DynaSoar Rocketry Interceptor III Rocket Boost Glider Review
By Chuck Pierce

As many of you may know, I've been a high-power model rocket enthusiast for many years, and am currently the president of the Huntsville Area Rocketry Association (HARA). I had gotten back into RC aircraft and joined NARCA in September of 2015. Rick Nelson has been my RC coach and had stumbled across an old HobbyLabs SR-71 boost glider kit, and picked it up for me. This kit was early 2000's vintage, with mechanical mixing for the elevons, and a clunky 72MHz receiver and Alkaline 4x AAA battery pack. It was a heavy kit and after banging up the nose on a landing, I decided to shelve it. However, I had gotten the boost glider bug.

DynaSoar Rocketry is known within the rocketry world as a great designer and provider of quality rocket boost gliders, and the owner is an accomplished model aviator in his own right. I ultimately decided to purchase the Interceptor III rocket boost glider. I flew the Interceptor III six times over the October 1/2 weekend. Based on the enthusiasm expressed by the present NARCA club members on this novel melding of rocketry and RC aircraft, I decided to write this article to provide more information on the Interceptor III and model rocketry in general.

The Kit Contents

The Interceptor III boost glider is produced and marketed by DynaSoar Rocketry (www.dynasoarrocketry.com) for $65. The kit is custom-made by the owner of DynaSoar Rocketry at the time of order, and the kit contains the following components:

1 wing
1 wing spar (carbon fiber)
2 pushrods
2 vertical stabilizers
4 wingtip pods
2 Body Tubes
1 Motor mount
2 centering rings
Velcro (for battery and rx/bec attachment)
2 Rail buttons with t nuts/screws
2 landing skids
3M blenderm tape

Lead weights
Spare depron

After purchase, the kit arrived with the components well packed and protected. The body tube and motor tube are cardboard tubes, the nose cone is plastic, and the wings and horizontal stabilizer are depron foam. All components are white. The decals shown in the graphic are NOT provided with the kit; however, a vinyl set of decals can be purchased from Stickshock23.com. Other items needed to complete the kit are receiver and receiver battery, dual servos (10-13 gram recommended), and a low-thrust solid motor for the power plant.

The Build

A hardcopy of the instructions is not provided in the kit but is available on the DynaSoarRockety website. The instructions are a living document, in HTML, and, notably, not as a downloadable set of instructions. The online instruction set includes verbal instructions with myriad photos. I will admit that I was less than impressed that I could not download a complete instruction set in PDF format and had to resort to saving and printing out the HTML webpage to get the verbal instructions, and copy/pasting the photos that I wanted into a printable document. Being an old(ish) engineer, I need a printed instruction set from which to work.

With the small gripe about the instruction set aside, the assembly of the model is rather easy and intuitive. The depron wings and V tail stabilizers are easily installed onto the airframe, and the motor mount is easily assembled and installed inside the airframe. The instructions provide guidance on installing and connecting the two elevon servos, elevon control horns, and push rods. For the onboard brains, I chose a 4.4g 6-channel LemonRX receiver (because that's the smallest receiver that I had on hand). A 6-channel receiver is overkill for this boost glider because channels are needed only for ailerons and elevator (mixed by your transmitter for elevons) and for a switch to change the elevator presets due to the CG change as the motor consumes propellant. For the onboard power supply, I chose a 450mah single-cell LiPo and prepared its Velcro mount location within the shoulder of the nose cone. I made an adapter cable that allowed the 1S battery to be connected directly into receiver; no BEC was required.

A major consideration in constructing this boost glider was to keep it light, to keep the wing loading as low as possible to maximize the glide slope. For adhesives, I used Foam Tac and foam-compatible CA. When attaching the wings and vertical stabilizers, I made fillets with medium CA and accelerator and was very happy with the results. The Center of Gravity (CG) for the liftoff/boost phase of this model should be at the intersection of the strakes and the main wing.

