Building Notes for RES – Dart Electric.

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3.2 The electric fuselage is constructed as a classic 'box'

- Important: please note the engine side and down thrust are already built in to the construction. The bottom of the fuselage and side panel (with the hole) are installed on the right to give right side thrust.
- In the nose place the long triangle section on the bottom, the short on the top.
- Before final gluing of the front top planking check that the motor is not rubbing against the triangle strip.

1 Photo

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- The fuselage top consists of 2 parts. Before gluing shorter rear part insert the battery hatch cover so there is an equal gap all round.
- The circular former (without holes) serves as a template for grinding the conical shape to fit the spinner. 38mm diameter is recommended.

2 Photos

Page 13

The wing is designed with ribs and sheeting top and bottom. The 2 spars are spruce strip and joined with vertical balsa webs. Top and bottom balsa sheeting is used to complete the 'D' box that absorbs most of the torsional forces. The rest of the profile (AG35) is such that the flat sections prevent the covering from sagging between the ribs.

- Remember to build a left and right wing!
- Number the ribs according to the drawing before cutting them out.
- The feet of the balsa ribs are fragile and break off easily. They can be strengthened locally with thin Cyano, but do not get any on the actual rib.

1. Put the foam jig together on the building board. Secure to the building board with pins, spray adhesive or double sided tape. The two parts are marked with a small chamfer at the joint – these must be the same side.
- The milled words 'flight' indicate the direction of the leading edge. The associated arrows also point to the cut outs on the front feet of the ply root ribs. The smaller cut outs are for the remaining ribs. There are also more, larger, cut outs which will be used later for the jigs to build the underside of the wing.

1 Photo

Page 14

2. Join rib No. 13, carefully glue the two parts together, and overlay No. 12 rib to check the profile and length. Thin Cyano is recommended.

- Setting up the ribs. Separate the ribs from their sheet and position in the foam jig starting with rib No 1 at the root end. Then fix the other ribs in ascending order.

3. The rib spacing from 16 – 17 is about half the other rib spacing. All ribs should be fixed to the building board (use pins etc.)

4 Photos

Page 15

4. Glue the base plate for the spoiler and the 3mm x 3mm spruce strip between ribs 5 to 8.

5. Glue the lower spar (6mm x 3mm). The spar should be slightly chamfered along 2 long edge to fit the notches in the ribs. When gluing make sure the ribs are vertical and that the rib spacing is maintained.

6. Glue the upper 6mm x 3mm spar. Chamfer to fit ribs, as above.

Builders note: Fit top spar first then use lightweight gardeners binding twine round top spar to dry fit lower spar. Cyano bottom spar when all are tight and ribs square.

7. Attach the 6mm x 6mm leading edge balsa strip.

4 Photos

Page 16

8. Prepare the top sheeting by gluing the appropriate parts together.

9. Attach at the leading edge first. This should be bevelled before gluing in order to keep the gap to a minimum. Finally glue the rest of the sheeting in place.

3 photos

Page 17

10. Glue the rear planking. The two balsa trailing edge strips should be dry fitted first before gluing to check the rear spacing of the ribs….but do not glue yet!

Note: the sheeting has a different width at the top (21mm) and bottom (22mm).

Now the intermediate sheeting between front and rear sections can be glued in place.

2 Photos.

Page 18

11. Adjust and glue the sheeting for the aileron servo between ribs 12 and 13.

12. Glue the trailing edge strip. Included is a balsa template for the correct angle alignment of the trailing edge. To increase strength the template soak in thin Cyano. It is also critical to ensure the correct orientation of the trailing edge with the right angle (90 deg.) edge of the two strips pointing downwards. (See photo)

13. Complete the rest of the upper planking.

14. Remove the wing half from the building board/jig.

6 Photos

Page 19

15. Set up the rib jig for making the underside. (See photo). The jigs are placed into the large cut outs on the foam base and fixed at right angles to the building board. One jig in position 1, one in position 9 and the third in position 17. The wing half is placed on the profile jigs with the upper surface facing downwards. As shown in the pictures, the wing halves are fixed with 2 screws, halved toothpicks and 4mm diameter beach dowels.

