RES-Dart

Building instructions

Design & Prototype: Franz Heindler, CNC construction: Erich Penz
Construction instructions: Josef Bimminger

Distributed by
ZELLER Modellbau e.U.
Brunnenweg 11
4560 Kirchdorf / Krems
AUSTRIA
Tel .: + 43 7582 21100 - 0, Fax: DW 99
office@zeller-modellbau.com
www.zeller-modellbau.com

This model is not a toy and is not suitable for children under 14 years!

Version: 3.3
Created by: JB / FH / RZ
Created on: 01/29/2019

NOTE: This version (3.3) has been translated from German to English using Google Translate *with no builder interpretation applied*.

What you see is what Google provided!

Table of Contents

1 Model description

My interest in flying wing aircraft was aroused many years ago. The MODEL book "Flying wing sailors remote controlled" by Reinhard H. Werner and something later showed the FMT specialist book “Fascination Nurflügel” by Hans-Jürgen Unverferth Paths and wrong turns and helped me to design flying wings that fly well. Much has developed since then, but just as much had already proven itself back then and has been incorporated into the Res-Dart construction. A rectangular wing with a relatively large wing depth as with the CEOZWO, much set as with the free-flight arrows in the middle of the 20th century. Century, sufficient sweep and rearwardly offset winglets, as they were already Curt Weller in the 1980s with his Elfe 2, formed the basis. Has been completed the concept with a specially designed profile and through the use of DSA Marginal arches. I can do it for anyone who wants to take a closer look at DSA pipes Homepage www.zanonia-flyers.de by Reinhard Sielemann and Dr. Hans-Jürgen Unverferth recommend. Research work was carried out by them with great effort and also published (e.g. AUFWIND magazine 5/2016).

RES-Dart is a dart wing that complies with the German F3B-Res regulations and with Res competitions can be used. It was specially designed for this purpose designed and constructed. The high starts should be done with a Res high start set under consideration of the typical rubber tension and the class-specific one wind conditions. The profile used was specially designed. In the profile construction value was placed on a very high maximum lift and good buildability. The thickness of approx. 9.5% enables light spars and offers good torsional strength. Only in the area of the front panelling, the profile contour is a curve. On the rest of the profile Similar to the AG35, flat segments prevent the covering from collapsing between the ribs. The chosen wing geometry and set were already practically checked and flown during the design phase. An important design goal were good rubber rope high starts. The flight tests showed problem-free take-off behaviour and the attainable starting altitudes proved to be very competitive. The RES dart has due to its wing profile, the low wing loading and the DSA winglets extremely good-natured flight characteristics that enable experienced RES pilots to get close crank out floor thermal systems and sometimes even close the thermal connection by hand find. Have fun building the RES-Dart and wish you all the best for your first flight.
Franz Heindler

2 Technical data

Span:	1,920 mm
Take-off weight:	From 500g in the glider or 580g in the electric version
Area:	47 dm2
Wing loading:	10.6 to 12.8 g / dm2
Winglet profile:	flat plate
Arrow angle:	22 °
V shape:	-1 ° / side
Control:	Aileron, elevation, spoiler

3 Assembly instructions

The structure of the model is largely made entirely of wood. For assembling the RES-Dart is necessarily experience and understanding of the construction of balsa / plywood constructions necessary. In addition, the individual components are made of very light hand-selected balsa wood, which is partly quite fragile and a careful one treatment requires.

The building instructions should be read and understood completely before building.

3.1 Glider hull

Only for the sailor version!

Side parts, base, cover and frames - 3 mm poplar plywood (1 piece each)
(2 x drawings)

Balsa 6 mm (1 pc.)
(1 x drawing)

The fuselage is designed as a classic box fuselage in plywood construction. He is tall enough to run the receiver, receiver battery and possibly an altitude logger accommodate. It is also provided with an adjustable high-start hook.

Danger!
The following individual construction steps refer to the hull in balsa / plywood construction.
The structure is analogous, the reinforcements are omitted!

1. Gluing the High start hook absorption in the fuselage floor. There make sure that the 2mm plywood part with the two small ones drilling is used. Deviating from series 2, the high start hook mount directly in the bottom of the fuselage should be milled (= 1 part fuselage floor made of Poplar plywood without separate high start hook mount out Birch plywood).

