PEAK OF FLIGHT

NEWSLETTER

ISSUE 402 | OCT 20 2015

IN THIS ISSUE

A Survey of Competition Rocket Gliders

https://www.apogeerockets.com/Rocket-Kits/Skill-Level-3-Model-Rocket-Kits/Slo-Mo

Apogee Components, Inc.
Your Source For Rocket Supplies That Will Take You To The "Peak-of-Flight"
3355 Fillmore Ridge Heights Colorado Springs, Colorado 80907-9024 USA
www.ApogeeRockets.com e-mail: orders@apogeerockets.com Phone: 719-535-9335 Fax: 719-534-9050

PEAK OF FLIGHT

A Survey of Competition Rocket Gliders

By Stuart Lodge

1912-CARL NEUBRONNER equipped a basic model aeroplane with a fireworks-type rocket. This performed satisfactorily and this was where it all started. In more recent decades, full-size Aerospace saw the need to evolve something similar, a leading to NASA's Space Shuttle and CCCP/Russia's equivalent, Energia-Buran, which represent Real World, 21st Century, Rocket Boosted Gliders.

First up, glider terminology and contradictions need sorting out…Model Rockets boost upwards at 100s of miles per hour, Gliders soar horizontally at ~20mph. The term, rocket boosted glider, covers a multitude of sins... what's it all about?!?

Figure 2: Underside of an S4A-Boost Glider 'folder' in launch mode…just needs a motor.

Boost Gliders

These are simple free flight gliders, normally resembling hand launched glider- a 'chuckie'. They are boosted skywards using standard model rocket motors. Key definition - the motor is normally ejected before the glide segment of the flight starts, although contemporary FAI rules have 'greyed' this key point, making motor ejection optional. 'A' & 'B' - 2.5 & 5 Newton second (Ns) are the normal motor impulse.

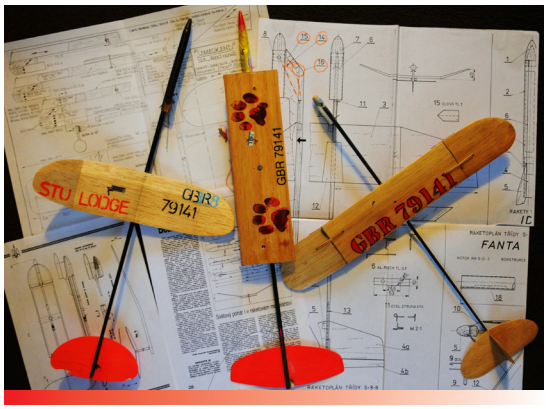


Figure 1: A rigid S4A-Boost Glider, with two 'folders' atop a selection of designs from around the world.

Rocket Gliders

These resemble Boost Gliders, but are normally bigger and equipped with radio control gear. Motor Specific Impulses vary and bigger RC gliders need 'D' to 'E' - 20-40Ns. Key definition – spent motor retained for the duration of the flight.

Rogallo Gliders

Key definition - Boost and Rocket Gliders are made from rigid materials, such as balsa, polyurethane foam, and contemporary composites et al . Rogallos are flexible – resembling a hang glider. Naturally, they need to be rolled up to fit in a body tube for launch, shedding this for the glide segment of the flight. These are rare and won't be featured much more in this piece.

Figure 3: Chuckie with a rocket boost! Bedrich Pavka (CZE) launches his rigid balsa boostie…and when these work well, you wonder why we try anything different.

Stability

Rockets are stable because the Centre of Gravity (CG) is 1+

About this Newsletter
You can subscribe to receive this e-zine FREE at the Apogee Components website (www.ApogeeRockets.com), or by clicking the link below
Newsletter Sign-Up

Newsletter Staff
Writer: Stuart Lodge
Layout/CoverArtist: Chris Duran
Proofreader: Michelle Mason

Continued on page 3

Competition Rocket Gliders

Continued from page 2

body diameter ahead of the aerodynamic static Centre of Pressure (CP). Gliders are different, with CG and CP loci residing at the ~50% wing chord location. The glide velocity is slow, much slower than any rocket boost speed. Simply fixing a nose-mounted pod to hold the rocket motor cannot deliver, and will result in a ground-seeking trajectory most likely!

Figure 4: Nige Bathe (GBR) sets up his 'Toblerone Special)…this S4A-Boost Glider's wing swivels 90 degrees and is then 'rolled up' around the fuselage and becomes a 'rocket'. At the top of the boost, it all unrolls and becomes a glider again.