6 Photos

Page 20.

16. Glue the aileron root rib doublers to leave a gap of @ 1mm from rib 19.

17. Glue CFRP hooks for wing securing bands in rib 1. De-burr, sand and degrease before gluing.

18. Now the feet can be carefully separated from the ribs and any burrs removed and sanded flush to maintain the profile.

5 Photos.

Page 21

19. Fit and glue spar webs from 2mm balsa. Between ribs 1 – 6 fit webs both sides, from rib 6 only one side is fitted on the rear of the spar. Note: the excess from the spar web sheet will be needed later for boxing around the wing joiner tube.

20. Drill the opening for the wing joiner into the spar box. The aluminium tube is used as the drill bit. One end of the tube is filed to create a 'saw tooth' profile. The tube is then inserted into the holes in the ribs and the tube used in a drill. Do not squash the tube. Afterwards the drilling can be done without much pressure.

Builders note: better to perform by hand to have better control. Use a triangular file to create the saw tooth and with gentile pressure manually the drilling can be performed easily. Don't forget to also make a hole in the web for the aileron servo wires.

6 Photos

Page 22

21. The tube should be sealed on one end with a balsa plug. A small hole should be made in the plug to relieve any pressure.

22. The aluminium tube is webbed on both sides with 2mm balsa.

23. Now the webbing is sanded flush with the spar and rib profile.

24. Install the aileron servo wires. Make sure the wire gauge used is suitable for the intended power requirement.

2 Photos.

Page 23

25. Join the relevant parts to create the lower sheeting.

1 Photo

Page 24

26. The lower sheeting can be applied in the same manner as the top. Start with the front sheeting, then the rear one and finally the intermediate pieces. Weigh the wing down while glue dries to avoid any warps.

27. When the glue has dried remove the wing from the jig. Shape the leading edge using the gauge provided to achieve the correct profile. The gauge can be soaked in Cyano to harden.

28. Now separate the aileron. The aileron leading edge is made using the spare 2mm balsa from the spar web sheet. Cut strips to length, glue and sand to shape.

Builders note: strengthen the horn position on the aileron by using lightweight balsa sheet infill between the appropriate 2 ribs

4 Photos

Page 25

29. That completes the basic wing construction and they can now be finish-sanded.

3.3.1 General Note: the ailerons can be connected using different systems, but whatever system used must have no free play or backlash, with a consistent neutral position. As an example a complete linkage is shown in the picture.

4 Photos

Page 26

2. Cut opening for the push rods in the top sheeting. Harden the inside edges of the sheet with Cyano thus avoiding staining the outside.

3 photos

Page 27

3. Control horn mount. Reinforce the area around the horns with the provided ply sheet.

4. The control horn are connected after covering. Note: In the neutral position the pushrod and servo must be at right angles. The same applies to the pushrod at the aileron horn. This gives equal movement up and down.

The easiest way to mount the spoiler and aileron servos is to glue them in. Wrap servo in masking tape or heat shrink, sand, degrease and fix with epoxy or hot glue gun.

Photo 4 shows linkage exiting on top surface.

4 Photos

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3.3.2 Spoiler linkage

General note: The spoilers are simply opened by pushing on the underside with the servo arm. Closure is performed by the plywood 'U' shaped guide.

For reference the linkage shown in the photo is for a Diamond D47 servo. The servo arm must be extended using 3mm x 1mm CFRP or plywood. The length of the extension must be individually adapted for the servo used and should be approx. 25mm. The cut out in the spoiler base plate is sized to suit the servo used.

1. To extend the servo arm, roughen, degrease, glue and reinforce with suitable thread.

Builders Note: The small Blue Bird BMS 101 servos supplied by Hyperflight already contain an extended servo arm.

