TABLE OF CONTENTS

1 Foreword

The company (Jochen) Causemann in Germany has thankfully set itself the goal of "stirring up" the market of the increasingly expensive DLG models with the SLINGSHOT Version 5, which makes it much easier to enter this fascinating field of RC model flying.
In order to achieve the planned sales price of a kit under 100 Euro, Jochen Causemann
some ideas of my KIS (Keep It Simple) models are considered.

The kit can be stored:

http://shop-rc.causemann.de/Slingshot-V5-KIS-HLG-DLG-SAL-F3K-Handlaunchglider-

A discussion about the SLINGSHOT V5 can be found on RC-Line at

http://www.rclineforum.de/forum/board19-fl-chenflugmodelle/board27-segelflug/hlg-sal/307582-slingshot-nach-kis-wer-m-chte/

It was/is an honour for me to have built one of the first prototypes of Slingshot Version 5 (in the building instruction called SLS5 for short) to create this building instruction.

For contents which are quoted by links in the Internet, I can take no responsibility...

Werner Stark, Linz, June 2011

2 Preparations

2.1 Interpretation

Before building the individual parts of the SLS5, the basic design of the model should be determined:

Span:

The wing is made in 2 halves (each 800 mm long) from
laminated balsa wood and AG-47 profile
delivered ready milled.

If you want to fly the SLS5 just for "fun", you should fly the full length, i.e. span depending on the V-shape
approx.1600 mm, use.
Those who want to use it (also) at competitions, for which it is quite suitable,
muss nach den F3K Regeln die Spannweite (projiziert auf die Horizontale) mit 1500 mm
limit.

Rigid ("rudderles") or hinged fin:

Die „rudderless“ Auslegung , also starres Leitwerk ohne Ruderblatt, wird vor allem bei den Schweden (SIRIUS model) has been used successfully.
Advantages: 1 servo less, no linkage that can "give way", higher throwing heights (?)

Nachteil: Flaches Kreisen (bei ruhigen Flugbedingungen) NUR mit SLW nicht möglich
Eindeutige Vor-und Nachteile sind auch in zahlreichen Internet Foren (z.B RC-Groups) nicht and usually end with the recommendation:
Everybody should fly like they're used to....

Servos for the ailerons (flaperons) in the fuselage or wing:

For the installation in the fuselage (head) speaks:

greater probability of reaching the recommended centre of gravity WITHOUT trim weight
Less "fumbling" when soldering the servo cables and mounting/dismounting the wing
More weight near the centre of gravity, lower moment of inertia ("more manoeuvrable")

For the installation in the wing speaks:

Shorter, more precise linkage
Possibility of RDS (Rotary Drive System) linkage

2.2 RC Components

Da der SLS5 ferngesteuert wird, ist neben der aerodynamischen Auslegung, auch die Selection of the installed RC components is important:
Sie sollten leicht, von der Technik „ausfallssicher" und kostengünstig sein und bezüglich ihrer size can also be installable/replaceable.

Servos

The choice of the "right" servos is a permanent topic in the DLG scene.
The "ideal" servo should:

Reset accuracy, be free of play
Have a high actuating force
Be small, cheap, fast and robust
(Leider) ist bei den meisten Servos der Hersteller (Fernost) nicht bekannt, sodass oft baugleiche Servos unter verschiedenen Markennamen (Brands), zu verschiedenen Preisen, in of different quality, are offered.

A good servo overview with manufacturer's data can be found at:
http://wiki.rc-network.de/Servos_%C3%9Cbersicht
French colleagues have tested the most common servos and published them here:
http://osegouin.free.fr/servo/servormances_v22_mai_2007.zip
Ernüchternd, dass bei vielen Servos die Herstellerangabe der Stellkraft, bei den Tests deutlich was undercut.

moderne Digitalservos haben gegenüber analogen Servos einen merkbar höheren power consumption, are (mostly) programmable for this

The positioning force should be at least 1 kg (10 N) per centimetre for side/height, for flaperons
At least 1.5 kg.
Achtung:Bei den Abmessungen wird von den Herstellern meist die Höhe OHNE Servohebel specified.

When installed in the wings of the SLS5, the thickness (width) should not exceed 11 mm.

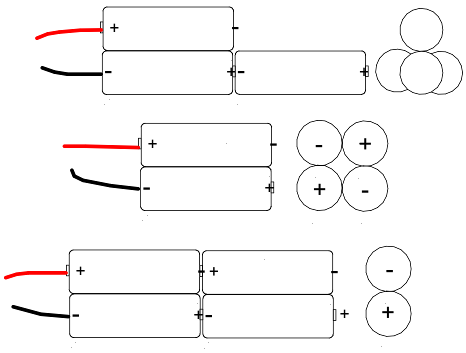
Since the SLS5 is 3-axis controlled, 4 servos are usual:

1x height
1x page (not applicable for "rudderless")
2x flaperons
(combined ailerons and flaps)

The vertical/transverse and longitudinal axes meet each other in the
Focus
The movement (rotation) around the transverse axis is
Rollen (Roll) and with the ailerons
controlled.
The movement around the vertical axis is called yaw and is controlled with the vertical tail
.
Die Bewegung(Drehung) um die Längsachse wird Nicken (Pitch) genannt und mit dem Elevator and/or flaps controlled by the flaps

Batteries

Many a DLG model has died because of bad, empty batteries.
Especially flying at low temperatures, below 0 degrees Celsius, is dangerous.
Die modernen LIPO (Lithium Polymer) Zellen (3,7 Volt/Zelle) haben sich bei DLG's (noch) nicht enforced.
Die für Servos und Empfänger üblichen 4,8 Volt müssen für LIPOs mit einem Booster/ Regulator can be adjusted.
When using several cells in series, they must be charged with a balancer
Erst die Verbreitung der 2,4 GHz Technologie und HV (High Voltage) Servos wird den Einsatz of LIPO cells.
Im Moment sind NimH (Nickel Metall Hybrid) Zellen der 2/3 AAA Grösse mit 1,2 Volt und einer
Kapazität von 350/400 mAh per cell usual.
NC (Nickel Cadmium) cells are used because of their poor capacity/weight ratio
hardly offered/used anymore.
A multiplication of the voltage of a battery pack is achieved by "serial" soldering
(plus to minus and vice versa), a multiplication of the capacity by "parallel" soldering
(plus to plus,minus to minus) of the single cells
Ein erforderliches Trimmgewicht in der Rumpfspitze sinnvollerweise durch einen
grösseren/schwereren Akkupack zu ersetzen, ist (meist) nicht möglich, da kein Platz dafür is there, although according to F3K rules the fuselage tip must have a radius of at least 5 mm.
Als schwerstes Teil (ca. 30 Gramm) der RC-Komponenten, wird das Akkupack durch appropriate soldering placed as far forward as possible.
A so-called "inline" soldering requires appropriate tools and expertise.
Um die erforderliche Gesamtspannung von 4,8 Volt zu erreichen, müssen die Zellen „in Serie" verlötet i.e. plus (red) to minus (black)



Depending on the space available in the fuselage head, the battery pack

for very slender fuselage heads as "pyramid"

or

as "dice"

or

as a "pole"

be soldered and "shrunk

For the "roomy" fuselage head of the SLS5 the "cube shape" is recommended.

One piece of a plug strip from the electronics accessories is suitable as a 2-pole socket

Aus Platz-und Gewichtsgründen werden Ein-Ausschalter in der Regel nicht verwendet und is replaced by a separable cable connection to the receiver.
Komfortabel (klein,leicht) sind sogenannte „Switch Jacks“ die „eingesteckt“ ausschalten aber "disconnected" allow charging and switch on the power supply.

Transmitter

Obwohl auch sogenannte „Bauch“/Pult Sender für DLG in Verwendung sind, bieten Handheld transmitter especially for the start of the rotary throw from the "handling" point of view Advantages
Ideal sind Sender mit einem Maximalgewicht (inkl.Akku) von 1 Kg , einer Kurzantenne und at least one 3-step switch
These requirements are met by (almost) all 2.4 GHz transmitters
Die Programmierbarkeit sollte Flugphasen oder genügend freiprogrammierbare Mixer dafür,und provide the "Flaperon" function
A discussion (in English) of RC systems suitable for DLG can be found:

http://www.rcgroups.com/forums/showthread.php?t=612427

Recipient

All receivers of the "MICRO;NANO,PICO" class with front plug should actually fit into the SLS5.

It may be possible to remove the housing and shrink the receiver
Receivers with plug-in quartz crystal should be secured against falling out when starting the rotary throw.
Die Anzahl der erforderlichen Kanäle hängt davon ab, welche Steckplätze für „Flaperons“ der Sender "or whether the channels can be freely assigned.