What's needed? The glider wing's lift potential needs neutralizing, whilst the model is boosting, to ensure that the glider boosts vertically. At this stage, the model rocket motor, a dense and fairly heavy piece of kit when full, plays a key role. Plug the motor into this (the nose mounted motor pod) and the CG migrates forwards to the wing's leading edge…even in front. The wing becomes ineffective as a lifting surface and many enthusiasts even add trim tabs, resembling an aileron or takeoff flap, to one of the wings, promoting a roll during the boost segment of the flight. This is all basic model aircraft trimming, which you can see by spending an hour or two with a traditional aeromodeller. Boost gliders have the motor at the front, to make life easier and it's obvious, when the motor's ejection charge fires and ejects the spent case, the CG relocates to the glide segment locus.

Boost Gliders...the build

Model Rockets are different from any glider. Gliders have wings; Concept, design and construction involve a new suite of skills. We need tooling and the ability to carve

Figure 5: Mike Francies (GBR) poses with his 21st century S8E/P-RC Rocket Glider, at the 2011Catalunya Cup

out and section wings from balsawood and other materials fuselages frequently from spruce, or composite tubes and tailplanes differ from rocket fins too. Finishing techniques are often traditional using dope, sanding sealer and tissue, most of the time. Bright colours help in any subsequent searches, with fluorescent panels definitely to be recommended!

More jargon…Decalage – these are the incidence angles of the wing and tailplane. These are a subject of debate too. Some line up wings and tails in the Zero-Zero state, leading to straight, high boosts, but critical in the

 Continued on page 4

Competition Rocket Gliders

Continued from page 3

transition phase, the coast segment into the glide; get it wrong and SPLATT! Employing a couple of degrees positive wing incidence, and things are more predictable. Inducing a roll in the boost phase makes life easier still. In aeromodelling basics, wings are made from ¼ inch soft-medium density, quarter grain cut balsa, with wingspans of 12-18 inches. Fuselages are spruce strips, or composite fishing rod tubes. Tailplanes are from 1/16 inch soft quarter grain balsa.

Too few Boost Gliders are seen in the fly-for-fun scheme of things, the great majority are seen in FAI's S4-Boost Glider events around the planet. Let's focus on FAI contest S4-Boost Gliders.

Figure 6: 'Mars Lander' S8E/P-RC Rocket Glider by Mike Francies (GBR), in glider mode at the Ljubljana Cup, in 2010.

Rigid Gliders

S4A-Boost Gliders boost using 2.5Ns (that's where the 'A' comes from) and weigh between 1 to 1.5 ounces, including the motor and ready to go on the launcher. Smooth impulse delivery is vital, contrasting with the hard whoosh normally delivered by hobby shop motors. The best boost glider propellants are made in Eastern Europe, where this event is an 'art form'. Soft-blowing A2-2 motors are pretty typical, with nothing in Estes' otherwise comprehensive motor array remotely similar. Coast times must be kept short, as gliders slow down rapidly as the thrust decays. Wing flaps are employed by some designers, held in the up position for boosting and released as the motor ejects for the glide. Others employ differential flaps for the boost segment, one fully up, the other half down to induce a gentle, slow roll.

Folders

Cold War developments led to USSR's Sergei Illin's novel take on S4-Boost Glider, evolving a wing that tucked in its tips and pivoted through 90 degrees on the fuselage mount ***(See Fig. 2)***. The wing is folded and parallel with the fuselage, during the boost segment of the flight. So the Glider becomes a true Rocket when boosting, with the ejection charge burning through a thread and releasing the spring-loaded wing. Suddenly lots of wing area appears and the Rocket becomes a Glider! Super, but harder to design and build.

Ironically...'folders' were ousted from FAI contests by the ultra-efficient Rogallo glider, which the Bulgarians brought to USA's 1980 World Space Modelling Championships. Flex wings were novel and had not been seen, consequently permissible in competitions. Rogallos were subsequently reclassified as FAI class S10 and haven't seen the light of day since! Folders nudged traditional rigid gliders off the podium in succeeding years. Contemporary

 Continued on page 5

Competition Rocket Gliders

Continued from page 4

Russian developments include stowing a folded glider in a normal rocket tube, boosting to silly altitudes before spitting it out! These resemble commercial Zing Wings, polystyrene wings that are designed to fold in half before being fired upwards by catapult, springing out their wings as the velocity decays. Balsa gliders can be made to do the same, 'rolled up' and slid inside a lightweight body tube. The performance is stellar – just a bit too good they are mostly 'fire and forget' because of the poor visibility of very small gliders!

Figure 7: Nuria Crusellas (ESP) prepares her folding wing S4A-Boost Glider on a high efficiency piston launcher at the Catalunya Cup, Spain, during 2009.

