LONG SHOT 2

Building instructions

Dear customer,

You have just became owner of our RC hand launch glider (Discus Launch Glider, DLG) Long Shot 2. It is the new version of our very successful Long Shot. Thank you for your decision.

The model is designed to be launched by the “discus launch” method. The flyer holds the model at the peg located in the wingtip, between forefinger and middle finger, rotates 360 deg and releases the model. The model will climb much higher than by the classical “javelin” style launch. Another important advantage is that the joints of your arm will not suffer pain and injuries are almost unknown

The basic feature of the HLG of this type is the rear position of the centre of the model side area. It is achieved with the large area of fin and rudder and low wing dihedral. This is the most important feature of the design, so do not change these elements.

The wing is equipped with a series of aerofoils AG 45xx ct designed by Mark Drela. It has very low drag, allowing a high climb during the launch and rapid cruising while hunting thermals.

The structure makes use of the excellent properties of modern materials. The result is light and very rigid construction. The weight of the model ready to fly can be as low as about 280 grams. The fuselage is of pod and boom design. The pod is carbon or carbon/Kevlar shell, carbon reinforced. The boom is made of carbon/glass composite tapered tube, which is very strong yet light.

Assembly

You will need:

RC transmitter, at least 4 channels, processor controlled and lightweight unit recommended.
Micro receiver, at least 4channels.

Note: the exact minimum numbers of Tx and Rx channels can depend on the type of equipment used. Number of transmitters need 5 channels receiver to controll 2 aileron servos in wing.

4 micro servos (6 to 9 grams). We recommend digital servos for the ailerons.
Power supply: 4 NiMh cells 250 mAh or similar, the weight should be about 30 grams.
CA glue, good Epoxy.
Basic modeling tools.

Fuselage

The fuselage is heavily loaded by centrifugal forces during the launch and must be firm and rigid.
Make up (drill and file out) the aileron servo cable access hole in the wing saddle, with the centre about 30 mm behind the wing leading edge for the servos located in front of the main spar and about 80 mm. for the servos located behind the main spar. This hole serves also as the aileron servo cables exit. **The hole must be oval and as small as possible**, about 12 mm wide and 18 mm long. A large rectangular hole would weaken substantially the pod in this area.

Cut the tube to length, shown on the drawing. We always try for perfect fit, but if the tube has some play on the pod, you can cut a piece off the front end of tube first, cut the tube to length from the opposite (thinner) side then.

WARNING: DO NOT GLUE THE BOOM TO THE POD IN THIS STAGE YET!

Make the slot in the boom end 40 mm deep to accept the fin. Mark the cut-outs on the tube with sharp needle and cut with fine razor saw. Use fine flat file to widen the slot to 2,5 mm width to accept the fin. The slot must be made exactly along the axis of the boom.

Take the rudder and elevator servos. Make up the opening for the servos in the balsa servo floor. Assemble the floor with the ply cross pieces, drill holes for the servo fastening screws and install the complete tray in place. **For the pod-side walls strength it is important to mount the servos on the servo tray provided. DO NOT omit the servo tray as it plays important structural role in fuselage resistance against the centrifugal forces during the launch** (the tray serves as the shear web, the fuselage sides are the "spar strips").

Make the canopy lock of double piano wire 0,8 mm. Bend to shape, the ends meet in the middle of the length of the lock. CA dip glue the lock wire to the hatch in the middle, spray CA activator. Do not use much CA, as it can get hot and warm the canopy during the hardening.
Secure with epoxy soaked rectangle of carbon cloth (see the procedure for the wing joiners).

Using a fine file, make small notches in the pod, so that the lock wire can not shift sidewise.

Wing

The foam color can vary according to the producer. The material is the same.

<u>VERY IMPORTANT WARNING</u>: NEVER touch the wing / stab surface with nitrate base solvent. The skin is slightly porous and the solvent would definitelly damage the foam core!!!
For the same reason do not use common CA glue for the wing / stab assembly.

The wing is supplied in two parts. Mark position of the two mounting screws on the root ribs and make up small half-round notches with rat-tail file. Use good 5 minutes Epoxy to glue the wing parts together. The dihedral of each panel is 6 deg. With one wing panel laying flat on the building board, the second panel is supported 155 mm at the tip (2x6 deg = 12 deg).
Carefully open the holes to 5 mm dia. The axis of the holes MUST be perpendicular to the horizontal plane of the model. Install two aluminum tubes, trim to length and epoxy in place. Use drill press and support both part of the wing equally. Check for correct fit, file out the holes if necessary. Install two aluminum tubes, trim to length and epoxy in place.

Locate the position of the launching peg: in the left wing tip for right hander and vice versa. Make the rectangular opening for the launch peg.