Altimeter

With the estimation of the throwing heights the door and gate is opened to the "hunter's Latin....
Even better is the comparison with objects of known height.
Most objective are measurements with an electronic altimeter (altimeter)
Complex "telemetry" systems are out of the question for reasons of weight, cost and size
for pure <height measurement.
Especially for the training of the rotary throw there are small, light altimeters for DLG's on the market:
those which directly indicate the respective throwing height
and
solche, bei denen die Auswertung der aufgezeichneten Höhen (Logger) mit spezieller software on the PC.
In general the measured heights are accurate to 1 meter.
A good market overview can be found at

http://openaltimeter.org/comparison.html

2.3 Tools

Although the construction time for the SLS5 is limited (approx. 10-15 hours), it can be useful to have the necessary tools at hand:
These are:
(straight) building board at least 1 m long
matching masking film
Fretsaw
Angle
Ruler (50 cm long)
Cutter Knives
Hand drill with 2.3.5 mm drill bit
MINI cut-off wheel for machining carbon parts
(Round) files
Sandpaper (with block) grit 50,100,150
electric iron for foiling
Adhesive: superglue, 5 min. epoxy (or equivalent)

2.4 Materials

As the kit is not always supplied with the same small parts, the following materials should be used
(as is the case in the usual handicraft cellar) must be in stock:

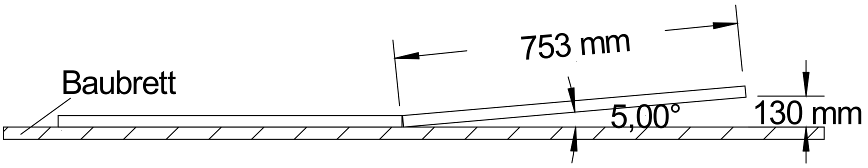
Balsa "filling" pieces in different thicknesses
Plywood scraps or GFK/CFK flat material in the thickness 1.2 mm

Carbon or Kevlar Rovings
Glass fabric
Steel wire 1 mm
Adhesive tapes

3 Construction of the individual parts

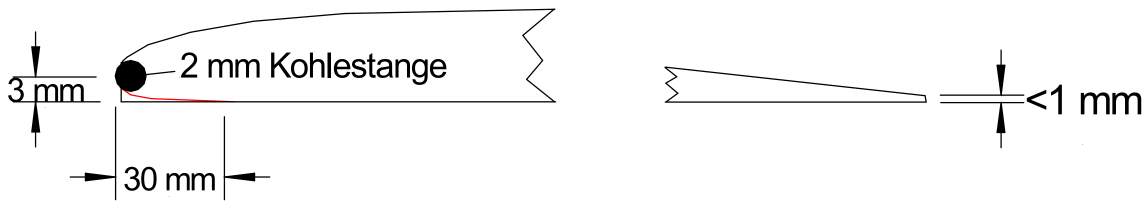
3.1 Wing

The V-shape has an influence on the flight behaviour, but hardly on the attainable throwing heights:
the more V-shape the more inherently stable the circling flight, the less V-shape the more "agile" the model becomes (slope flight)
Sensible V-shapes are between 3 and 7 degrees on each side.
Since measuring an angle in degrees is cumbersome, the V-shape is usually given as "base" in millimeters.
A good compromise for the SLINGSHOT is 5 degrees per side.



With a span of 1500 mm the wing halves must be "trimmed" to 753 mm and "underlaid" with 130 mm (2 x 65 mm) when glued together.

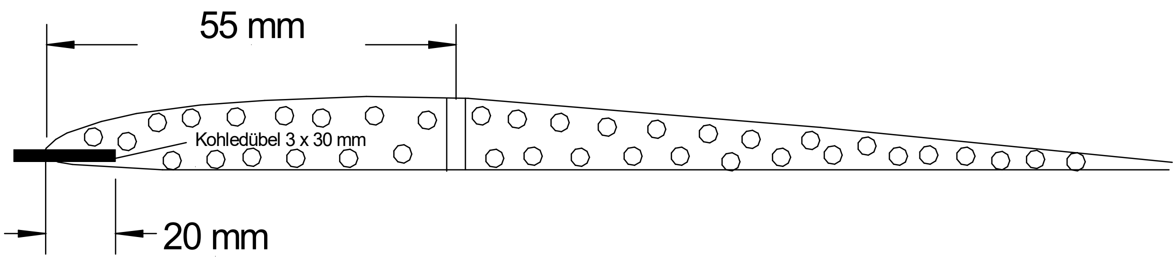
First of all, the reefs created by milling, the area of the leading edge (starting 30 mm behind the nose edge ,running approx. 3 mm upwards) and the trailing edge (if possible below 1 mm) should be sanded in the direction of the span using a sanding block and sandpaper of grain size approx. 180.
If the wood in the leading edge area is very soft and you want to avoid a "saw tooth" leading edge in the long run due to "rough" landings or even collisions in the air (midairs),
it is recommended to use a 2 mm carbon rod with a length of at least 500 mm (each side):
Grind / mill a 2x2 mm "groove" in the nose area and glue the carbon rods with Seku before grinding.



If the wood is very soft in the end slat area, "harden" this after sanding by approx. 10 mm "deep" with thin SEKU.

Now mitre the glued surface of the two halves of the wing according to the chosen V-shape, and

Grind the "space maintainer" for the wing screw connection (approx.5 mm) and the nose dowel (3 mm). Then pierce approx. 2 mm deep "holes" in both surfaces to be bonded, which will take effect after bonding. with five minutes of epoxy like "kink enhancements"...



Glue the wing halves together:

Cover the building board in the gluing area with foil, and coat both gluing surfaces with 5 minutes of epoxy (or resin),
Press together and allow to harden securely.
After drying, glue the carbon nose plug with SEKU and cut a glass fabric strip (approx. 50 g /m², approx. 50 mm wide, approx. 380 mm long) to size. Make a hole for the plug in the "centre" and pull the strip over the plug.
First tack the strip to the lower side of the end strip with SEKU, then pull it around the surface and tack it down over the entire surface with SEKU (or resin).
Then drill the hole for the screw fastening 55 mm behind the leading edge for an alloy or carbon tube with inner diameter for the used screw, cut the tube to length and glue it in place.

Glue in the throwing pin:

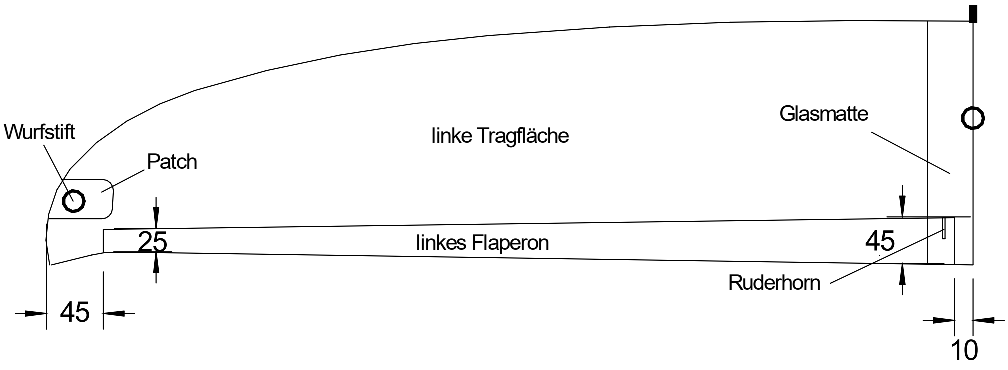
As far out as possible (throwing radius !) and just behind the centre of gravity.
For right-handed people to the left half of the wing and vice versa.
In order to protect the fingers, the diameter of the throwing pin should be at least 4 mm and be about 50 mm long.
The position should also be chosen so that the fingers feel "comfortable"...
Since a centrifugal force of approx. 15 kg is applied during the dropping process, the point of the throwing pin must be reinforced.
Glue a "patch" of 0.8 mm plywood (or carbon/glass mat) above and below the edge sheet and drill a hole through it vertically (to the floor).
Glue in the throwing pin with 5 min. epoxy or UHU-Endfest.

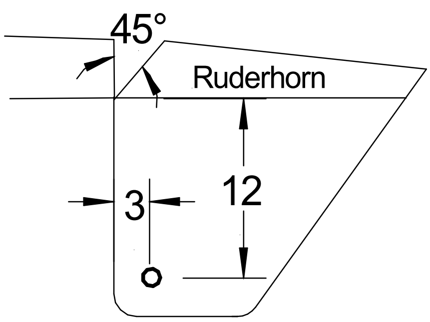
Disconnect the ailerons:

Actually they are "flaperons": mixed ailerons and flaps

Whether the hinge line should be better on the top or bottom of the profile is "controversial" from an aerodynamic point of view.

If you also want to use the ailerons as landing flaps (deflection approx. 45 degrees downwards), we recommend the "down" linkage.
Whatever:
Cut the ends of the ailerons with the fretsaw and cut them out with a stable ruler and a fixed knife with a "diagonal" cut (approx. 45 degrees).
Then prepare the wings for hinging with a "straight" cut.
You can also cut the flaperons with a "straight" cut and then grind them.





