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GOING ALL OUT WITH THE TOP FLITE GOLD EDITION DC-3/C-47

BOB BENJAMIN CONVERTS THIS SCALE KIT INTO A CLASSIC WARBIRD...WITH ELECTRIC POWER

Flight photos by Gary Ritchie; all others by the author.

Several years ago a guest at our field was asking about one of my scale airplanes. We got into a discussion of the *must-build list* that every scale modeler carries around in his head, and eventually the DC-3 came up. "I've got one of those", he told me, and in response to my interest explained that it was *one of those big Top Flite jobs*. "One of these days, " he admitted, "I gotta' get around to seeing if it will fly."

I had long since been aware of that kit (TOPA0500), but during the years I was aggressively involved in RC Scale competition flying I did not pay much attention to it. Even with a wingspan of nearly seven feet (82 ½ inches) it's a bit small for TOP GUN level competition. Moreover, the kit is labeled as being *close to scale* (not *exact scale*) with a few subtle modifications to provide easier/safer flight characteristics. But then I considered that since I am no longer doing much competitive flying, that sort of thing

doesn't matter any more. I thought, *Top Flite has a reputation for producing well engineered scale kits that are plenty accurate enough for air show demo flying. It'd be fun to build something like that without having to worry about solving one "scale problem" after another and whether the static judges would notice what I'd missed fixing.* Ever since I was a six year old kid watching American Airlines DC-3's on approach to Boston's Logan Airport, I have known that I would need to have one of my own someday...*and besides, a model like that deserves to be more than just another hangar queen.*

THE TOP FLITE GOLD EDITION KIT:

This kit has been on the market for a while, so I'm not going to do an ordinary product review. Instead, I'll concentrate on what was necessary to turn the stock Top Flite DC-3 kit into a successful electric powered model. I will also explain the changes I made to finish it as a C-47 and to enhance its appeal as a *super scale job* you won't be able to stop thinking about.

Not so long ago getting a model like this to fly *at all* on electric power would have been a serious challenge. Not any more...with today's brushless outrunner motors and lithium-polymer (Li-Poly) batteries, I was able to build this airplane with NO material substitution or structural lightening. There were NO compromises regarding power...mine gets into the air from our very ordinary grass strip *way* before I can ease the throttles all the way open...and no sweating out flight duration with three or four nervous minutes the

best you could hope for. I fly for eight or ten minutes without worrying about battery charge and land with power in reserve.

The instruction manual is excellent. Every step is explained clearly and there is lots ofsupplemental information. I began by building the airplane exactly the way it tells you to. I had no issues with either the quality of the balsa in my kit or with the cutting. The balsa supplied was just heavy enough to do the job, and laser cut parts tended to fall out of the sheet with just the touch of a fingertip. If you find yourself wondering what you're supposed to be doing, you need to go back and read the instructions again.

Recommended equipment for the standard (glow engine powered) DC-3 include two .25 to .52 engines, a single pressurized fuel tank in the wing center section, and ten-inch three-blade props. The deviations from scale dimensions as called out in the instruction manual include moving the engine nacelles slightly outboard and lengthening them slightly to provide more room for various engine installations. The wing area has been increased by stretching the chord at the tips, and more pronounced wing washout is incorporated. The control surfaces have been simplified, but the plans show "scale" layouts with the option of building accurate hinge lines and rib spacing. The dedicated Robart retract landing gear is simplified in detail but accurate in overall outline. The molded plastic engine nacelles included permanently "open" cowl flaps to facilitate engine cooling, and there are no provisions for dummy scale radial engines. Several other contours/dimensions are "pretty close"... I decided not to worry about them.

