Rocket Gliders part 1

Learning Objective	In this lesson we will begin our study into one of the more complex model rocket configurations, the model rocket glider.
Grade Level	9 – 11

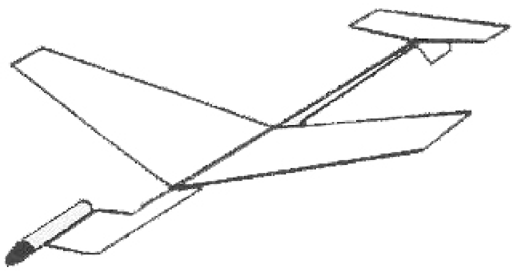

Figure 1 – Typical Rocket Glider

– Introduction –

A rocket glider (Figure 1) consists of a rocket motor attached to a glider such that the model climbs in a true rocket (ballistic) flight but converts after burn out to a glider. The burnt out motor stays with the glider.

Figure 2 – Typical Rocket Boost Glider

A rocket boost glider or boost glider (Figure 2) behaves in the same way as a rocket glider except that the motor and booster pod become detached from the model at burn out and return to earth separately. The booster usually returns by either parachute or streamer. Of the two types of glide recovery models the boost glider is the easier to build and fly. We will focus on the boost glider for the rest of this article.

Types of Boost Gliders

The boost glider has two phases to its flight pattern. The first is the ballistic or rocket phase during which wing lift is neutralized in some way so

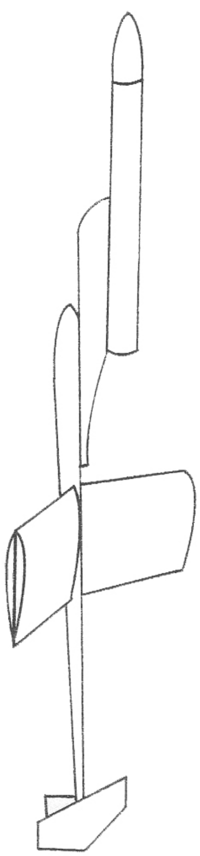

Figure 3 – Folding

Wing Boost
Glider with
wings
folded over

as not to affect the vertical climb. In the second phase the model converts to a slow speed glider. The wings are now the main means of creating the lift that keeps the model airborne. For ballistic climb, the centre of gravity (CG) should be in front of the the centre of pressure (CP) of the complete model. For the glide phase the centre of gravity should move behind the centre of pressure. Obviously the secret of success with boost gliders is to have the centre of gravity change position as the motor and booster pod leave the model.

On the smaller boost gliders, those that use mini-As or B and C motors the centre of gravity change can be achieved by having a long pylon on the boost unit (Figure 2) so that the motor is far forward. This brings the centre of gravity of the booster/glider combination forward usually in front of the wing for the boost phase. As the booster pod drops off the centre of gravity moves back to the position required for glide trim.

For boost gliders designed to use D or E motors the wings must be very strong to take the high drag forces created by boost speeds.

To achieve this the wings must be thick enough to have a spar running spanwise. But as the wing thickens drag forces increase. Drag tends to slow the glider down and stop it from reaching the altitude that a plain rocket using the same motor might achieve.

Swing Wing Design

Building stronger wings usually means using low aspect ratios.

However the best gliders have high aspect ratio wings. Consequently the wing design for the boost phase is not the best for the glide phase especially since high aspect ratio wings having less area are usually weaker and tend to shred to pieces in boost.

The logical answer to these problems is to try and reduce drag during boost. Several methods that come under the heading of Variable Geometry Models achieve this. An early method was called Flop-Wing or Folding-Wing in which the wing was folded half way along its length reducing the span and increasing the thickness of the wing (Figure 3 and Figure 3b). To its advantage this method causes the airfoil of the stubby wings to become symmetrical leaving little or no lifting characteristic and making possible a good vertical boost. Upon unfolding the wing can become a highly efficient lifting surface.

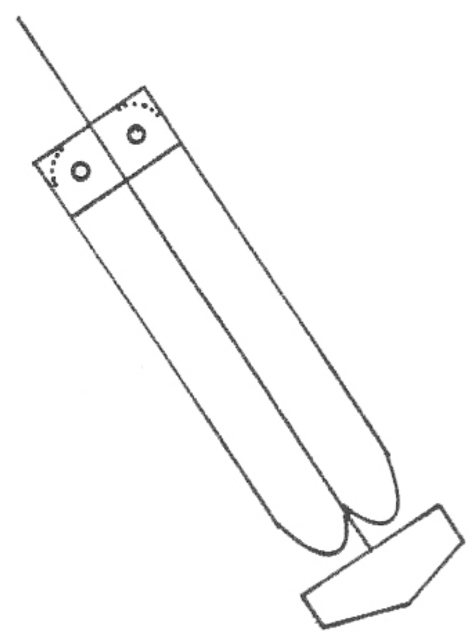

Figure 4 – Swing Wing System with wings swung back ready for launch

To its disadvantage the double wing thickness during boost still results in significant drag forces. Worse still, should the leading edges of the wing halves not match one another, during boost phase air can force its way between them and force the folded wings to open prematurely. If the model is in a bank when the wings open, one panel may be held closed by aerodynamic forces with the result that the model spins to the ground.

Because of these problems another method was developed whereby the wings pivot at the root and swing backwards alongside the fuselage. This is called the “Swing-Wing” system (Figure 4).

Figure 3b – Rocket Boost Glider with folded wings

Swing-wing systems have proven to be more successful and more reliable than flop-wing systems. Yet, occasionally one wing will not deploy while the model is in a bank and the model spins to the ground. In swing-wing gliders the wing airfoil can be of the typical uncambered (uncurved) glider type, which in boost on a fixed-wing model would have high drag, but when swung back has very little drag. It can also be of high aspect ratio.
The ideal variable geometry boost-glider would be one in which the complete model folded into a rocket tube and after being boosted to normal rocket altitude would be ejected and unfolded

into a high efficiency glider. The “FIexwing” boost-glider has some of these characteristics. It can be folded into a rocket tube and ejected at apogee, but it is not a high efficiency glider.

Canaroc Nomad Parasite Glider

For radio-control one requires fixed wings, and once again a compromise is made. Lower altitude is gained due to high drag, but with its highly efficient rigid wing, the model can be controlled to hunt for thermals to ensure a long flight duration.

Parasite Glider

There is one other type of rigid wing boost-glider called the “Parasite Glider”. In this type, a small rigid-wing glider, much smaller than would usually be used for the given motor size, is strapped onto the side of a normal rocket. The glider is so small it barely affects the rockets flight path, other than reducing maximum altitude because of increased drag. Unfortunately, the glider is usually so small that it is often difficult to see from the ground.

In our next lesson we will go into detail about how gliders works.

Note: This article is an edit of the article "Rocket and Boost Gliders" by Bill Henderson from the Spring 1982 edition of Space Modeller magazine. Re-printed with permission.