Oar horns:

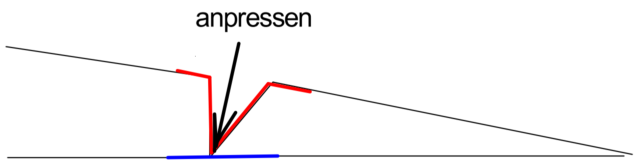
Cut 2 pieces from 2 mm plywood or carbon/glass flat material.

Drill the 1 mm hole for the pushrods as "mechanical" aileron differentiation approx. 3 mm behind the hinge edge.
"Lever arm" approx.12 mm (see RC programming).

Cut slits 5 mm before the end of the flaperons and glue in the rudder horns "symmetrically" with 5 min. epoxy.

Hinge flaperons:

simple:



with an adhesive strip approx. 15 mm wide

double (more durable but stiffer):

1 adhesive strip approx. 15 mm wide
1 adhesive strip approx. 20 mm wide
press together with a pointed object (pencil)

Surface treatment

Vor der Oberflächenbehandlung kann man die Tragfläche farblich „aufmotzen“, wobei man sich aus Gewichtsgründen sparsam und auf die leichtere Tragflächenhälfte (meist die dem Wurfstift opposite half).

Für eine bessere Sichtbarkeit (Lageerkennung in grösserer Höhe) empfehlen sich dunkle Streifen auf the underside of the wing.

Foil with the supplied iron-on film

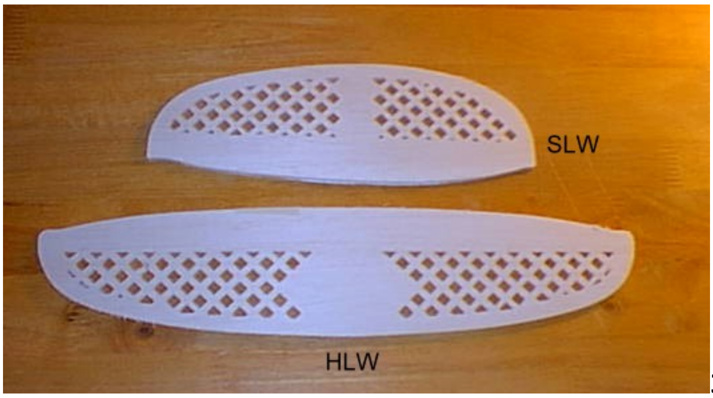
The adhesive layer is the more matte side of the film.
There is no protective layer to peel off.
Auch die gegenüber anderen Folien geringere Temperatur sollte man durch Probieren find out.
Dir Tragflächen(hälften) zuerst unten, dann oben mit ca. 5 mm Überlappung an der Nasenleiste, iron.
Do not overlap the end strip to reduce the risk of warping.

Alternative lacquering (approx. same weight increase as filming):

1 time pore filler/rapid sanding primer (e.g. CLOU)
Sanding over with grit 200
1 time water seal (e.g.TIGER)

Weigh it out:

up to a weight difference of 5 grams, nothing needs to be done.
You won't feel a thing in flight.
In addition, glue the corresponding weight in the wingtip of the lighter wing half.



3.2 Tail units

They are made of 3 mm balsa
as "flat" records,
ready milled, delivered.

Fin SLW

Elevator HLW

Due to the long lever arm of the tail unit beam, every gram in the tail unit area must be balanced with about 3 grams in the fuselage head.
Absolute lightweight construction and yet strength are required.

If the balsa wood supplied is (too) soft, 3 mm wide should be applied to the hinge area before sanding
Glue strips of carbon flat material with SEKU, available in model shops as "Carbon Stribs

vertical tail (SLW)

The most vulnerable part of EVERY DLG model.
In order to dampen the twisting and sliding moments during and after take-off as much as possible, the area above and below the tail unit beam should be as large as possible.
The lower part of the SLW is therefore subject to a lot of stress during landings.
If possible, catch the model or at least land exactly against the wind.

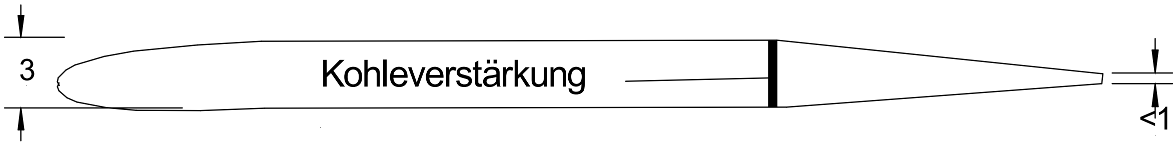
Elevator (HLW)

Whether it is better to mount the CPR above or below the tail unit is a matter of controversy among aerodynamic experts: it is a matter of avoiding (or not) the downwind vortex of the wing...
With the recommended linkage with thread and counter-tension spring, the arrangement on a pylon below the tail boom is easier to realize.

Grinding

after (optional) gluing in of the carbon reinforcement, an approximately symmetrical profile
be sanded.
End strip end preferably under 1 mm, possibly "harden" with thin SEKU.

Do not simply round off the leading edge but grind it elliptically.



With the SLW it can't hurt to glue carbon or Kevla threads onto the leading edge of the lower part after sanding, as a "landing ball".

The CPR should be used for transport reasons and to adjust the setting angle, and thus the EWD, can be made removable:
Glue 2 approx. 5x5 mm small plates made of 1 mm aircraft plywood or solid GFK/CFK flat material at a distance of approx. 40 mm on the underside/centre as screw reinforcement

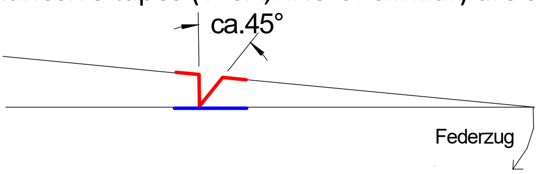
Harnessing

Now "cover" the tailplane separately with the supplied iron-on foil:
First the underside with 5 mm allowance in the area of the leading edge, then the top side.
To prevent warping, do not "wrap" the trailing edge...

Hinge

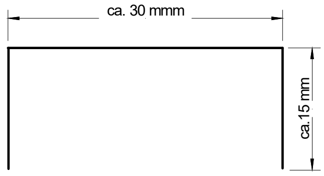
Cut off the rudder blades just behind the cutouts (or the glued-in carbon strips):
Either with a straight cut and later approx. 45 degrees grinding or with 2 cuts:
first inclined at an angle of about 45 degrees and then cut the damping surface vertically.
Whether the hinge should be closed at the top or the bottom is aerodynamically of little importance, but rather the later direction of pull of the return spring which should pull the CPR rudder blade to "low" and the SLW rudder blade to the inside of the circle (to "left" for a right-handed person).

Adhesive tapes (TESA,TIXO or similar) are sufficient for hinges in 2 versions:



the simplest form is a simple adhesive tape (blue),
but which can be damaged by sunlight or moisture
and must therefore be replaced more often.
More durable is a double adhesive tape (red+blue), where
after mounting the "touch point" with a
pointed object (pencil) should be pressed together.

Return spring

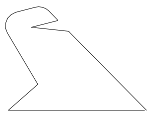


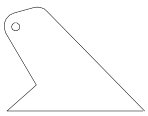
bent from 0.3 to 0.5 mm steel wire as square "C
The thickness of the wire and the length of the middle part
determines the restoring force (the longer the "softer") and
and should not exceed the holding force of the servo
The servo is overloaded and needs a lot of current when it "hums"...

Ruderblatt komplett (180 Grad) aufklappen, einen Schenkel der Feder in das Ruderblatt, den anderen in insert the damping surface

Rowing Horn

make from 1 mm plywood or GFK/CFK flat material
The distance of the slit (for attaching the thread loop) to

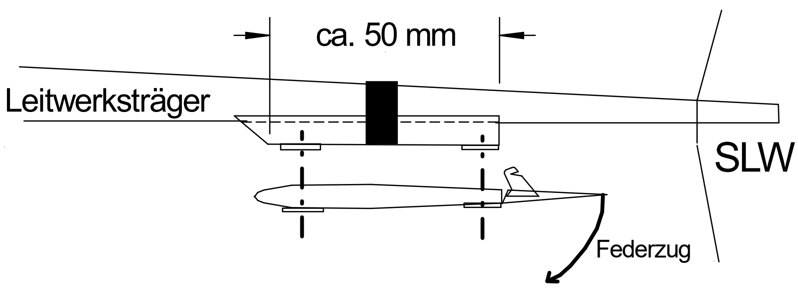


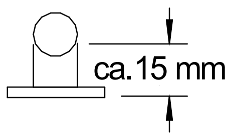


Pivot point depends on the selected lever ratio to the servo arm.
If you do not need to unhook the thread, a hole in the rudder horn is sufficient
and a knot in the thread to secure
The rudder horn must always be pulled in the opposite direction to the spring.
be glued in such a way that the thread can move freely

CPR pylon

Cut the pylon to size from 8-10 mm balsa with transverse fibres and sand the nose area round.
2 supports (approx. 10x20 mm) cut to size from 1 mm plywood or GFK/CFK flat material and glue to the pylon
Glue 2 screw reinforcements (approx. . 5x5 mm) on the CPR and fix them to the pylon with 2 wood screws (from the servo accessories).
Sand the pylon with sandpaper wrapped around the tail unit carrier and glue it to the tail unit carrier at an angle to the SLW and secure it with a carbon roving or glass fabric.
Drill a 2 mm hole in this area and glue in an approx. 10 mm long tube (Bowden cable inner tube) as thread guide.