CHANGES FOR ELECTRIC POWER:

I replaced the *wet power* system with a pair of Great Planes / Electrifly Rimfire 35-48-850 brushless outrunner motors operating through two Electrifly Silver Series 60 electronic speed controls (ESC's) that control two independent Electrifly 4S 3200 mAh 20 C Li-Poly battery packs. I added a top hatch to the fuselage for access. Support equipment consists of one Electrifly PolyCharge 4 Li-Poly charger and a pair of Equinox Li-Poly cell balancers, which I use on *every* battery charge.

It was necessary to make one important change in the otherwise standard electric power system. Every manufacturer of ESC's of which I am aware recommends that the wire leads connecting an ESC to a battery not be altered. In most scale models that would not present an issue, but it does with this one. It was easy enough to mount an ESC in each nacelle directly behind the motor it controls in order to ensure good cooling airflow, but the structural design of the wing and the position of the landing gear make it impossible to put anything else in there. (In the glow engine powered airplane the fuel tank location is in the wing center section.) Structural issues aside, the Li-Poly packs have to go as far forward in the fuselage as possible to balance the airplane, but the power leads are too short. I had to change *something,* so I conferred with the technical department guys at Great Planes. They agreed that my best choice would be to make the battery pack leads longer and explained that the trick to making this work would be to keep both extensions exactly the same length and to use the heaviest possible wire in order to minimize added resistance. I made a separate twelve-inch extension of 12 gauge wire and Deans Ultra

connectors for each motor circuit, plugging them in between the existing pack connectors and the ESC leads. It worked OK on my airplane.

The Top Flite engineers invested serious effort in *designing out* two common sources of danger for multi-engined scale models. They added several degrees of downthrust to each engine by setting the firewall/engine mounting plates at an angle, in order to minimize the tendency for models like this one to *zoom* sharply nose-up when full power is applied for takeoff. They also built in several degrees of *out-thrust*...left offset on the left engine, right offset on the right...to prevent severe yaw and probable loss of control in the event of an engine failure.

I gave this one a lot of thought. For me, the odd appearance of the propellers that would result from the thrust offset would *matter*. I already knew from a lot of experience that I could deal with the downthrust issue. Full scale DC-3/C-47's do it every time they fly. The pitch (elevator) trim control wheel has a clearly marked TAKEOFF setting, and confirming that the trim is set correctly is part of every pre-takeoff checklist. I am not comfortable with the idea of manually adjusting the elevator trim on my transmitter immediately after every takeoff, but the *Throttle to Elevator* mixing function of my Airtronics RDS 8000 system made it easy to program in a touch of *down trim* at high throttle settings.

The out-thrust issue exists in response to the probability that sooner or later, one engine will quit before the other while a glow powered airplane is still flying. The left-right

offset makes the pilot's job in an engine-out emergency much less critical, but it has an effect on scale appearance that's hard to ignore. I chose to bet on the reliability of my Electrifly electric power components to keep me out of trouble.

SCALE STUFF

I found a full scale C-47 at the McChord Air Force Base museum about twenty five miles form where I live in western Washington State. That airplane is actually a TC-47D restored to represent a C-47A (the definitive WWII version of the airplane) that served during *Operation Dragoon*, the Allied invasion of southern France from the Mediterrean coast in the region of Marseilles in August, 1944. Those strange *bottom-only* black and white invasion stripes were in fact standard-issue markings for *Dragoon*.

To turn my DC-3 into a credible miniature of McChord's pseudo-C-47A I had to change the overall color from aluminum to olive drab and gray, remove the airliner tailcone fairing (this was done for access to glider tow fittings on C-47's), replace the left/front cabin window with a tiny navigator's station window, make a navigator's sighting dome, and add the wide military cargo door at the left rear. A lot of C-47's were DC-3's *impressed* from the airlines and converted. Specific details of cabin window arrangement, door position, engine cowl shape, air intakes and exhaust stacks and various antennas varied widely from one DC-3 to another depending on the airline operating it, and a lot of those variations followed the airplanes into military service. With one exception, all those details on the engine nacelles of my model are specific to *my* museum

aircraft, and might not apply to the model you choose to build. However, the molded plastic engine cowls provided in the kit have the trailing edge cowl flaps molded in the OPEN position to provide good cooling air exit for glow engines. Regardless of whether an electric conversion is finished as an airliner or a C-47, those cowl flaps need to be rebuilt in a *closed* configuration so air will be forced to exit through the wheel wells and provide sufficient cooling flow across the ESC's in the mid section of the nacelles

