Elastic Launched Glider Trimming
A Three Part Video

Part 1 The Glide

This video is the first in three parts showing the steps needed to trim a Catapult or Elastic Launched Glider often referred to as an ELG. Making these small models fly properly can be challenging because tiny adjustments may have a significant effect on the flight, especially during the high-speed launch. There are three phases to an ELG flight: Launch, Transition and Glide. The launch is more like shooting an arrow into the air than an airplane flight. Then, as the glider slows down, it transitions into a slightly nose-down attitude and glides, to the floor, in a circle. Long flight times are achieved during the glide, not the launch. So we will concentrate on making the airplane glide well first, then work on the launch and transition.

Decalage is the angular difference between the wing incidence and the stabilizer incidence. The decalage angle is established when the glider is built. The angle MUST be zero. If the decalage is not zero, meaning the wing and horizontal stabilizer are not parallel to each other, the glider will never fly properly.

To check the decalage, rest the wing where it meets the fuselage on a good straight edge (like the edge of a counter top or desk or even a ruler). View the glider from the side and measure the angle the horizontal stabilizer makes to the straight edge. If these are not parallel to each other, remove either the wing or horizontal stabilizer. Sand or shim and re-glue it to achieve a zero degree decalage angle.

Adjusting the decalage is easy to do if you built the BASS basic ELG. Use masking tape to hold the wing on the fuselage, at least during testing. Loosen the tape and put a small shim under either the front (leading edge) or rear (trailing edge) of the wing to make the decalage angle zero.

The center of gravity location is usually shown on the construction plans as a circle divided into quarters with opposite sections shaded or given in the building instructions . If not, start by getting the glider to balance in the center of the wing chord. Use modeling clay, usually applied to the nose of the glider, to balance the glider like a seesaw on two points, such as the tips of an open pair of scissors or needle-nosed pliers.

To test the glider prior its first real flight, hold the glider by the fuselage, under the wing. Give a gentle push, aiming at a spot on the floor about 20 feet away. The speed of the launch should be just a little faster than walking speed. Launch the glider by bending your elbow, not flicking your wrist.

If the nose of the glider lifts and drops and lifts and drops, the glider is stalling because it is tail heavy. Add a pea size piece of clay to the nose. Continue test gliding and adding weight until the glider stops stalling.

If the nose drops and the glider dives, the glider is nose heavy. Remove a small piece of clay (about half the size of a pea) from the nose. Continue test gliding and removing weight until the glider stops diving.

Fine adjustments to the center of gravity can be made by pushing the clay on the nose a bit forward or aft. In extremely rare occasions weight might be needed on the tail of the glider. Before adding weight to the tail, verify the wing is the correct distance from the nose of the glider.

To get the glider to fly in a circle, the horizontal stabilizer needs to be tilted when viewing the glider from the front or rear. This amount of tilt should be shown on the construction plans. If not, make one side 1/4

inch higher than the other. If the right tip of the stabilizer (when viewed from the rear) is raised the glider should turn right, while raising the left tip should make the glider turn left. As a last resort, a small piece of clay can be added to the tip of the wing on the inside of the circle as well. If you are flying in a basketball-size gym, you want a glide circle to be 20 to 30 feet in diameter. Be sure your glider will turn within the available area.

Part2 The Launch

This video will address the launch of the glider. Do not attempt this until you have completed the glide procedure shown in the first video. You will probably need a small amount of rudder trim to get the glider to begin the transition from the high speed launch into the glide turn. The best way to do this is to mount the rudder to the side of the fuselage (instead of on top) and put a small (1/8 square) shim of 1/32 thick balsa between the trailing edge of the rudder and the fuselage. The rudder should be on the same side of the fuselage as you want the glider to turn (right if you are right handed). You only want the very bottom of the rudder to deflect. This small deflection will not have any effect on the glide, but it will have a big effect on the high-speed launch.

Once you have a smooth circling glide, you can trim the glider for launching. Start slowly, using partial power. This means pull the elastic back only a few inches. Hold the glider with the nose slightly up (about 5-10 degrees) and the wings level (no banking). Release the glider and watch what happens. Ideally, it should rise slightly without stalling or diving and turn into its gliding attitude.

If the glider climbs steeply, or stalls, place a thin wedge between the trailing edge of the wing and the fuselage. If this is not possible place a small wedge between the trailing edge of the stabilizer and the fuselage. As a last option bend the trailing edge of the stabilizer down by half to one millimeter. Bending the trailing edge is quick but the wood will return to its original position making this a continuing and uncertain adjustment. Again, re-trim the glide as described before. Once the proper glide is confirmed, repeat the partial power test. Do this until you get the slight rise and turn into the glide.

If the glider dives, place a thin wedge between the leading edge of the wing and the fuselage. If this is not possible place a small wedge between the leading edge of the stabilizer and the fuselage. As a last option bend the trailing edge of the stabilizer up by half to one millimeter. Again, bending the wood is quick but it will return to its original position making this adjustment ongoing and uncertain. Again, re-trim the glide as described before. Once the proper glide is confirmed, repeat the partial power test. Do this until you get the slight rise and turn into the glide.

Now you can start increasing the launch power. Aim the glider at about 30 degrees of elevation and 10 degrees of bank in the direction of the turn. Release the glider and watch. If the glider climbs and turns into its glide circle, that is what you want. Increase the power some more, and increase the launch angle.

After any adjustment has been made to the glider during launch testing, it is absolutely critical to confirm the glide has not suffered. Test the glide with a gentle hand launch. If the glide has degraded bring it back to a proper flight before continuing to test a power launch. Remember flight time is achieved in the glide not the second or two of launch.

Part 3 The Transition

If it stalls, increase the bank angle. If it turns too tightly (or even dives) before it begins its normal glide, then decrease the bank angle.

If changing the angle of bank does not correct the turn on launch, you may have to adjust the amount of rudder trim. Increase the trim if the glider is not turning into the glide and decrease the trim if the turn is too tight during the transition. Remember, the rudder affects the turn at high speed while the stabilizer affects the turn during the glide.

As you progress with adding more power you will need to adjust the elevation angle and bank angle to get the glider to transition properly. You want the glider to transition into a circling glide at the top of the launch. This is achieved through experimentation with the elevation angle and bank angle. Try to change only one element at a time.

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As you trim your glider use a logbook to record what you did and how it affected the flight of the glider. To avoid a deduction in flight time points Science Olympiad rules require a logbook having a minimum number of flights, with required and optional data. This can be a powerful tool to record what does and does not improve the flight times. Once you have your glider launching and gliding well, practice, practice and practice. Try for consistency in the amount of stretch of the rubber, the launch elevation and bank angle. Each glider will be different even if built from the same plans.