Make patches from the carbon cloth/adhesive tape according to the pattern (four patches for the wing centre connection, two round patches for the peg reinforcement. **Do NOT** try to separate the cloth from the tape in this stage!!! Soak the carbon with thin slow curing epoxy and lay down over the center/tip connection seam and over the peg hole, top and bottom. Press with fingers and attach in place with wide adhesive tape all over the patches. After the epoxy sets, remove all of the adhesive tapes. The surface of the patches is nice and shiny.
Open carefully the 4 mm holes for the mounting screws and the opening for launching carbon peg. Epoxy the peg well in place.
Note: It is possible that the flat peg will bend from the launching force later and the peg/epoxy joint will loose. When it happens, apply drop of thin CA into the seam for the good and permanent joint.

Attach the wing on the fuselage with the front screw. Locate and drill hole 3,2 mm dia. for the rear plastic screw in the pod and run M4 tap. Be sure the wing is square with the fuselage.

Tail

Iron on the plastic film supplied on the vertical tailplane. It is the very lightweight Solarfilm Lite.
Wind a piece od sandpaper around the boom and sand the stab mount to fit the boom surface.

Vertical stabilizer:
Remove strips of covering film where the fin meets the boom. Insert the fin. Be sure the fin is mounted exactly in the directional axis of the model. When satisfied, CA the fin in place.
Be sure to secure in place with thread (Kevlar or similar).
Use good adhesive tape to hinge the rudder. CA in place the horn.

Horizontal stabilizer:
Screw the stab on the mount. Position the assembly carefully on the boom, so that the stab is perpendicular to the fin and square to the boom. CA drop in place. When satisfied, use more middle density CA. Or, you can use epoxy to install the stab. It provides you with some more time for the correct alignment.
BE SURE to drill the mount and to secure the mount on the boom with thread (Kevlar or similar). CA soak.

Final assembly

Screw the wing to the fuselage. Push the boom/tail group assembly on the pod and use the thin CA glue **NOW**, while checking for correct position of the tail in respect to the wing. Secure the seam with epoxy bead all around.
Install the servos in fuselage. Connect the rudder and elevator horns to the servo arms.
As the usual pushrods of plastic tubing/piano wire would increase substantially the overall model weight, you can use pull-pull lines from the Dyneema 30 kg test line. The weight of the pull-pull system is next to nothing. The Dyneema line is probably the best material for this purpose. It will neither wear, nor stretch in time, the friction in the outlets is very low.
Tips:

- We recommend following method to run the lines through the boom: twist together two copper wires about 0,5 mm dia. and approx. 1 meter long. This tool can be run easily through the boom. Tie the line to its end and run through the boom.

- It is a good idea to soak the end of the line with thin CA and to cut the very tip off at an angle, so that it could be run easily through the servo arm/horn holes.

- Installation of the pull-pull lines is quite easy if you know how to do. The servo arms and the movable surfaces should be in neutral positions with appropriate tension in the lines. There are several methods, we recommend following:

Servo arms:	**Right** side:	squeezed piece of Al or brass tube, knot.
	Left side	small screw with washer. The washer is important element.

Horns: Knots CA secured. Use **very** small drop of CA, so that the lines stay flexible.

Method of installation:

1. *Connect the lines to the horns on movable surfaces, make knots but do not secure with CA yet.*

2. *Run the* ***"left"*** *line through the boom (left hand end of the rudder horn, direct connection of the elevator horn/servo arm). Connect the line with the* ***left*** *servo arm, with the end with the SCREW, under the washer, wind around and tight the scew. Try to achieve the appropriate tension, in the line with both servo arm/movable surface in neutral positions.*

3. *Run the* ***"right"*** *line through the boom amd connect to the right servo arm end. Use short piece of alum tubing and press partially with pliers. It allows fine adjustment of the line length. Play with the line in the tube to achieve both neutral positions of arm/horn and the appropriate tension. When satisfied, press firmly the tube and tie a knot behind.*

Note: Instead of alum tubing, the small brass rivets which usually come with servos can be used.

***4.** The tension in the system lines can be fine tuned by the adjustment of the left line (under the screw). If the washer is not held, the line is stretched by tightening the screw.When satisfied, turn firmly the screw, while holding the washer with pliers so that it cannot turn.*

***5**. When not satisfied, you can always return few steps back.*

***6**. When satisfied, CA secure all knots.*

***7.** IMPORTANT: Do not glue the left end of the line on the servo arm. You can always tune the tension in future, if necessary. Secure the free end of the "left" lines: unscrew the servo arm central screw, wind the line around and screw back.*

Or, you can use the micropushrods consisting of tefon tubing and steel inner part. The terminals can be done from Z (servo arm) and L (horns) - shaped piano wire 0,8 mm, joined to the steel wire with piece of heat shrinking tubing and thin CA. The pushrods must be run on the outer boom surface and attached at few posts with CA or adhesive tape. If you use the pushrod, the stab can be fully detachable. It is also easier to mount the servos side by side.