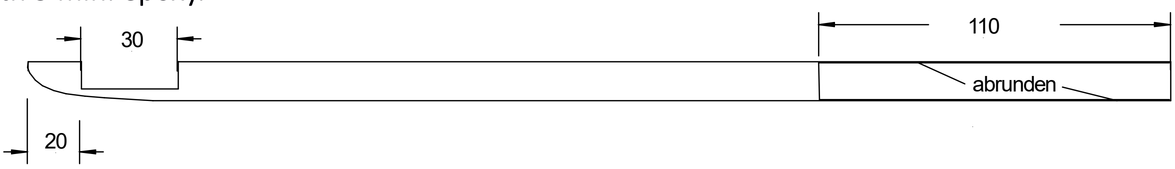




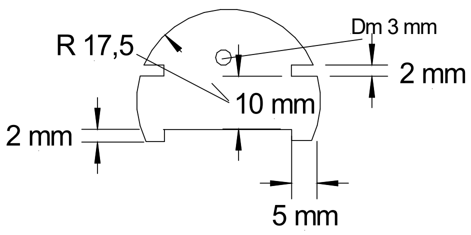
3.3 Hull

This is actually only a necessary "evil" to accommodate the necessary RC components or to "hold together" the essential parts (wing, tailplane).
Unfortunately, DLG single-wing models have not (yet) established themselves due to the lack of attainable throwing heights.

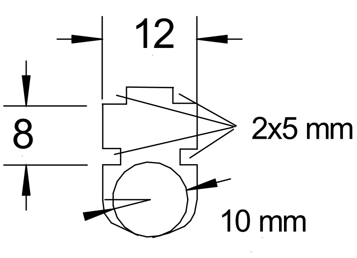
Round off the edges of the supplied 3x10 mm jaw strip (keel) to a length of 110 mm, cut out the front end for the battery used, and glue 110 mm deep into the "thicker" end of the supplied carbon tailplane carrier with 5 min. epoxy.



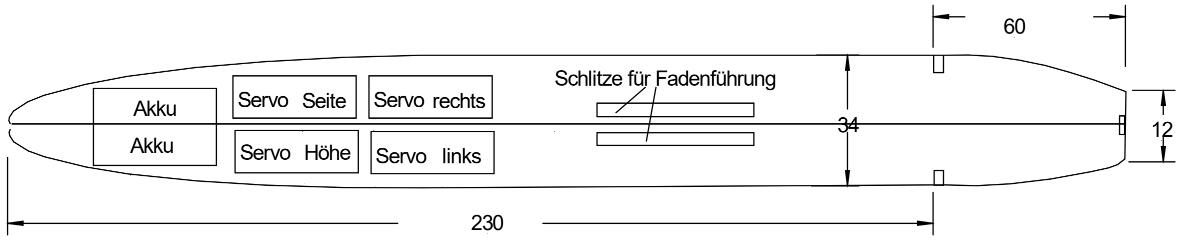
Cut the parts of the fuselage head frame each from 2 mm plywood:



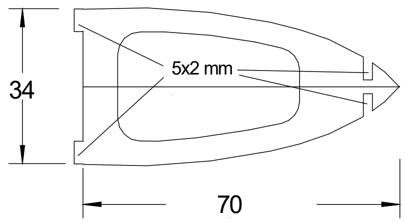
Main bulkhead, 3 mm hole for nose dowel



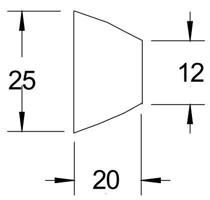
Auxiliary bulkhead



Servo board



Area support



Screw reinforcement

Glue together the fuselage head frame with 5 minutes of epoxy each in the following order:

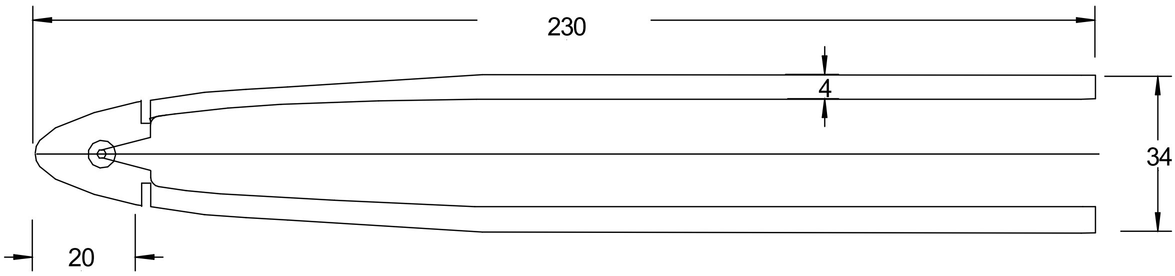
Servo board with a length of 60 mm on the tail unit carrier
Main bulkhead on the servo board
Auxiliary bulkhead (thread from the end of the tail unit carrier) on the tail unit carrier and into the servo board
Surface support in main and auxiliary bulkheads (results in +2 degree angle of adjustment)
Screw reinforcement under the surface support

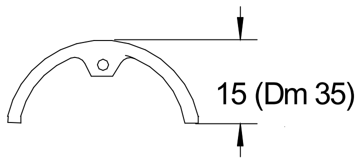
Then "cover" the fuselage frame with 4 adapted parts of the supplied PET nose and fix it with SEKU glue it down.

Canopy:

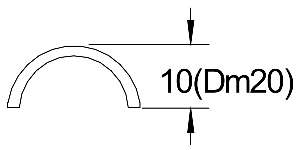
first cut and glue the frame parts (base plate, rear frame, front frame) from 3 mm poplar plywood.

Base plate, cut a wedge-shaped slot in the front for the clamping screw





Rear bulkhead, 2 mm Koch drill for the locking pin



front bulkhead

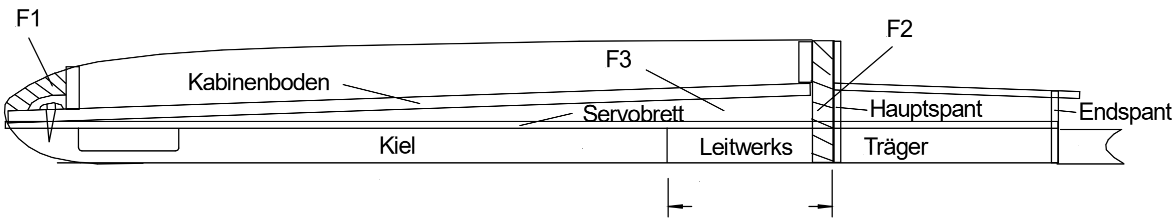
Then adjust the canopy made of PET and glue it to the frame with SEKU.

Glue in the locking pin (approx. 20 mm long) from 2 mm round material (toothpick ?)

Fill the front end of the base plate up to the front bulkhead with balsa (F1) so that there is enough space for the clamping screw.

Adjust canopy:

In the heights:
Glue conical strips of 4 mm balsa onto the servo board (F3)
In length:
Glue balsa fillers (F2) to the main bulkhead and the tail boom and adjust/grind them so that the contour of the canopy "harmonises" with the rest of the fuselage head.
Drill a hole for the locking pin, screw in the clamping screw and slide the canopy horizontally.
Finished it should look something like this:



4 Assembly

4.1 Assembly of the cell

Once the individual parts (wing, SLW, HPW, fuselage) are ready for assembly, assemble the "airframe" in the following order before installing the RC components:

Wing:

Insert the nose dowel into the hole in the main bulkhead of the fuselage and align it.
the distances of the wing tips to the end of the fuselage must be equal
Mark and pre-drill the hole for the fixing screw on the surface support.
Fix the wing with a wood (SPAX) screw approx. 3,5 x 30.
Um das Wackeln durch die V-Form zu verhindern, entsprechendes Füllmaterial auf die
Glue the surface support.

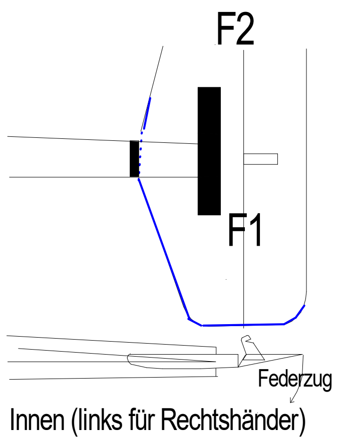
CPR

screw the CPR onto the pylon so that it is "parallel" to the wing.
If necessary, grind or underlay the support plates.

