 3/8 inch at the flip of a switch.



Photo 31

The center of gravity (CG) or balance point of the EP-380 came out exactly as called out in the instruction manual. It is located  $2 \frac{3}{16}$  inch back from the wing leading edge. Since the battery box is centrally located with respect to the CG position, changing from a Ni-MH to a Li-Poly type battery pack will have little affect on the CG position.



Photo 32

Flying the Cox EP-380 was a true pleasure. It is a good trainer aircraft as well as a good all-around sport flyer. Many experts and pilot instructors (*such as your Editor*) prefer to start their beginners with full, four-channel flight controls (aileron, elevator, rudder and throttle). The EP-380 allows this type flying and yet is still suitable for a beginner. It is a good Advanced Trainer that can also serve with distinction as a “first” airplane.

Flying a tail dragger, instead of a nose gear configuration can be a little more difficult. But the main thing is you will learn early on how to steer the aircraft on the ground with your left hand and turn and bank it in the air with your right hand. If you fly from a rough field or a grass field, with somewhat tall grass, the EP-380 is just as easy to hand launch. If you are more of a beginning RC pilot I would suggest you let a helper launch your plane so that you can have both hands on the controls stick at the time of release.



Photo 34

Control throws can be adjusted by your instructor or yourself to suit your particular feel of flying. The EP-380 is reasonably streamlined and can move quite fast at full throttle. So please try to learn to fly at reduced throttle settings. Also make sure, when setting up for a landing, to slow the airplane down while still a ways from the landing strip. Whatever you do, don't dive the airplane with your elevators as you approach to make a landing. The EP-380 is a very "clean" streamlined aircraft that takes some time and distance to slow down for landing.



Photo 35



Photo 36

Instead of diving, keep reducing the throttle setting to slow the aircraft and let it settle in. Just before touching down, kill your throttle completely and pull back on the stick for a little up elevator. That will flare the airplane (bring the nose up a little more) so that you don't nose over on landing and possibly break a propeller.

#### SUMMARY



Photo 37



Photo 38

The Cox EP-380 proved a capable and easy flyer. I believe that using Li-Poly batteries, with the right ESC, is the way to go. The airplane is designed well and certainly constructed well. I can see the possibility of adding a set of twin floats to this aircraft from some fun at the lake in the summer.

I also see the possibility of adding a more efficient brushless motor and companion ESC to this aircraft. You would need a motor in the 100-125 watt power range. Because of the beam mounting employed the best configuration brushless motor would be what we call the "in-runner" type. There are several good brands available and also with appropriate gear drives. Something to think about later on! All and all the Cox EP-380 was a very pleasing experience.

For more information on this new, and well designed, sport trainer, please go to:

<http://www.coxmodels.com/prodinfo.asp?number=006104>

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#### SPECIFICATIONS:

Aircraft: "EP-380"

Type: An electric ARF RC aircraft intended for training and sport flying.

Distributor:

Cox Hobby Distributors

P.O. Box 274  
Penrose, CO 81240-0274  
Phone: 719-372-9876  
Toll Free Order Line: 877-269-9235  
FAX: 719-372-3419  
E-Mail: [support@coxmodels.com](mailto:support@coxmodels.com)

Wing Span – 45 inches  
Wing Area – 315 square inches  
Length – 35 inches  
Average all up weight: 26.2 ounces  
Wing Loading – 12.0 oz/sq.ft.  
Street price of the ARF kit alone (as of June 2006) - \$114.99  
Motor: “380” type brushed ferrite (also known as a SPEED-400) (supplied with ARF kit)

**Items you must still purchase:**

RC Equipment on Review Model:

**Four Channel radio system** required – Polk’s TRACKER-III transmitter and SEEKER-6 Dual Conversion receiver, two JR-S75 sub-micro servos (elevator and rudder), one Hitec HS-81 servo (ailerons) and a 6-inch aileron servo extension cable

**Speed Controller (ESC)** – Castle Creations Pixie-14 on this model, but read text for recommended ESC’s

**Battery** – Three cell FMA Direct (3S1P) Li-Poly 1250 mAh) (20C load capable) (weight 4.2 ounces)

**Connectors:** Anderson Power Pole (APP) also known as Sermos

**Propeller**– APC 9 X 6 in Slo-Fly

**Motor Current** – 10.5 amps (at start with a fresh charged battery)

**Voltage** (under load) – 11.24 volts

**Watts** – 116

**Maximum RPM** – 6000

**Power Loading** (at 26.2 ounce total weight) - 4.42 watts/oz (70.7 watts/pound)

Range – 7 to 12 minutes depending on throttling.

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