Dethermaliser

Gliders get into thermals & up-draughts and soar away. Using a dethermaliser (DT) is the means to spoil a glider's trim, prompting a more rapid return to terra firma. How? Burning fuses and tiny clockwork/electronic timers may be used to tip the tailplane on its mount, drop a trim-weight from the nose, or release a trim-destroying flap. DTs should be employed in every boost…you'll get less building time as a result!

Rocket Gliders

Rocket gliders are better when much bigger and radio controlled…sorting the CG-CP migration nicely. RC Rocket Gliders are a fantastic diversion, exciting and spectacular too, flying on 40Ns impulse, (that's the 'E' in S8E/P-RC Rocket Glider) achieving ~1000' in 10 seconds. But lot more expertise is needed, many rocket gliders have complex built-up wings, sheeted over in balsa; others layered up from contemporary composites. Rocket Gliders are 'experts only'.

Radio Control requires a two or three channel radio, at the basic level with rudder (Yaw axis) and elevator (Pitch axis) control only. Ailerons (Roll axis) may be controlled by the third channel. RC gear just gets better; ultra-lightweight receivers, servos and power packs are available in the Hobby Shops. Vee-tails, combining rudder and elevator functions on the same surfaces, are often employed and work by "mixing" the servos' functions. Some use 'spoilers' to flop the glider onto the turf for spot landings.

Figure 8: S8E/P-RC Rocket Glider features bigger, more sophisticated designs. Mitja Zgajner (SLO) boosts away at the 2011 32nd Ljubljana Cup, Slovenia. Check out the snow on those mountains.

Get the best quality tubes at the best price!

New Mid-Power Tube Assortment

You get:
(4) AT 29/13
(4) AT 41/18
(2) AT 56/18
(2) AT 66/18
(1) AC-56
(1) AC-66

The classic tubes-o-plenty

You get:
(6) AT 13/18
(6) AT 18/18
(6) AT 24/18
(6) AT 33/18

www.ApogeeRockets.com/Building_Supplies/Body_Tubes

Continued on page 6

Competition Rocket Gliders

Continued from page 5

Decalage

Re-read the boost glider basics, but RC rocket gliders normally feature a few degrees of wing incidence. The glider is able to be trimmed nose-heavy in the boost segment, with readjustments dialed into the RC gear for the glide segment. Normally, a whisker of down-elevator is programmed in for the boost segment, keeping the glider boosting straight. Traditionally, motors were always mounted in a nose pod, atop the fuselage, just like a big boostie. They were effective, but crude and ugly! The 1990s saw underslung motor mounts coming into play and these days the motor is normally to be found under the wing. Research has shown that to have the motor tube between the wing mount and the fuselage boom, with ~3 degrees of thrust inclination, focused through the glider's CG position, really improves the boost segment. Contemporary composites, like aramid (Kevlar, carbon and glass fibres) are common selections in construction. FAI's contest class is a duration-based, precision landing event, the objective being to able to land on a specific spot, with a flight duration of exactly 6 minutes; points are lost for being early or late and for being more than 1 metre (yard) from the landing spot.

Figure 9: Nige Bathe and Mike Francies (GBR) pose at the 34th Ljubjana Cup, in 2012. These S8E/P-RC Rocket Gliders are at the 'Formula 1' end of life with extensive use of contemporary composites throughout. Sensational performance.

Ground Support Equipment (GSE)

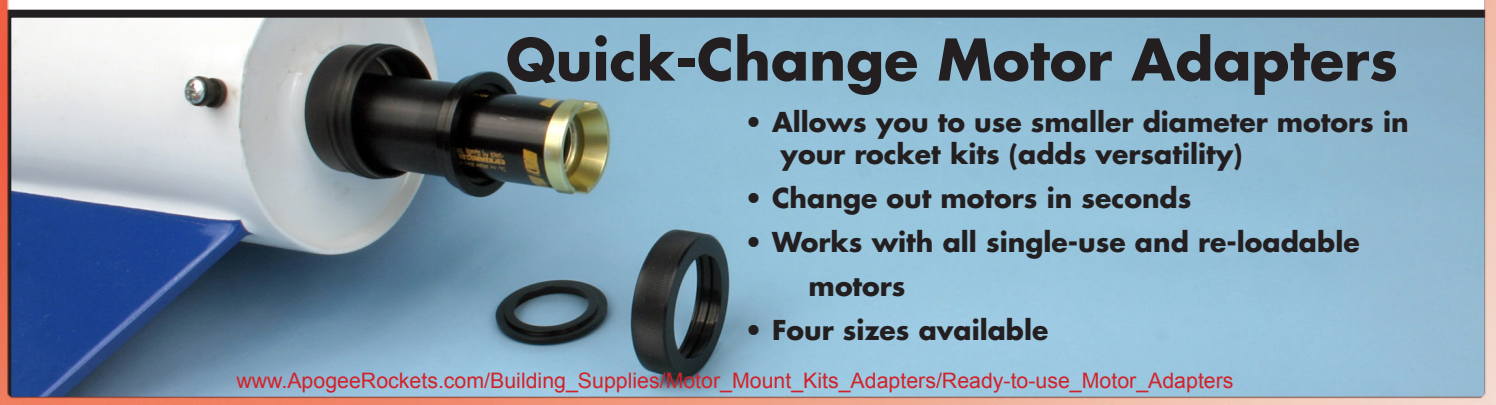
Launchers! Gliders don't resemble rockets and with the motor placement towards the nose, an 'umbilical' is often needed. Consequently, simple pad and rod combinations don't work, leaving the glider's wings flapping in the breeze and the ignition wires dangling and in danger of fouling the tailplane! Small boost gliders need wing support, usually rods set up parallel with the launch rod. Also remember that most boost gliders usually need launch lugs too. Big radio controlled rocket gliders have special needs, like a heavy duty launcher, usually angled upwind, facilitating better guidance of the glider during the boost segment. Reliable GSE is vital to the successful flying of rocket boosted gliders.