SLW

Whether it is better to place the SLW in a slot in the tail boom or laterally
(with superglue) is controversial:

Better the SLW becomes loose during landing, than that it (and the tail unit) is completely destroyed in an "unhappy" landing.



With a slotted tail unit carrier, a slot approx. 30 mm long cutting/milling into the rear end of the tail unit and round off the front end to avoid notch effects.
Glue the SLW with SEKU (perpendicular to the CPR) so that the surfaces above and below (F1,F2) of the tail unit are about the same.
This ensures that the torques at the start of the rotary throw are balanced and therefore the torsional load of the tail unit beam minimized.

Then wrap carbon-Kevlar threads around the tail unit carrier directly in front of the slot and "soak" it with thin super glue.

In any case, the SLW with glass or carbon fabric with the tail boom connect.
Drill a 2 mm hole in the tail unit carrier at a suitable place and glue in an approx. 10 mm long tube (Bowden cable inner tube) as thread guide

4.2 RC installation

Once you have decided on the components to be installed, their installation positions should be superior:

all components should be easily accessible and replaceable. DO NOT glue in place

place the components as far forward as possible in the order of their weight

For the SLS5 is recommended:

at the very front the battery
behind it servos for side and height
Servos for flaperons behind (shorter linkage path)
behind it receiver

Linkages

Are the connection from the servo lever to the rudder horn of the respective control surface.
In addition to the quality of the servos, the linkages are essential for the exact control of a DLG.
You should:

- free of play
- adjustable and exchangeable
- "rigid" and yet light

its

The rotation of the servo (exception linear servo) is usually +/- 60 degrees around the neutral position and is converted by the linkage (exception RDS) into straight movements "pull" and "push".
A good compilation of this "kinematics" can be found at

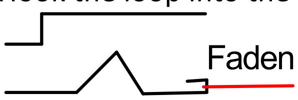
http://www.czepa.at/ruderhebel.html

The direction of rotation, the neutral position and the "servo travel" can (usually) be changed on the transmitter side
but should already be given by the "mechanical" linkage.
The method often used in the past with Bowden cable inner tubes and 0.8 mm steel wire separates for weight reasons and was replaced (mainly in the USA) by Teflon tubes and 0.8 mm carbon rods.
For the linkage of HLW and SLW the use of threads (available in fishing accessories under the term "leader") has proven to be a good solution: For the tensile strength a Kevlar thread is usually woven in.
Ideal is a "Pull-Pull" linkage with threads that do not change their length due to humidity or temperature changes and hardly put any strain on the servo.
Since this linkage is not easy to realize in practice with the long, narrow hulls, one of the threads is replaced by a return spring (push-pull).

Bring all servos into "neutral" position before linkage:

linkage threads (side/height):

cut to length with (approx. 10 cm allowance), tie a small loop at one end, the other end to a (sufficiently long) steel wire (0.5 mm) and through the thread guides in the tail unit carrier into the fuselage and pull through.
Hook the loop into the rudder horn.

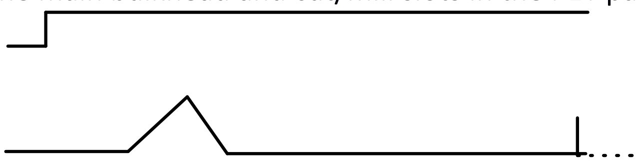


For fine adjustment of the thread lengths each made of 1 mm steel wire
bend the following "extensions":

Hook this "extension" into the servo lever with the "Z" end and wrap the thread around the hook and secure it with glue.
By bending the "V" the length can be adjusted afterwards.

Push rods (flaperons)

Roughly estimate/draw the course of the push rods from the servo lever to the rudder horn, drill holes in the main bulkhead and cut/mill slots in the PET parts.



The push rod made of 1 mm steel wire cut to length with addition and bend to size.
Thread it into the fuselage and with the "Z" end into the servo lever.
Mark the end (hole in the rudder horn),
cut to length with 5 mm allowance, bend at right angles INSIDE and hook into the rudder horn.
By bending the "V", the length of the push rods can be adjusted subsequently.
If the push rod bends under load, replace it with carbon rods or "store" it approximately in the middle with suitable tubes.

4.3 Programming the transmitter

A DLG model experiences during a flight (exception: thermal connection)
2 basically contradictory flight conditions:
at the (turn) start**:**
Drop speed preferably above 100 km/h.
Goal: the highest possible starting height
In glide:
Speed about 15 km/h.
Goal: stay up as long as possible.

Ausserdem versuchen Dreh-und Schiebemomente das Modell beim Abwurf (Rechtshänder) to the left and on your back.

To control these fundamentally different flight conditions and their necessary rudder deflections "manually" with the sticks is almost impossible.

In principle, every control movement also causes a "disturbance" and should be limited to the most necessary.

Therefore you put special trims as "flight phases" on a multi-step switch of the transmitter which should be easily accessible without releasing the stick.

Even if the transmitter programming does not know explicit "flight phases", they can usually be represented by "freely programmable mixers".
Usual:

Flight phase 1 takeoff/speed:

for the rotary launch or to "come home" (against the wind)
prevents the tendency to "rebound" at higher speeds
Both flaps slightly upwards.
and/or
CPR slightly on low.

Flight phase 2 normal/neutral:
to search for thermals or make a "route
Trim for best glide
Both flaps and CPR on neutral ("in Strak")

Flight phase 3 thermal circles :

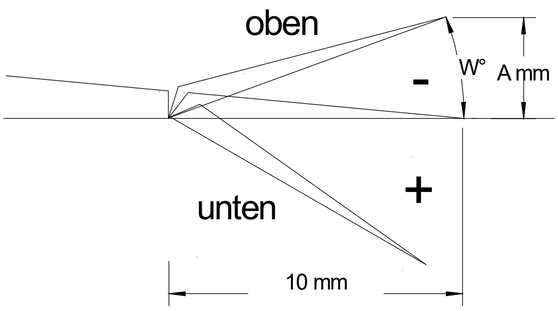
Trim for lowest sink rate
Both flaps noticeably down
and CPR slightly on "High" (SNAP FLAP)
Caution die Thermikstellung kann man leicht übertreiben: das Modell wirkt
zwar optisch sehr langsam, mit Hilfe der Stoppuhr stellt man jedoch fest, dass es
therefore no longer stays on top ("sagging")
If the flaps are also used as a landing aid ("flight phase" 4), the required (large) deflection downwards is usually placed on a slider.

In order to reduce thrust when circling with aileron, an aileron differentiation (more deflection "up", less deflection "down") is usually programmed or mechanically adjusted.
However, there are also reports of successful "flat" circles with rigid SLW ("rudderless"), without or with "reverse" differentiation.

The use of a "combi-switch" to combine SLW and aileron is often used, but it is not optimal, because the deflections of the ailerons "disturb" the profile of the wings.

Circling only with SLW is certainly advantageous in weak wind conditions, but it requires that you have to master this with your (wrong ?) thumb.

It does not make much sense to give absolute values for the size of the rudder deflections, because they have to be adapted to the personal habits of the pilot, or depend on the "Dual Rate" and "Expo" functions of the transmitter:



The relation deflection in millimetres versus deflection in degrees for a rudder blade/flap depth of 10 mm:

Angle	Rash

W °	A mm
1 °	0,175
2 °	0,349
3 °	0,523
4 °	0,698
5 °	0,872
6 °	1,045
45 °	7,071

This makes it easy to convert to the actual rudder blade/flap depth

5 *Flying in*

Das Einfliegen und Trimmen eines DLG ist das „Um und Auf", um das Potenzial des Modelles voll auszuschöpfen Man sollte mindestens den gleichen Zeitaufwand wie für den assembly for this:

The flight behaviour (of each flight model) is essentially determined by 2 factors:

The position of the centre of gravity and the setting angle difference (EWD)

To understand theoretically what actually happens aerodynamically during trimming/flying in, I recommend the excellent article by Oskar Czepa (F1A World Champion 19551):

http://www.czepa.at/urknall.html

.

Focus

Is usually marked with the symbol in drawings.

"Store" the ready to fly SLS5 under the wings:

Since the centre of gravity is a matter of millimetres, the fingers as bearings are somewhat imprecise.

A small device with rounded strips at the top is better suited for this.

The model is in the centre of gravity when the fuselage head swings slightly down.

As long as ballast (hopefully not a lot) is placed in the tip of the fuselage or the rear end of the Give tailplane carriers until the center of gravity is 65 mm (approx. 35 percent) behind the leading edge.

35 % is a so-called "stable" centre of gravity position.

Later you can adjust the center of gravity to your personal flying style.

EWD

ist die Differenz zwischen dem Winkel, den dieTragfläche zur Rumpflängsachse aufweist, und dem des Höhenleitwerkes (HLW) zur Rumpflängsachse, jeweils positiv measured upwards.