After going to all that trouble to make the props *look right*, it was an easy call to add one final touch. *VarioPROP* adjustable pitch multi-blade propellers for electric powered airplanes are made in Germany. One of the U.S. distributors is E-Flightline Hobby in Port Orchard, WA, about an hour's drive from where I live, which made the decision easier. I used a pair of the size 8B three-blade hubs fitted with 11.9 in. *scale profile* blades. It worked out that trimming ¼ in. from each blade, recontouring each tip *round* to match the full scale blades, and rebalancing gave me a pair of three-blade propellers that are nearly perfect in appearance and fit the nacelle-to-fuselage clearance exactly. So far my best performance has been with a pitch setting of 8 in.

I sent photos of the McChord AFB C-47's *4th Troop Carrier Squadron* insignia to Michael Gross at Red5 Design Inc. He made up a set of pressure sensitive vinyl markings that match all those on the full scale airplane, but once I got started on *scale goodies* I couldn't stop there. The image of a tough old C-47 switching on her landing lights as she turns onto final approach was too much to resist. I got a complete set of working LED lights from Dan at LAZERTOYZ Discount Electric RC Supplies and now my C-47 flies

with three-position red, green and white navigation lights, a flashing red beacon on the belly, and dual wing landing lights that can be turned on and off by an auxiliary channel switch on the transmitter.

The model was covered with balsa sheet exactly per the instructions. I primed the entire structure with *non-tautening* clear *nitrate* dope from AeroDyne and then covered the *open structure* of the control surfaces as well as the entire sheeted structure with traditional *silkspan* (heavy tissue) applied wet, using dope as the adhesive. I sealed everything with several more coats of dope and then a talc-dope primer. *Everything* on the airplane was finish sanded...obsessively and aggressively. All surface color was added using Stits PolyTone color from *Stits Lite by F & M Enterprises.*

FLIGHT NOTES:

I'm going to assume that if you decide to go to all the trouble necessary to build an airplane like this one, you are interested in flying it in a *scale performance envelope.* There are two keys to accomplishing this with the Top Flite DC-3 regardless of what color it is painted...*power and discipline.* *Power* means selecting a motor-battery-prop combination that will produce only enough thrust *wide open* to permit an aggressive climb, then using *just enough* of that power to fly the airplane in a way that makes you think of a lumbering WWII era transport. Wildly overpowering multi-engine RC scale jobs is a common trap, and you don't need to fall into it with this one. *Discipline* means remembering that this is a C-47, not a P-47. I understand that it is indeed a *model* that you

are free to fly in any manner you wish, but to get the most out of it as a *scale job*, it helps to remember a few things. Your DC-3 or C-47 should always look as if it ought to be going a little faster by RC model standards, and any climb should look as if the airplane is working really hard at it. Two parameters that full scale pilots *never forgot* were the *standard rate turn* and the *maximum bank angle*. A standard rate, or *two-minute* turn means that in that time the airplane will have completed exactly three hundred sixty degrees of turn, or one full circle. In *one* minute you would get one hundred eighty degrees, another way of defining *turning around and heading back where you had just been.* You can imagine how important that might be if you had to fly in poor weather conditions with only basic instruments.

Any maneuver in which the angle of bank exceeds *thirty degrees* would be considered *aerobatic*, and not approved for these airplanes, although that doesn't account for some of the things wartime pilots had to ask their C-47's to do to get out of trouble. If you keep those limits in mind while flying your model, I can pretty much guarantee that the spectators are going to be telling each other *how realistic that is*, even if they don't know why.