Figure 10: Balkan Cup, Dupnica in Bulgaria 2012. Two S4A-Boost Glider 'folders' on the launchers ready to go, Macedonians; Zoran Atanososki & Stanisa Petrovic get ready.

Flare out

'Booster roosters' are complex and need more knowledge in terms of design, building and flying than virtually every other kind of model rocket. Crucially, they form an interface between Space Modelling and Aero Modelling. Get to know someone who's keen on the latter and lots more expertise will materialise in a very short time. And you'll avoid coming home with the gliders in 'kit form' after every flying session!

Once more, this is a snapshot, we've not covered rear-motored boosties. They exist, more commonly found



 Continued on page 7

Competition Rocket Gliders

Continued from page 6

'Stateside than in Europe. The USA is also keen on canard gliders; That is to say, models with the tail at the front and the wings at the back of the fuselage. Over five decades now, almost everything has been checked out by an enthusiast somewhere, but the elite kit is to be found in FAI competitions around the World. However, to summarize, boost gliders are where Space Modellers and traditional free flight Aeromodellers could find common ground. Rockets and gliders form the perfect synergy, so give them a go!

About the author

Stuart Lodge is a famous name in rocketry in the United Kingdom and also among competition modelers in Europe. He's written several rocketry books, in- cluding "Model Rocketry," "The Model Rocket Handbook" and "Stu's Space... The Gospel According to Stuart Lodge. A Cornucopia of Space Modelling & Model Rocketry: The World Game."

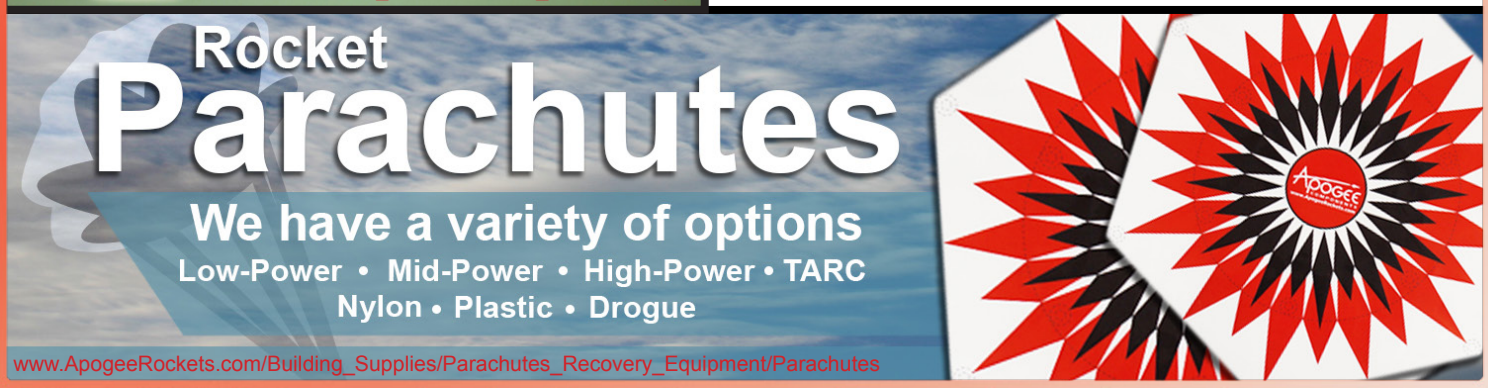



Figure 11: Stuart Lodge