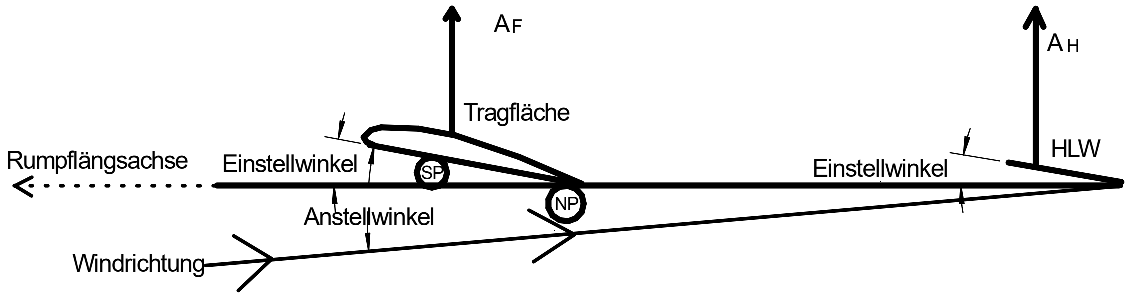
Example:

Angle of attack wing +3 degrees

Setting angle CPR +1 degree

EWD 2 degrees

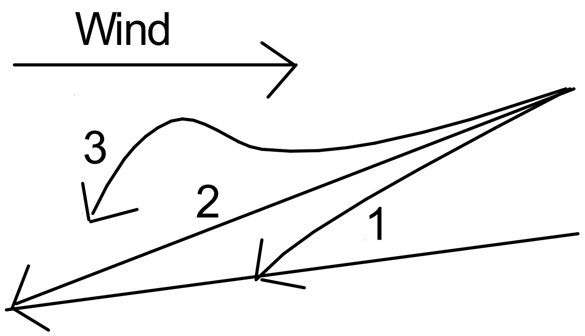
Der Anstellwinkel ist der Winkel zwischen Windrichtung (Anblasrichtung) und der Sehne des Profile



The EWD optimum for DLG use is approx. 1-2 degrees
To "measure" the optimal EWD is far too complicated and inaccurate.
You have to fly them (laboriously).
If the SLS5 was built correctly, it has a "built-in" EWD of 2 degrees:
Angle of attack wing +2 degrees
Setting angle CPR 0 degrees

Trim Flights
serve to determine the "static" stability

Für die ersten Trimmflüge ist ein Helfer als Starter durchaus sinnvoll .Man hat die Hände frei, um to immediately correct any surprising irregularities in the model.
Aber Vorsicht: Helfer meinen es gut und neigen dazu, das Modell nach oben zu werfen, to keep it up as long as possible.
Eine ebene oder leicht abwärts geneigte Fläche (ca. 30 -50 Meter lang) ist für die ersten Trimmflüge geeignet. Ein (höherer) Grasbestand ist im Hinblick auf das lower rudder no disadvantage.
Always start exactly against the wind, with the fuselage tip pointing slightly downwards.
Da man bei einem neuen Flugmodell die Fluggeschwindigkeit nicht kennt , ist es besser, to let the model "take off" itself after a few running steps.
Das Trimmen besteht nun darin, dass man die Schwerpunktlage und die EWD, schrittweise so verändert, bis das Modell "optimal" fliegt, d.h einen möglichst straight gliding flight without control deflections.
Very important:Always change only one factor (C.G. or EWD) and "secure" it with at least 5 test flights.
The statistical dispersion of angle of throw and speed is simply too large to be able to determine from a single test flight whether the "setup" has a positive or negative effect.
Empirically (in practice) the trim can be assessed as follows:



2 Normal trimmed: das Modell macht einen langgestreckten (15-30 Meter, je nach Gegenwind und Starthöhe) Gleitflug: Gratuliere (Glück gehabt), fürs erste ist das Modell richtig

.

3 Pumps: das Modell steigt trotz nach unten gerichtetem Abwurf nach oben, wird slower and tilts downwards, it "pumps".

Of course you can do this by "pushing" (i.e. elevator slightly down to "low") temporarily compensate but important is a permanent correction:

Etweder durch Bleizugabe im Rumpfkopf den Schwerpunkt weiter nach vor legen

or

reduce the EWD: thin (0.5 mm) plywood chips

under the wing trailing edge - or elevator leading edge - or trim the tailplane accordingly "lower" in case of a pendulum tailplane.

1 Undercutting: trotz Erhöhen der Abwurfgeschwindigkeit "sticht" das Modell nach 5 - 10 meters into the ground. It "undercuts".

Natürlich kann man das durch "Ziehen" (d.h Höhenleitwerk leicht nach oben) temporarily compensate but important is a permanent correction:

Entweder durch Bleizugabe im Leitwerksbereich den Schwerpunkt nach hinten or enlarge the EWD in small steps:

Usually only the tailplane is suitable for this:

Place thin (0.5 mm) plywood plates under the end strip of the tailplane

Actually, in case 2 you could already start with the first turn casts, but it is better to adjust the center of gravity and the EWD more precisely:

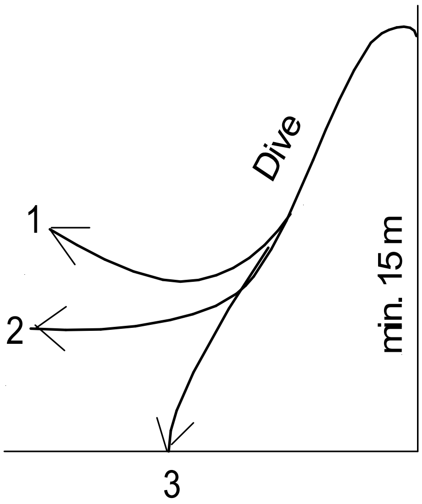
Dynamic stability

Zur feineren Abstimmung der Trimmung sollte man vor den ersten „ernsthaften“ Dive test and determine the "dynamic" stability:

The torques around the centre of gravity (SP) of the upward directed lift (AF for wing and AH for tailplane) cancel each other out in the so-called neutral point (NP).

The distance from the centre of gravity to the neutral point is measured as a percentage of the wing depth and is called the stability measure.

"Flyable" is only a positive stability measure, i.e. the centre of gravity BEFORE the neutral point, as deflections caused by gusts or control errors are "automatically" compensated (stabilised).
If the centre of gravity and neutral point are one above the other (stability measure = 0), there is "indifferent" stability. The model would become uncontrollable in case of a "deflection
Now for the dive test:
Before the Dive Test (again) check that the CPR returns to its original position after a deflection.
Bring the SLS5 "somehow" (preferably with a bungee/catapult) at least 15 meters above the ground, then bring it into normal glide flight and then give a short depth rudder and observe the flight path closely.



1 The model describes a very tight interception radius and would go into "pumping" without any tax adjustment:
too much EWD and/or centre of gravity too far forward

3 The model would become steeper and steeper without tax adjustment and fall into the ground, "undercuts" the model:
too little EMD and/or centre of gravity too far in the back.

2 is OK, if the model after the "puncture"(Dive) picks up the nose by itself in a large radius
i.e. does NOT undercut at the moment.

Basically, the following applies: Centre of gravity further forward: the model flies inherently stable (almost by itself)
Schwerpunkt weiter hinten. Das Modell fliegt "nervös",es muss ständig korrigiert but it's gonna be very "thermikgeil".

The range of "flyable" centres of gravity is about +- 10 percent of the wing depth
The EWD range from 0.5 to 1.5 degrees

Im späteren Verlauf des Einfliegens/Trainings wird man merken, dass jedes Modell eine has a "preferred" circle direction.

Es ist aber (auf Wettbewerben) ein ungeschriebenes „Gesetz", dass das Modell, das als first curve, which defines the direction of the curve.

Dass die Thermik aufgrund der Coriolis Kraft eine bevorzugte Kreisrichtung hat, ist due to the low mass of the air a "fairy tale".

6 Rotational throw start

The spinning throw in athletics

Einige Sparten der Leichtathletik verwenden die Drehwurftechnik, um Ihre Sportgeräte to throw as far as possible:
The hammer throwers accelerate their 7.25 kg heavy equipment with 3-4 full turns.
The discus throwers the 2 kg heavy discus with 1.5 turns.
Den Speerwerfern wurde der Drehwurf des 800 g schweren Speeres verboten, da die Stadien dafür zu were small....