2. Shaft side parts and with 3mm Birch plywood parts amplify. It is important to ensure that a left and a right side wall built becomes! To better ones alignment of the parts should be the 4mm beech rods (on the illustration by CFRP solid rod shown) into the 4mm holes inserted, but not glued! Additional reinforcements can be now also on the side of the fuselage parts are glued on. There are 3 mm distance from the edges of the fuselage to be observed.

3. Hull bottom with side panels stick together. It is important that the side walls right-angled to the floor to be glued and the high start hook mount down shows so that a smooth outside of the fuselage floor. In this step will also be the three spacers between the

glued side walls. The floor closes flush at the rear. Furthermore care must be taken that the the bottom of the trunk around the nose area about 3mm must be underlaid to to follow the contour of the sidewall.

4. Head rib flush with side walls glue in.

5. Glue the back of the fuselage. In the bonding must be ensured that the bags for the fuselage cover pointing upwards, so that the lid attached later can be. The back of the trunk is in the unglued condition very much fragile. Optionally, between the front torsion pin and the trailing edge of the large trunk opening a 10 mm strong piece balsa glued in will. With the grain across to the hull elevated the the resilience of the trunk.

6. Glue the nose of the fuselage and the fuselage stick together. The nose with an integrated lead chamber is made from balsa and in layers constructed from a piece of plywood.

7. High start hook
   The plastic coating the luster terminal must be removed, so that we only have the metal part in front of us lie to have. Next the 2mm steel wire according to sketch bent will. (Sketch is not to scale 1:1!) Attention, when very far back lying hook should be the angle reduced to 0 ° (= parallel to Fuselage floor) as the model otherwise to the early notching tends! Subsequently will the Luster terminal With the plywood mount as the steel wire with the washer (metal or GFK) as shown in the pictures see glued with 5min epoxy. It is important to ensure that the GRP and metal parts in front of the bonding sanded and be degreased.

8. Gluing the high start hook in the trunk.
   If the high-start hook mount is milled directly into the bottom of the fuselage, the high-start hook can be removed executed and screwed.

9. The fuselage can now be sanded. The balsa trunk lid should be sanded at the same time.

10. The trunk can now be covered. A paint job is not to recommend as opposed to it the film increases the strength. The two 4mm beech rods (on the picture represented by 4mm CFRP solid rods) are only after the construction of the wings (will still needed there as an aid) in the corresponding holes glued. When gluing on it make sure that they are equally far on both sides protrude.

3.2 Electric hull

Only with the electric version and as an accessory!

Side parts - poplar plywood 3 mm (1 pc.)
(1 x drawing)

Fuselage floor and cover, frames and reinforcements - 3 mm poplar plywood (1 pc.)
(1 x drawing)

Fuselage cover and frames - 3 mm poplar plywood (1 pc.)
(1 x drawing)

The electric hull, like the sailor hull, is constructed as a classic box hull.

The most important notes:

- Engine camber and side pull are already considered. The fuselage floor and side part with the additional hole in the front to be installed on the right so that analogously to the side move right results.
- Long triangular ledges at the bottom, short ones above.
- At the latest before the final gluing of fuselage cover check whether the trial mounted engine left back at the triangular moulding. ggf. building instructions

- The fuselage lid consists of 2 divide. Before gluing the short back part the lid for insert the battery opening so that an exactly equal gap results.
- The circular frame without recesses serve as a template for conical grinding of the front fuselage for spinner 38 mm dia

3.3 Wing

(4 x drawings)

(4 x drawings)

The wing has a classic rib construction with partial balsa planking on the upper and underside. The spar is made entirely of wood. The spar straps consist of pine strips and are boxed upright with balsa and form with it the nose panel has a closed profile that absorbs most of the torsional forces records.
The profile contour is only a curve in the area of the front paneling. On the rest of the prevent profiles, similar to the AG35, flat segments cause the covering to collapse between the ribs.

Notes for wing construction:

- There must be a left and a right wing half are built
- Ribs loudly before cutting out number overview.
- The feet of the balsa ribs break off very easily and should therefore with great care treated will. (Tip: the little feet can with thin superglue to be soaked in order to achieve a higher strength. However, it must be ensured that the superglue doesn't get up to rib soaked. This would later make removal of the feet difficult.)