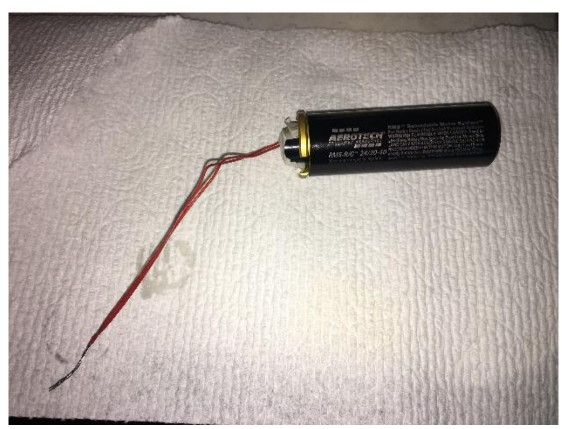
The Finishing and Detailing

For decals, I ordered a $20 vinyl decal set from StickerShock23 (www.stickershock23.com). Obviously, decals are not mandatory for a fully successful flight. The vinyl decals, however, are high quality and are easy to install. After application of the decals, moderate heat, such as from a hair dryer, needed to be applied to the decals, to soften them for better adhesion to the depron surfaces. I chose to paint the wingtips and elevons red and used a Sharpie marker for that job, as Sharpie ink is much lighter than enamel or acrylic paint and is much less likely to damage the foam. I used painter's tape to mask off the area to be painted, and much to my chagrin, due to the porosity of the depron, some of the Sharpie red seeped under the tape. Since the Interceptor III is belly landed, I decided to laminate the bottom of the airframe with black self-adhesive polyester film, to help protect the belly for landing damage. In hindsight, for landing on a grass field, however, the bottom of the body tube really doesn't need the added protection.

The Power Plant

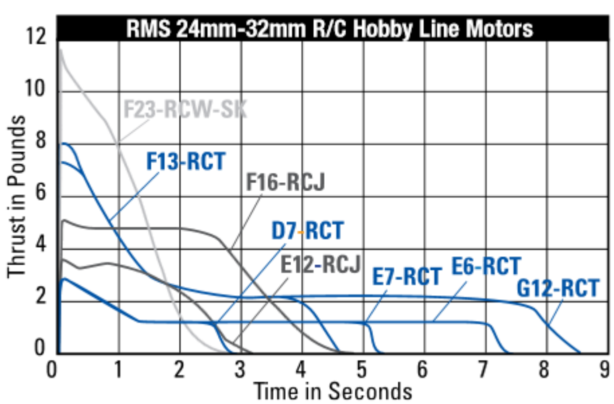
The power plant for all of the DynaSoar boost gliders is the Aerotech E6 solid motor. The E6 is a reloadable ammonium perchlorate composite propellant motor. It requires an Aerotech 24/40 aluminum casing and an E6 propellant load. DynaSoar Rocketry sells both the motor casing ($57.50) and 3-packs of E6 reloads ($19.50). This is about the best price that you'll find on this specialty motor system, as DynaSoar Rocketry does not try to make much profit on the motor.

Each reload consists of a propellant grain, nozzle, o-ring, and igniter. A silicone lube is applied to threads and surfaces that contact the aluminum casing, to facilitate removable of the charred insulator after use. The 24/40 case is made especially for RC use by closing off the forward end of the motor (which is where the ejection charge is placed on conventional solid motors). The aluminum casing is reusable, whereas the reload contents and igniter are consumed during the flight. After assembly of the motor, the motor is installed in the motor tube of the boost glider.



The E6 (E6-RCT, in the graphic below) motor is chosen for the Interceptor because it is a low thrust, long burn motor. As can be seen in the graphics, the E6 provides 40 N*seconds (9 lb*seconds) of total impulse with an average thrust of 6 N (1.2 lbf). The burn time of the motor is a little over 7 seconds. 21.5g (0.75 oz) of propellant will be consumed during the burn, meaning that the CG of the boost glider will move forward as the propellant is consumed.

The designation of the motor provides important information about the motor. The Letter describes the impulse class. An E motor, for example, has an impulse range of 20-40 N*sec. The Number following the Letter defines the average thruster of the motor. So, an E6 motor has 6 Newtons of thrust (average) and lies somewhere within the 20-40 N*sec impulse band. Important information not provided by the motor designation is the exact impulse, which isn't as important for low-power motors as it is for high-power motors, and the initial thrust, which is important to determine the liftoff thrust-to-weight ratio of the rocket. The rule of thumb is that the liftoff thrust-to-weight ratio of an unguided model rocket should be greater than 5:1; however, an RC boost glider can have a lower thrust-to-weight ratio since the rocket's attitude can be adjusted by the RC pilot. The total impulse is typically how motors are categorized, as A through G low-power motors. Total Impulse can be determined multiple ways. Typically for model rocket motors, the total impulse is calculated by multiplying the average thrust by the burn time. A more exact method for determining the total impulse of a motor would be to calculate the area under the motor's Thrust vs. Time curve, by integration. Within an impulse class, E impulse for example, differing formulations and grain and nozzle configurations can provide different thrust levels. In the graphic below, an E12 and E6 have roughly the same total impulse, but the E12 has twice the thrust (average) of an E6, but burns only half as long. A low thrust motor is important for boost gliders, to maximize the controllability of the boost glider during ascent.