Leider ist die landläufige Meinung, dass (auch) zum Werfen eines ca. 300 Gramm schweren slingshot glider's power is necessary, hardly to exterminate.
Dass dem nicht so ist, versuche ich an Hand folgender (vereinfacht dargestellten) physikalischen Laws to prove

Kinetic energy:

No matter which object you try to throw as far/high as possible, the decisive factor is how much kinetic energy (KE) you have "packed" into the object before you throw it
The formula is: KE= mass (weight) times velocity squared divided by 2
At first glance, the mass (weight) is a good way to increase the KE.
Das stimmt auch, wenn man z.B. versucht, einen Tischtennisball und einen gleich grossen Throwing stones against the wind.
Leider benötigen wir für einen Schleudersegler möglichst geringes Gewicht, um die to increase glide performance.
This leaves the speed, with the advantage that KE increases fourfold at twice the speed.
Unfortunately also the (air) resistance increases with the square of the speed

Acceleration

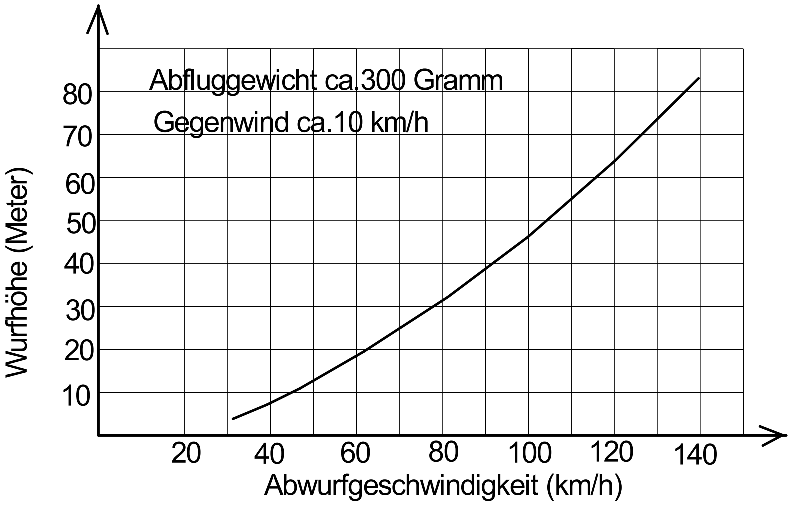
To accelerate an object from standstill (speed =0) to the ejection speed VA requires work.
The formula for work is force times way.
Also doch Kraft ? JEIN; entweder grosse Kraft und kurzer Weg, oder kleine Kraft und long way.

Potential energy

After reaching the "peak height", the remaining energy is converted into "potential" energy (PE) and initiates the sliding (measured in cm/second).
(position) Energy PE = weight (= mass x acceleration due to gravity) x height

The rotary launch of a DLG is most similar to the discus launch, hence the name "Discus Launch" (DL), but is very different in details:

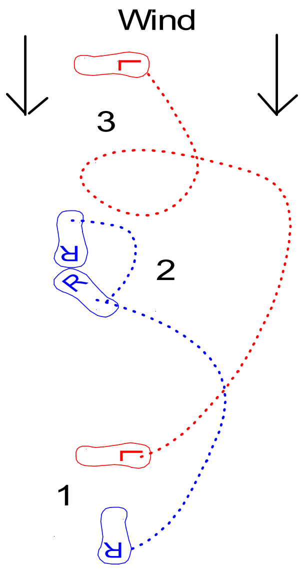
Ein Diskus muss beim Abwurf mit dem Handgelenk auf den optimalen Anstellwinkel „eingestellt“ werden und durch Abrollen über den Zeigefinger in stabilisierende Drehung to be transferred.
In the case of a DLG, increasing the take-off weight only leads to higher throwing heights to a limited extent.



It is determined by the physical conditions of the thrower and is in the "average" range at approximately 280 grams.
The diagram shows the relationship between Drop speed and drop height for one model with approx. 300 grams take-off weight and a headwind of about 10 km/h

During the climb the kinetic energy by the force of gravity and the resistance of the model, whereby the resistance is the biggest "energy guzzler" when the tail unit "swings" after being released.
Now for the procedure:

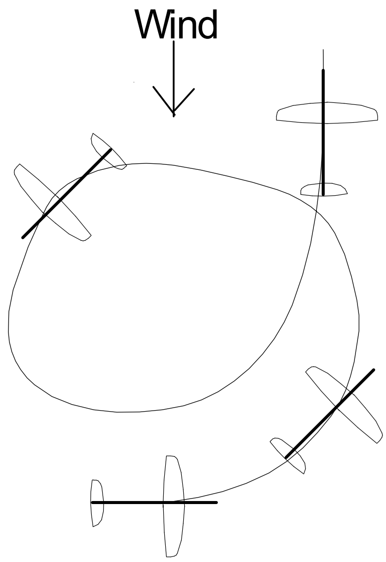
Usually 450 degrees (1 ¼ rotations) are common:



Starting position (1) for right-handed persons(for left-handed persons mirror-inverted)
is parallel to the wind, with the left shoulder against the wind
is directed and the right ear of the model is on the ground
body weight on the right leg (R)
Then turn it slightly so that the model lifts off the ground.
Basically the stretched throwing hand should be
(passive, about 90 degrees) stay behind the body and let it
under no circumstances "overtake".

Then (2) quickly "jump in" with your right leg and on the ball of your foot
turn approx. 180 degrees and thereby move pelvis, hips and shoulders against the
Turn clockwise, or "wind up" like a spring
This is for the acceleration (ejection speed)
the most important phase and must be trained systematically

The end position (3) before the ejection is similar to the starting position
When dropping, look in the direction of the throw, keep the throwing arm
stretched, relax the twisting of the body and the model can be accurately
let go against the wind



Intercept the swing with the left leg (L)

Flight path of the model:

is spiral with a radius
of approx. the half span plus arm length

Of course, it would be advantageous to use the rotational acceleration
not to start from zero, but after a start-up,
as its speed (approx. 15 kmh)+ possible
Headwinds have increased ejection speed.
However, it is very difficult to make these two movements
to run harmoniously.

According to the motto "on the shortest way to the destination (altitude)", would
a vertical ascent is ideal.
Leider muss das Modell nach dem Steigflug durch entsprechendes „Nachdrücken“ d.h. Depth rudder, into the glide angle.
This is the more difficult (timing and deflection), the steeper the drop/angle of climb is.
In principle: the stronger the wind, the flatter the throw, approx. 60 degrees when there is no wind.
Since the entire turning throw is very fast and can hardly be controlled by "thinking along",
an "observer" or better a video camera should be used for the training
(see chapter 5.6) can be used.

Nach ca. 100 Trainingswürfen sollte der Abwurf soweit "automatisiert" sein, dass das Modell ohne Verreisssen und ohne "Verwackler" mit maximaler Geschwindigkeit gerade gegen den Wind is rising.

Always remain relaxed and never think about the "use of force....

Die besten Wurfhöhen erreicht man, wenn man zwar „kraftvoll“ aber trotzdem locker wirft and is not afraid to destroy the model.

Die reine Abgleitzeit (ohne Thermikeinfluss,“dead air time“) kann man (fast) nur vor Determine sunrise:

10 Flüge: die besten und schlechtesten 2 Flüge streichen, den Rest addieren und durch 6 divides results in the average sliding time

Wenn man die Wurfhöhe kennt (siehe Höhenmesser Kapitel 5.5), kann man die Calculate the sink rate of the model:

Sinkgeschwindigkeit (cm/Sekunde)=Wurfhöhe (Meter) x 100 geteilt durch Abgleitzeit (seconds)

Good sink rates are between 30 and 40 cm/second

Slow-motion videos of spinning sausage launches by English pilots:

http://www.youtube.com/watch?v=q102cFi5H0k

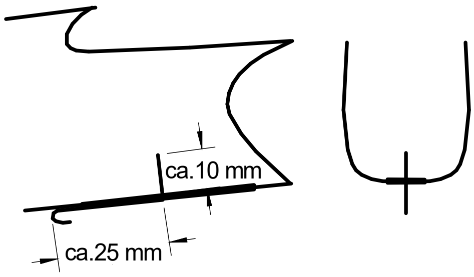
or Swedish pilot

http://www.youtube.com/watch?v=RtCwsGHK7jo

7 Bungee start

Just like electrifying a DLG, "starting up" is actually a "sacrilege" and is not provided for by the manufacturers.
There are situations, however, for which a "bungee" start makes sense:
in case of injuries, or if you need a higher starting altitude to fly in (Dive-Test).

Cover the fuselage in the area of the high-launch hook (approx. 20 % of the wing depth) inside and/or outside with
Glass or carbon fabric up to a total thickness of approximately 1,5 mm
Dann ein 1 mm Loch „querdurch" bohren, den Hochstarthaken aus 1 mm Stahldraht „einhängen" und
Secure with adhesive tape to prevent it from falling out.
Disassemble again for manual start.