The instruction manual recommends half-flap (twenty degrees) extension for takeoff. I agree. As it turned out, I didn't have to worry about abrupt climb-outs. I have enough experience flying scale models that it is natural for me to *ease* the throttle open for takeoff. My C-47 breaks ground at a safe airspeed just as the power is coming up just past *half- throttle*. Controlling any *excursions in pitch* with a little subtle stick input seems

like a very natural thing to do. After a couple of flights I removed the throttle-elevator trim mix entirely.

So far I have not had any opportunity to see what having a motor failure feels like. My suggestion is that if you are building this model *electric* and trust your ability to set up a reliable motor installation, you probably don't need the out-thrust feature. If you are using glow engines, DON'T CHANGE IT. Whether or not you take advantage of the downthrust or remove it in the interest of esthetics depends on your ability as a pilot and the amount of surplus power built into your particular model by your choice of motors and props.

The instruction manual offers some useful tips for FLYING the airplane. I suggest you study that material carefully, as there is a lot of useful information packed into those few paragraphs. I want to emphasize one characteristic of the airplane mentioned there. This DC-3 / C-47 will *spin* if you let it get into an uncoordinated turn at low speed (this means allowing *adverse yaw*, where the nose points opposite from where you have told the ailerons you want it to go, or simply not using enough coordinated *rudder* as you bank and turn the airplane.) The airplane will also respond nicely to standard *spin recovery* techniques, if you know how to apply them.

Things like this are part of the challenge of flying scale model of complex airplanes. I made sure my C-47 won't be able to get ahead of me by adding two subtle features. I

adjusted the ailerons mechanically for differential throw - more *up* than *down* – and programming in aileron-to-rudder coupling that is always ON when I fly.

THE AIRTRONICS RDS 8000 FHSS 2.4 GHz SYSTEM

There has been a lot of talk in the RC world lately about the new 2.4 GHz radios. I am using one of the Airtronics 8 channel RDS8000 systems in this C-47 project, and I could not be more comfortable with the choice of a radio for a model that means a lot to me. There is not enough space available in this article to tell you all the things you need to know about the new Airtronics system...go to http://www.airtronics.net/airtronics_RDS8000.asp and check it out for yourself.

SUMMARY:

A veteran scale modeler has taken an off-the-shelf sport scale kit and pulled out all the stops. Bob explains how an experienced model builder can turn an ordinary model into a show stopper with a few accessories, some research, and a lot of dedicated model airplane building skill.

SPECS:

PLANE: Top Flite Gold Edition DC-3

Manufacturer: Top Flite

Distributor: Great Planes/Hobbico

TYPE: RC Scale

FOR: Advanced builders/flyers

WINGSPAN: 82 ½ in.

WING AREA: 750 sq. in.

WEIGHT: 168 oz.

WING LOADING: 32 ¼ oz./sq. ft.

LENGTH: 55 ½ in.

RADIO: Minimum (4) channels required for basic model; flown with Airtronics RDS8000 FHSS 2.4 GHz transmitter and 92824 8 channel receiver (7) channels used. (7) Airtronics servos used: (2)94358Z rudder and elevator, (5) 94761 for ailerons, flaps and retract gear switching and (1) Airtronics 4-cell 750 mAh NiCd

POWER SYSTEM: (2) Great Planes Electrifly Rimfire 35-48-850 brushless outrunner motors, (2) Electrifly SS 60 electronic speed controls, (2) Electrifly 4S x 3200 mAh 20 C Li-Poly packs, (2) three blade, 11.9 in. diameter *varioPROP* propellers

FULL THROTTLE POWER: 42 amps, 620 watts (per motor) 1240 watts total, 7.4 watts/oz., 118 watts/lb.