1. Put the slipway together and open fix it to the building board (pins, spray glue or thin double sided use tape). The two slipway parts are on the separation point with two small bevels marked, these must be on the be on the same side (see picture).

   The milled lettering "FLUG" indicate the direction of flight. The associated arrows demonstrate also on the millings of the front little feet the plywood root ribs. The small millings are for the ribs. It there are also larger millings, which later for the slipway ribs needed to build the bottom will.

2. #13 rib shaft.
   Carefully move the two ribs put together and for control the profile course and the length the use rib 12 (overlay). Then the two rib parts at the glue point on both sides thin superglue wet.

- Setting up the ribs. Before the positioning the ribs in the slipway these should be plastered. It comes with rib # 1 on the root rib position began, then all other ribs in increasing order set up and fixed.

3. The rib spacing from # 16 to # 17 is about half of the other rib spacing. All ribs must be perpendicular to the building board to be fixed (pins, with a small drop of glue fix).

4. Base plate for spoiler and 3x3 Mandibular ridge between rib # 5 glue to # 8.

5. Lower spar chord jaw 6x3 mm stick together. The jaw ridge should be on two long edges are chamfered to suck into the recess of the ribs to fit at the bonding make sure that the ribs are vertical and the rib spacing is maintained.

6. Upper spar strap jaw 6x3 stick together. The jaw ridge should be on two long edges are chamfered to suck into the recess of the ribs to fit at the bonding make sure that the ribs are vertical and the rib spacing is maintained.

7. Attach the leading edge Balsa 6x6

8. Prepare the upper cladding parts. Some parts need to be before the bonding are traded.

9. It comes with the front paneling began.

This should be done before gluing to the leading edge to be beveled (see picture) to the glue gap low to hold.

Then the planking completely glued.

Page 16

10. Glue the rear paneling. In front the bond should be the two balsa strips can be attached. Thereby becomes the right one rib spacing guaranteed. But do not glue the end strips yet!

    Attention, the rear planking has at the top with 21 mm and at the bottom with 22 mm a different width!

    Then the two planking parts between the front and rear paneling fitted and glued.

Page 17

11. Planking for aileron servo adjust and glue. This will on ribs # 12 and # 13 appropriate.

12. Glue the end strip. For the right one alignment of the balsa end strips are included in the balsa template kit at. For greater stability you can carefully use the templates beforehand low viscosity superglue soaked will. It is also important to ensure that the right-angled cutting edge of the both end strips pointing downwards (see image).

13. Top side, except for planking at aileron servo, planked

14. The next step is the wing half from building board taken.

Page 18

15. Setting up the slipway ribs for the machining the bottom. The ribs are now in great shape millings in the Helling base plate placed and in fixed at right angles to the building board. There will be a rib in the area rib # 1, one in the area of rib # 9 and one in the area of rib # 17 set up. Subsequently becomes the wing half with the upper one planking down on the slipway placed. The wing half is like on the images evident, with screws, halved toothpicks and the 4mm beech rods fixed.

    Slope Strips
    (1 x drawing)

Page 19

16. Rudder fin glue in. The frontal plywood final rib with a distance of approx. 1mm glue to rib # 9.

17. GRP hooks for surface mounting glue into rib # 1. The GFK got to in front the bonding be sanded and degreased. The milling edges must be well deburred

18. Now the feet are off the ribs separated and possibly overhangs sanded flush with the contour.

19. The spar boxes made of 2mm fit and glue the balsa. Between rib # 1 and # 6 is the spar boxed on both sides, from rib # 6 only one-sided on the trailing edge side. Danger! The waste that is made up the balsa board with the spar castings milled parts results, becomes later yet for the round boxing required!

20. Opening for insertion into the spar casting drill. As drill becomes the aluminum insertion sleeve used. To becomes one pipe end jagged. Then the pipe is through the millings in the ribs inserted and the pipe in a drill clamped. It must care must be taken that the pipe not bruised becomes. Then it is done without much pressure drilled through the caste system. Link to video on vimeo: https://vimeo.com/168662077

21. The plug-in sleeve is fitted with a balsa piece on one side locked to prevent slipping to prevent the insertion rod. There should be a little hole for it pressure equalization in the closure be made.