Aileron servos:

Check that the servos you are going to use are in good condition, without play. The servo replacement is time-taking job.
Open carefully the servo cables outlet in the wing bottom center. If necessary, extend the aileron cables. Cut-off the servo flanges. Run the servo cables through the channels in wing. Push the aileron servos into the openings in the wing, glue in place with silicone glue and secure with adhesive tape.

Install the horns in the ailerons: The horns must protrude throughout the aileron. Make up epoxy fillets in all four corners, so that the aileron is "clamped" in between!!!
Connect the horns with servo arms. The link from servo to aileron must be made **without any play**, otherwise the ailerons can flutter during the launch.

Recommended method: make the pushrods from 2 mm soft steel of aluminum wire. Bend about 4-5 mm of its end in right angle and make M2 thread. Run M2 tap into the appropriate hole in the servo arm. Screw the rod directly into the servo arm. Shorten the rod to appropriate length; make M2 thread and screw the clevis on. This way, the perfect connection without any play is achieved.

Locate the position of the aileron horns, cut notches through the ailerons, insert the horns and **epoxy** them in place.

The extension cable between wing exit connector and receiver can consist of 4-wires only, which divide into two plugs to be pushed into the receiver. For example:

1. + and left aileron servo signal
2. – and right aileron servo signal

A single 4-pole connector is used for the servos to extension lead connection:

1. + both servos
2. – both servos
3. left aileron servo signal
4. right aileron servo signal

Install the micro receiver and battery. Do NOT insert the aerial into the carbon fuselage, neither run the aireal on the carbon surface as the control range can be seriously decreased!

Check for the CG position. It should be about 80 mm behind the wing leading edge. A piece of plasticine can be inserted into the fuselage nose to shift the CG into correct position.

Control movements

The model is normally equipped with 4 servos: two for ailerons, one for stabilizer, one for rudder.

Ailerons - **direction control**
(measured from neutral aileron position)
12 mm up, 6 mm down
brakes: 30 mm down
flaps: 3 mm down
brakes and flaps should be compensated for with appropriate elevator movements: down elevator for down ailerons.

Elevator
up/down 10 mm

Rudder
left/right 15 mm, coupled with ailerons
Note: If the wing airbrakes deploy down (as mentioned above) be sure to install the rudder servo.

These movements can vary according to your personal preference.

Flying

Generally:

Discus launching is not likely to harm your body in any way, but it is sensible to warm up your muscles before trying to launch at full power. If you suddenly strain your muscles when they are still stiff from driving for several hours, or if you work in an office and don't get much exercise, then it is advisable to treat your joints and muscles with care.

Waving your arms about is not going to help much. The best method is probably to jog up and down the field for a few minutes, gradually building up speed. (You don't often see modellers doing this on my flying field.) A more appealing alternative is to launch about ten times, starting very softly, then gradually building up to almost full power by the tenth launch. In this way your muscles will become warmer and at the same time, you will have had sensible and useful launching practice.

In the first attempts, test glide by “ordinary” overhead launch and make the necessary trim changes. Then try to launch with more force, still in the “javelin” style. When satisfied, try the first discus launches.

Start with full 360 deg circle, slowly and **smoothly** from the very beginning. It is important to do always the same sequence of footsteps. Draw the model from your back and twist your body from this position. Release with slight nose up.
Apply full down elevator on the top to bring the model into the level flight.
Increase very slowly the launch velocity. You will be surprised, how easily you can get really reasonable height.

Usual mistakes:

Very important: Keep you arm straight all the way, **especially in the release stage**. Avoid any tendency to “throw” the model. Surprisingly, it is nor quite easy.

Use your body as a “torsion spring”: Draw the model from behind of your back. Unwind before the launch and in the last launch phase twist the body and move your arm.

Move the CG and trim the elevator, so that the model climbs mildly. Play also with the CG position so that the amount of the inherent stability suits your flying style: these models fly at low heights and often must cope with lots of turbulent air. Larger amount of longitudinal stability provided by more forward CG position can be of advantage.

The wing flaps are in neutral position for launch and fast flights while hunting for thermals and for rapid returns from downwind distances.
The ”neutral position” is with flat wing surface bottom.
For the low sinking rate deploy the flaps about 3 mm down (measured in the wing centre). Deploy the flaps about 40 deg down for escape from height and landing. The directional control with fully deployed flaps should be done with rudder rather than with ailerons. The model with flaps full down slows down. When moved rapidly back to the neutral position, the model can stall because the velocity is too low for the wing in this configuration.

Important notes:

- NEVER launch model **if there are persons** in front of you!!! Remember, the velocity of the model can be close to 150 km/hour
- If released too early, the model can fly low over the ground, to the right side (right hander). BE ALWAYS SURE there are no persons in this segment!!!
- Secure the receiver crystal in place with adhesive tape. Otherwise, it can slip out of the socket due the launch acceleration!!!
- Do not launch model in weeds taller than about knee-height. You would easily damage the outer wing tip.

Have a joy with your new LONG SHOT 2!
Horejsi model
Czech Republic