TOP RPM: 9350

DURATION: estimated 10-plus minutes (All flights are cruising comfortably at half-throttle...no aerobatics or abrupt maneuver

MINIMAL FLYING AREA: Large developed RC field with maintained grass or paved runway.

COMPONENTS NEEDED TO COMPLETE: Motors, batteries, speed controls, radio, all covering and finishing materials and incidental hardware as listed in the instruction manual.

PHOTOS:

1 Always start at the beginning. The comprehensive instruction manual includes a full set of parts templates. I had no problems with the laser cutting of balsa and plywood parts.

2 The fuselage is built upside down. Here I'm using a combination of pins, clamps and masking tape to hold the 3/32 in. sheet balsa skins, which are assembled *wet*, in place.

3 When you sand all the sheets, strips and blocks to blend with the molded plastic cockpit enclosure it starts to look exciting.

4 Lead weights and clothespin clamps keep the basis wing structure in line while the glue dries. I use Titebond ™ aliphatic resin wood glue rather than CyA for better strength and added working time.

5 Here's the framed up wing with the Robart retract units in place, ready for the sheet balsa lower skins.

6 You skin the bottom wing surface first, install all the mechanisms and wiring, then sheet the top.

7 The green right wingtip LED nav light from LAZERTOYZ is threaded through holes drilled in successive ribs and protected with lots of masking tape. The next step will be to glue the hollowed-out balsa block wingtip in place.

8 The wing center section with all the servo and lighting system wires in place, along with the Robart air tank and control valve and pull-through strings for the ESC wires, ready for top sheeting.

9 The basic engine nacelle structures are laminated from several balsa sheet and light ply parts. You can see where I have marked for the cuts that will eliminate the downthrust I elected to remove from my airplane.

10 I should have done this earlier...trimming the nacelle sides to equal length eliminates the side-thrust offset.

11 Primary structure of the *Number Two* (right) nacelle with the Electrifly SS-60 ESC installed temporarily to check clearances. After the nacelles are finished the wire leads will be pulled in through the wing by that heavy yellow string.

12 Here's how I began to modify the engine nacelle/cowl flaps to improve cooling. That's the full scale subject in the photo.

13 I added a collar of 1/32 in. plywood to the base of each nacelle...the separate cowl flaps were attached in the *closed* position over these.

14 Here is the *Number One* (left) nacelle all finished and ready for installation of the ESC by pulling the bundled wire leads through to the wing center section. The rectangular blocks are for the cowl attachment screws, per the original kit design.

15 One of the Rimfire 35-48-850 motors in place on its Electrifly brushless medium motor mount, ready for the cowl.

16 The wing center section with everything in place. The black two-wire leads with Deans Ultra connectors run from the two Li-Poly packs in the fuselage to the ESC's in each engine nacelle. The white cylinder is the Robart retract air tank. You can see the red Robart selector valve at the lower right of the opening. The "extra" white thing at top left is the LAZERTOYZ lighting control module.

16A Here's that access hatch opened up. The ends are cut along existing formers, extra structure added, and *those little magnets* added at each corner. Everything is sanded for a tight slip fit and there is no tendency for anything to shift in flight. You can see the Electrifly Li-Poly packs in the right place – as far forward as they will go – to balance the airplane.

17 Here's what it looks like all put together. The intake housing on top of the nacelle is carved from balsa as are the main components of the exhaust manifold and the oil cooler at the bottom. These details vary from one DC-3 / C-47 to another.

18 & 19 General views...ready for service.

20 “Is the door open...can I come along?”

21 Rear quarter view shows the flaps fully extended .

22 Close-up from the front shows the nose door originally used to load airmail and gives a good look at the *varioPROPS*. That flying pack mule logo belonged to the 4th Troop Carrier Squadron, McChord AFB, Washington.

23 This airplane has more than enough power to get away from a grass strip easily.

24 Gear up and on the way.

25 This one is all business.

26 & 27 Down and dirty for landing.

28 & 29 Almost home