RMS-24 R/C Hobby Line Rocket Glider Reload Kit Data

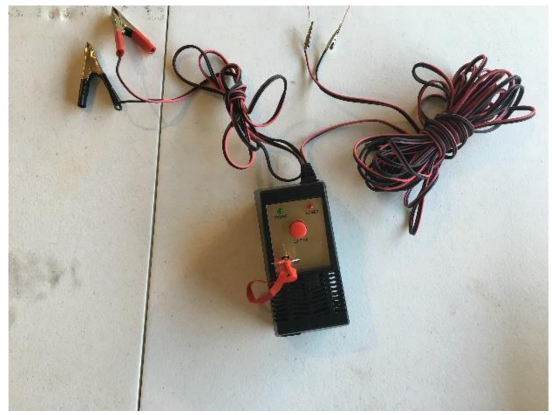
Hardware	Reload	Total Impulse	Prop. Wt.	Loaded Wt.	Delay Times
RMS-R/C 24/20-40	D7-RCT (3 pak)	20 N-sec	10.5 g	41 g	plugged
RMS-R/C 24/20-40	E7-RCT (3 pak)	30 N-sec	17.1 g	46 g	plugged
RMS-R/C 24/20-40	E6-RCT (3 pak)	40 N-sec	21.5 g	52 g	plugged
RMS-R/C 24/20-40	E12-RCJ (3 pak)	36 N-sec	28.3 g	59 g	plugged

Preparation for flight – Transmitter Setup

Since the Interceptor is a delta wing, the transmitter must be setup for elevon mixing. I use a DX6, which makes elevon mixing very simple. Knowing that the mass of the boost glider will change, due to the consumption of propellant, it is important that the transmitter be prepared to adjust the neutral position of the elevons to account for the shifting CG. Although there are no flaps on the Interceptor, I used the flap feature in my DX6 transmitter to allow the neutral elevator position to be modified by the flip of a switch. I programmed Switch A to be my Flap Switch. Per the vendor's instructions, during the powered boost phase, approximately 1/8" of down elevator is needed, and during glide and landing after the motor has burned out, approximately 1/4" of up elevator is needed, due to the nose-heavy configuration. In the Flap System settings, I set Switch A Position 0 to be gear up and -8% elevator and Switch A Position 1 to be gear down and +15% elevator. The 'gear' part of these settings is obviously irrelevant. As such, the rocket will be launched in Position 0, and at apogee the switch will be flipped to Position 1.

Launch Pad Setup

To launch the Interceptor III, a launch pad and launch controller are required. For my flights, I borrowed my rocket club's launch pad, which consists of a pad with inclination and azimuth adjustments and a 1"x1"x8' rail with a 1/4" slot for the rail buttons on the boost glider, and I used a single-channel electrical launch controller that I had on hand. The Electrical Launch system draws its power from a 12v battery. For safety, the Electrical Controller has a removable key switch, which arms the controller, and a Big Red Launch Button, which supplies the power to the igniter, which starts the solid motor. The electrical launch controller can be seen in the graphic, where the battery wire/clips are on the upper left, the igniter wire/clips, and the control unit with the key switch and Fire Button is lower center.



With the E6 reload installed in the motor casing, the motor installed in the Interceptor III, and the electrical launch controller disconnected from the battery, I loaded the boost glider onto the launch pad and rail. I set the launch rail to approximately 10° off vertical, pointed slightly upwind, with me standing downwind. I chose these settings because I knew that a boosting rocket will have a tendency to cock into the wind and that tendency would give me the best opportunity to control the rocket into a mostly vertical ascent. Al Clark volunteered to be the Launch Officer and operated the electrical launch controller. We both were positioned a safe distance from the pad, should the motor malfunction, and the glider was angled away from us and the spectators.