22. The plug-in sleeve is on both sides boxed upright with 2mm balsa.

23. Now the tasting is flush with the Holm and ground to the profile contour.

24. Pull in the servo cable. On easy, cables adapted to the power requirement respect, think highly of.

25. Prepare the lower cladding. It have to deal with parts again will.

26. Then the lower planking similar to the one above upset will. It comes with the front planking started, then the rear glued and final the Intermediate pieces fitted. During the drying time should the wing half well on the sliding weighted or fastened so that there are no delays sneak in.

27. After the bond has dried can the wing half of the taken slipway and sanded down. For the leading edge contour balsa stencils are included. For greater stability, the use the templates carefully beforehand low viscosity superglue to be soaked.

28. Then the rudder flap split off. The rudder caste is from the border of the 2 mm balsabrettes created in which the milled parts for the spar casings found to have. The afford cut to length, stick together and then sand down.

29. The wings shell-ready and be sanded

3.3.1 Linkage of rudder flaps

General remark:
The articulation of the two rudder flaps can be done in several ways. It is make sure that a backlash-free and resettable articulation is realized.

Below becomes exemplary a "Cross linkage" shown.

1. Production of the linkage made of 0.8mm steel wire and 1.2mm CFRP solid rod The steel wire will be like on the pictures shown cut to length and cranked (Z-bend) and then with the CFRP solid rod glued with superglue. The cut the linkage beforehand and the shorten the CFRP rod if necessary. Before the bonding have to all adhesive surfaces roughened and degreased will. The bonding is done with shrink tubing secured.

2. Breakthrough for linkage in the cut upper planking. Edge of the breakthrough with low viscosity cure superglue (preferably from inside to outside glue stains to avoid).

3. Control horn mount.
   To ensure a good introduction of force into the should ensure rudder flap the area around the control horn be reinforced.

4. Control horn and servo are only starting glued after covering.

   Note: When connecting, it must care must be taken that the linkage and place the control horn in neutral form right angles. The same also applies to the rudder horn. This results in the same rudder deflections up and down.

   Both the elevator and spoiler servos the easiest way to tape (with masking tape wrap) or shrink, if necessary grind, degrease and then with 5-min epoxy or heat seal adhesive on the fix the planking on the inside.

   Linkage variant exposed at the top

3.3.2 Spoiler linkage

General remark:
The spoiler flaps are opened by simply pressing the flap open with the Servo arm. The closing is made by a piece of plywood guaranteed.

The linkage shown is done with a Dymond D47 servo. Here the servo arm with a 3x1 CFRP profile or one appropriate GRP or plywood cutout can be extended. The servo arm length must be individually adapted to the used servo can be adjusted and should be about 25mm. The cutout in the spoiler base plate must also be customized.

1. Extend the servo arm.
   Roughen the adhesive surfaces well degrease. Reinforcement with CFRP winding.

Page 28

2. Opening in Spoiler base plate to adjust.

Page 29

3. Glue the spoiler flap plywood carrier. Possible only after covering the flap.

Page 30

3.4 Winglet with DSA tube

The winglets are built in the classic balsa rod construction. At the winglet foot comes a so-called DSA pipe is used. DSA means pressure-suction discharge and improved the flow conditions at the wing-winglet transition. This has essential Effects on the very good-natured behavior and the controllability in slow flight.

1. The individual balsa parts for the winglet are prepared and as a test composed. The individual diagonal struts are marked with small holes, please refer image. Fix the parts on the building board and stick together.

2. Then the winglet can roughly be sanded

3. Construction of wing winglet transition. The parts you need are on the image visible. You're with me again marked small holes

Page 31

4. Be into the # 18 plywood rib two toothpicks stuck and the Balsa parts threaded according to the pictures and glued. This phase of construction should be done beforehand be played through dry once, this ensures that nothing glued together incorrectly.

Page 32

No textI

Page 33

5. Next is the rounding for the DSA pipe ground. For one quality accuracy of fit becomes round material With one requires a diameter of 14mm. Glue on it with double-sided duct tape sandpaper. Then the gutter for the ground CFRP or plywood tube and the edge curve sanded.

6. Gluing the winglet and the wing transition.

Note: The winglets can also be used with easier V-position outwards, so not 90 ° to the wing. Thereby however, the range increases. For a maximum applies to F3-RES competitions span (tip-to-tip) of 2,000mm. The V-position should be a maximum of 75 ° so as not to negatively affect the flight behavior influence.