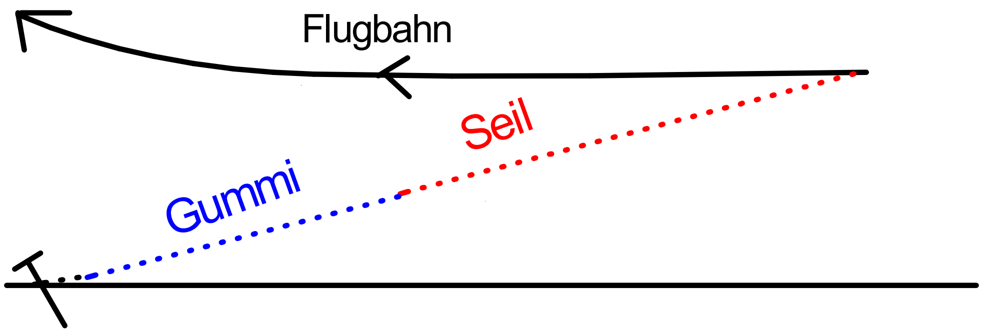
Also the high start facility (bungee)
you can build it yourself:
At the hardware store:

- a centigrade nail
- a rotating snap hook
- 5 meters 5 mm rubber cord
- 15 meters of "mason's lacing cord"
- 2 "curtain rings" 20 mm diameter

shopping,
attach the snap hook to one end of the rubber, one ring to the other end of the rubber.

At one end of the thread a ring and a flag (to find the end better), at the other end a loop and hang up in the ring of the elastic rope.
A plywood take-up device cannot do any harm

To bungee start, drive the nail through the eye of the snap hook into the ground at an angle to the pulling direction (with the wind), hang the end of the rope in the high start hook and pull it out.
A fabric-coated 5 mm rubber cord "locks" at an extension length of approx. 10 m and thus achieves Tractive force of about 7 kg.
Keep the model above your head so that the tail unit cannot touch it when you release it horizontally, exactly against the wind.
With the flap position "neutral" the model accelerates for about .2 seconds and then rises to about 35 meters...



10 competitions

There is hardly any other class of model aircraft in which you can "mix in" on competitions with less expenditure of money and time.
The success factors are:

Modell 40 percent
Pilot fifty percent
Glück 10 percent

Competition rules (FAI)

For all classes of model aircraft, the rules are) und der für coordinated and published by the "supreme aviation authority", the FAI (Fédération Aéronautique InternationaleModelfahrt) und der für , CIAM (Commission Internationale d'Aeromodelisme), based in Lausanne.
Applications for rule changes can be submitted by any National Aeroclub (NAC).
The rules valid for DLG (FAI class F3K) can be found:
http://www.fai.org/aeromodelling/documents/sc4

Competition Tactics

Grundsätzlich sollte man sich vor dem Wettbewerb mit den örtlichen Gegebenheiten vertraut do.
den Zustand der Modelle mit Testflügen überprüfen und sich je Wetterlage für ein „A",“B“ etc. model.

Tactics

The following tips are based on translated contributions to RC Groups:
http://www.rcgroups.com/forums/showthread.php?t=1274623
and our own 10-year competition experience

- All flight tasks concerning
  Concentrate on the requirements of the flight task.
  Inform yourself about the intermediate result of the competition.
  Try to identify the models and their pilots in your group
  Ist ein Top Pilot in Deiner Gruppe,bleibe „cool“ und nütze ihn als (weitere)
  Possibility to display upwind.
  Use the preparation time to check the trim of the loaded model with a loose start.
  When you hit upwind, remember the position including wind offset but "hide" it from the competitors.
  With a bunch of models, stay in the open air.
  It is not worth losing your model or that of a competitor to Midair
  Most of the time the updraft fields are large enough to fly outside of the pulsation.
  Always keep the airspeed high.
  Never waste (frame) time, if your model will land 10 meters away from you, go already there while your model is still in the air
- Flight tasks with remaining time for tactics within the frame time
  Do not start immediately after the start of the frame time, unless you have noticed during the preparati time if and where upwind is.
  Use already flying models to detect upwind
  Wenn Du die erforderliche Zeit bei weitem (mehr als 50 %) nicht erreichen kannst, abort the flight as quickly as possible.

Training

This chapter is <u>not intended</u> an Piloten, die ihren SLS5 neben anderen Modellen nur zum „Spass“ gelegentlich (am Hang) einsetzen, sondern an Piloten, die an Wettbewerben teilnehmen, oder ihre Ergebnisse to <u>improve.</u>
Der Weg, um bei einem Wettbewerb erfolgreich zu sein, beginnt bereits Monate vor dem Tag des Competition

Man sollte möglichst oft, bei jedem Wetter, mit allen Modellen und in einer Gruppe mit anderen DLG Train pilots and pay attention to the following:

- Körperliche Fittness ist wichtig.Wöchentliche Übungen, vor allem in der Wettbewerbs „toten“ Zeit, (Aerobic,Stretching) helfen, auch einen 2 Tages competition with about 100 starts.
- Start the training after the warm up (tuck jumps, trunk arm circles) with a few hand starts to check the trim, then a few loose turn throws
- Experiment with the trim (center of gravity, EWD, flap position, ballast) to get the best
  To be found for the respective flight conditions.
  Observe in which circular direction the model is more "comfortable" to fly.
  Notiere diese Einstellungen und bestimme das bestgeeignete Modell, wenn Du mehrere zur
  I'm at your disposal.
- Always take off against the wind.
  Vermutest Du Aufwind im Rückraum ,steuere am Ende des Steifluges eine entsprechende
  Curve or better half a loop and half a roll.
- Try to catch the model (at the fuselage head) during landing.
  Bei ruhigen Bedingungen versuche das Modell am Randbogen für einen raschen Re-Start zu fangen. Good restart times are around 2 seconds
- Before EVERY flight, try to detect upwind and take off/fly directly there.
  If you have upwind, circle only a few times, land after 2 minutes maximum,
  und starte wieder in den gleichen Aufwind solange, bis er zuweit entfernt ist.Beachte dabei,
  that the updraft "moves" with the wind.
- Try to make as much "distance" as possible by setting the flaps accordingly and only choose the thermal position when you obviously have upwind.
- Train flying back against the wind with appropriate flap positions/ballast.
  Zurückfliegen aus einem Aufwind in gerader Linie ist gefährlich, da der Aufwind „schlechte“
  Air is drawn in, lateral evasion is more favourable
  Vermeide dabei „Ziehen“.Der Geschwindigkeitsverlust dabei führt meist zu einer
  „Aussenlandung“.Versuche die Grenzen besser beim Training als auf einem
  ...to explore the competition...
  A detailed discussion (in English) on this topic can be found at
  http://www.rcgroups.com/forums/showthread.php?t=1247670
- Train to land "spontaneously" within 20 seconds (also from high altitude) "at the point".
- Train individual flight tasks

With the following table you can better estimate your performance (except for flight task poker):

Performance/flight task	750 points	800 points	850 points	900 points	950 points	1000 points
Simultaneous start	3 x 2:15	3 x 2:24	3 x 2:33	3 x 2: 42	3 x 2:51	3 x 3:00
Increase	Best flight 105 seconds =771 points	Best flight 120 seconds = 1000 points	Best flight 120 seconds = 1000 points	Best flight 120 seconds = 1000 points	Best flight 120 seconds = 1000 points	Best flight 120 seconds = 1000 points
5x2 minutes	5 x 1:30	5 x 1:36	5 x 1:42	5 x 1:48	5 x 1:54	5 x 2:00

						Not possible
3 out of 6 Max 180	3 x 2:15	3 x 2:24	3 x 2:33	3 x 2: 42	3 x 2:51	3 x 3:00
Last 1 x 5 min	3:45	4:00	4:15	4:30	4:45	5:00
Last, second to last 2x4 min	3 x 3:00 or 4:00 + 2:00	2 x 3:12 or 4:00 + 2:24	2 x 3:24 or 4:00 + 2:48	2 x 3:36 or 4:00 + 3:12	2 x 3:48 or 4:00 + 3:36	2 x 4:00
1-2-3-4 min	1+2+3 + 1:30 or 1+2 + 1:45 + 2:45	1+2+3 + 2:00 or 1+2 + 2:00 + 3:00	1+2+3 + 2:30 or 1+2 + 2:15 + 3:15	1+2+3 + 3:00 or 1+2 + 2:30 + 3:30	1+2+3 + 3:30 or 1+2 + 2:30 + 3:30	1+2+3+4 Not possible

Dates:

Current competition dates can be found for:

International (Euro CONTEST Tour) on: http://www.contest-modellsport.de/
National (Austria) at: http://www.f3k-austria.com/
National (Germany) on: http://www.rc-network.de/forum/showthread.php/242429-2011-Deutschlandtour-TERMINE
National (USA) auf: http://www.rcgroups.com/forums/showthread.php?t=988356
National (Europe) on the respective F3K homepages of the countries

Evaluation

With the exception of small (10 participants,2 groups) club competitions, manual evaluation with a calculator is hardly possible.

Ich selbst habe eine PC Programm entwickelt, das zwar alle Belange eines HLG/F3K Wettbewerbes abdeckt, aber veraltet/überladen ist und nur runs under DOS or Windows DOS windows, see

Ich empfehle daher das F3KSCORE Program, das von PeterJubel/Oleg Golovidow entwickelt wurde/wird und auf die gültigen F3K Regeln is coordinated.see http://olgol.com/F3KScore/