The Flight – Ascent and Recovery

With the Interceptor III on the pad and the launch controller connected to both the 12v battery and the motor igniter, I verified that my TX was in boost mode (i.e., Switch A was in Position 0). Per the Safety Code of the National Association of Rocketry, I verified that the skies and range were clear of all aircraft and personnel, and provided a verbal 5-count to launch. When Al pressed the Big Red Button, the Interceptor's motor ignited, and the boost glider started its boost toward the heavens. As the boost glider left the rail, it angled slightly upwind and started a slow roll; so, I applied an appropriate amount of elevator and aileron to guide the Interceptor into a more vertical ascent. As soon as the motor burned out, I flipped Switch A into glide/landing mode (which changed the neutral position of the elevons to approximately 1/4" of up elevator) and the boost glider quickly transitioned from vertical flight to horizontal flight.

The wing area is not large on the Interceptor III, but it did still have a decent glide rate. I circled a few times, almost putting the glider in the trees once, before setting it down on the ground near the corn field. It wasn't a stellar flight, but it wasn't horribly bad either, at least not for my first boost glider flight. The second flight was awful as the ascent was 30° - 40° off vertical and the flight time was very low.

The third flight, however, was awesome! The ascent was nearly vertical, the glide rate was good, and I set the glider down on the runway, just a few yards away from the spectators and me. I'm guessing that my flight time was around 45 seconds. The owner of DynaSoar Rocketry says that he usually gets about 75 seconds of flight time, and his longest flight has been approximately 2 minutes. I definitely have room to improve. The YouTube video of my third flight can been here: https://youtu.be/Wf24c2uL-sY. On the following day, I loaded up a motor and let Al Clark fly it, and Al, being the master model aviator that he is, found a superb glide slope and had a great flight.

Supplemental Information on Safe Model Rocketry

As many of you know, I have been a model rocket enthusiast for the last 17 years (not counting the years that I launched model rockets as a child and teenager) and am currently the president of the Huntsville Area Rocketry Association. As in model aeronautics, in model rocketry there are definitely ways to hurt yourself and others and to damage property if someone is being careless. Some personnel dangers can result from hot motors, the electrical system, and recovering rockets hitting people. Property damage can result from fire and from models recovering (with high kinetic energy) on buildings, equipment, and vehicles. AMA membership covers model rocketry up through G motors, but I have not really been able to find out much about the AMA model rocketry safety code or the rules governing rocketry in general.

I am a member of the National Association of Rocketry (NAR). The NAR specializes in model rocketry and has established a robust safety code for the launch and recovery of model rockets. The NAR Model Rocket Safety Code establishes safe distances between personnel and launching rockets, guidelines on materials that can be used in model rockets, launch procedures, and instructions for dealing with motor misfires. By following these guidelines, members of the NAR have $2M of liability insurance, but more importantly, they are showing that they take model rocketry safety very seriously. In any hobby, there can be dangers caused by the foolish or the careless, but by following the safety code and having a mindset of 'Safety First,' model rocketry can continue to be a very safe and fun hobby, as it has been since the 1950s. More information on the NAR can be found at www.nar.org, and the NAR Model Rocket Safety Code can be found at http://www.nar.org/safety-information/model-rocket-safety-code.

Summary

For those interested in both model rocketry and model aviation, RC rocket boost gliders are an awesome melding of the two. Besides the kit and on board components, a rocket motor and launch equipment is required for each flight. The motor casing is a one-time expense, but a propellant reload is consumed for each flight. The launch equipment can usually be borrowed from a rocketry enthusiast, such as myself. For that matter, I'd also be happy to loan my motor casing to anyone wishing to fly a boost glider with an E6 reload. A 3-pack of E6 motor reloads costs approximate $20, making the per-flight cost $3.67.

Speaking for myself, I thoroughly enjoyed the Interceptor III rocket boost gliders flights. Of course, I was the RC pilot. For the launch, everyone at the field stopped what they were doing to watch, and seemed to enjoy the launch and recovery nearly as much as I did. The build of the boost glider is not difficult for anyone moderately skilled in either model aviation or model rocketry. The owner of DynaSoar Rocketry was extremely helpful and responsive and willing to answer my myriad questions, pertaining to the build and configuration of the glider and my transmitter. Foam-compatible CA and/or foam glue are the only adhesives needed. The rocket is ballasted and balanced for the boost phase and the transmitter is set up to compensate for the changing CG. With just a little bit of effort and a little practice, flying RC Rocket Boost Gliders can be an extremely rewarding experience for the adrenalin junky in us all.