7. The thin-walled 15mm CFRP tube is sanded and degreased (not necessary when running with plywood round tube). Subsequently it gets into the gutter of the Wing transition and to the glued winglet. On a good one bonding is to be observed! The CFRP or plywood tubes should be 133 mm behind the nose edge of the rib 18 begin (see picture)!

8. Toothpick locking bolts and in rib # 18 stick together.

9. In conclusion, this will entire component finely sanded.

3.5 Completion

1. RC installation
   When choosing the RC components - especially the servos and extension cords - necessarily on lightweight components. These due to the geometry, parts are behind the focus. Heavy components inevitably lead to the addition of lead in the tip of the trunk, which is the total weight unnecessarily increased.

2. Covering
   For the covering it will be easy material like the Oralight © transparent iron-on films recommended. Everything should be done again before covering the exact fit and ease of movement of the rudders and flaps are checked. One on a trial basis assembly of shell construction is recommended. Attention, the outer three rib panels and the rib panels of the winglets must in order to a collapse of the covering in the cold and to prevent bulging in heat, with ever ventilated with a needle prick. It will not done, there will be negative ones effects on flight characteristics

3. Attach the rowing and spoiler flaps. The flap hinges are made with Tesa executed. Then the linkages completed will. On backlash-free pay attention to linkages.

4. Control of the set and the trailing edge using the templates or the wing slip. Eventual deviations by careful fix twisting and re-ironing.

5. Receiver battery, receiver etc in fix the fuselage. All components should as far forward in the trunk as possible be attached to possible little lead for setting the correct focus to need.

6. Attaching the winglets to the wings:
   - glue or
   - fix with adhesive tape

7. Securing the wings to the fuselage:
   - with rubber rings / O-ring
   - with adhesive tape (e.g. our COROPLAST duct tape # 132741 - leaves themselves peel off residue-free and is elastic)

4 Settings

4.1 Focus

The center of gravity is set according to the specification. If lead is needed in the nose of the fuselage, can do this through the small opening in the fuselage nose brought in will. Then the hole is taped locked.

4.2 Rudder deflections

Unless otherwise stated, all dimensions are in mm.
"+" means up
"-" means down
In order to be able to adjust the aircraft perfectly, 3 flight phases should be programmed, which can be selected via a switch.

Aileron:	+ 11 / - 17	
Elevator:	+ 12 / - 12	
Spoiler:	90 °	Elevator admixture +2 to + 3mm

Flight phases	*Elevator position*
Begin:	+ 0.5
Speed:	+ / - 0
Thermal:	+ 2

4.3 Fly in

Before the first hand start, the angle, the center of gravity, the rudder deflections and the correct deflection direction of the rudder flaps is checked. Hand starts take place with elevator position thermal (elevator 2 mm up). With the correct center of gravity the RES-Dart now shows an elongated gliding flight. Is one of the hand starts if the ailerons need to be trimmed, the profile contour and the offset should be repeated checked and corrected if necessary.

If the rudder deflections have been set according to the assembly instructions, the following has occurred method to control of Center of Gravity meanwhile proven:

1. Stable and steady circling flight with fully pulled elevator
2. When the elevator is fully pulled, aileron is fully in the opposite direction
3. Quick, correct reaction - focus too far ahead
4. Sluggish, correct reaction - focus ok
5. No or opposite reaction - focus too far back

Depending on the weather and the desired reaction speed, the flyers so quickly to a meaningful center of gravity close to the maximum performance check out.

4.4 Rubber rope high start

After the manual starts, the elevator will be in neutral position for the following rubber rope starts reduced to approx. + 0.5 mm (see flight phases). For the first attempts at startup, the hook should be set so that it is approx. 5 mm in front of the center of gravity. During further flight tests and optimization, the hook position can gradually be adjusted be laid at the rear. Optimal high take-off heights are only achieved with a hook position behind the center of gravity reached. If there is more than 2 mm of hook back, the starts are still safe, however significantly more course corrections are necessary. As usual with RES, the RES-Dart is thrown upwards at the start of the rubber rope. To see from about the middle of the following video: https: //vimeo.com/161731682

Have fun building and flying yours