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2. Adjust the cut out in the spoiler base plate for the individual servo installation

2 Photos

Page 30

3. Glue the plywood guide to the underside of the spoiler blade (better to do after covering)

2 Photos

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3.4 Winglet with DSA tube

General Note: When building the winglets don't forget to build a right hand and left hand!

The winglets are classic balsa strip construction. A DSA tube is placed at the base of the winglet. Translated the DSA means 'pressure suction discharge' and improves the airflow at the winglet/wing junction. This has a major impact on the very good natured behaviour and controllability in slow flight.

1. Trial assemble the balsa parts. The individual diagonal struts are marked with a small hole (see photo). Pin parts to the building board and glue together.

2. Now the winglets can be roughly sanded

3. Construction of the wing/winglet transition section. The required parts can be seen in the picture (18, 1 – 6). They are all marked with small alignment holes.

2 Photos

Page 32

4. 2 toothpicks are inserted into plywood rib 18 and the balsa parts are treaded and glued as per the picture. Do not glue in the toothpicks. It's suggested that the assembly is dry fitted first to ensure everything is in the correct order.

Builders Note: Don't forget to make a left and right hand side!

4 Photos

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4 Photos

Page 34

5. Next the recess for the DSA tube must be formed in the tip. Use a sanding former of 14mm diameter for a good fit. Sandpaper can be glued to the former with double sided tape then the channel sanded for the CFRP or plywood tube. Blend and radius the edges as necessary.

6. Gluing the winglets and the tube.

Builders note: Direct translation: Note: the winglets can be glued with a small 'V' position (toe out) i.e. not 90deg to the wing. However this increases the wingspan. For RES competitions the max. span tip to tip is 2000mm. The 'V' position should be a maximum of 75deg in order not to impede the flight characteristics. Take a look at the various build blogs for a better understanding.

4 Photos

Page 35

7. The thin walled CFRP tube is lightly sanded, degreased, and then securely glued into the recess on the underside of the winglet transition block. Both CFRP and the ply tube should start 133mm behind the nose of rib 18 (see photo)

4 photos.

Page 36

8. Make a location pins from a toothpicks and glue to rib 18

9. Finally the entire assembly can be finish sanded.

1 Photo

3.5 Completion. *(General notes for electric and glider versions)*

1. R/C installation. When selecting the r/c components – especially the servos and extension cables – it is essential to use lightweight items. Due to the wings geometry these parts are located aft of the C.G. Heavy components inevitably will lead to the requirement to add weight to the nose, with the resulting increase in overall weight.

2. For the covering it is recommended to use light material such as Oralight iron-on film. Before covering ailerons and spoilers should be checked for fit and free movement. Please note the outer 3 rib panels should be 'ventilated (with a pin hole) to prevent the covering in this area from collapsing in the cold and bulging in the heat. This will affect the flight characteristics if not done.

3. Hinge the spoilers and ailerons with suitable clear tape. Again make sure there is no backlash in the linkages.

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4. Check the trailing edge reflex with the gauge and correct if necessary by carefully adjusting and re-ironing.

5. Fit the battery, receiver etc. into the fuselage and adjust their position in order to use as little nose weight as possible to achieve the correct C.G.

6. Attach the winglets to the wing using glue or adhesive tape.

Builders note: magnets can be used for quick and easy removal. Suggest 2 (3mm diameter min.) are used per tip for security.

7. secure the wing to the fuselage with rubber bands/'O' rings. Adhesive tape (Coroplast no. 132741) which is flexible and can be removed without marking the surface.

1 Photo

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4 Settings

4.1 Centre of Gravity – 21mm forward from trailing edge at the junction of the wing and fuselage. (See diagram)

The C.G. must be set as specified. For the glider version if lead is needed in the nose it can be placed in a hole drilled as far forward in the nose block, with the hole sealed with tape.

4.2 Control movements.

Unless otherwise stated all dimensions/measurements are in mm.

'+' means upwards

'-' means downwards.

In order to be able to adjust the aircraft perfectly 3 flight modes should be selected on a switch on the Tx

Aileron		+11/-17
Elevator		+12/-12
Spoiler	90deg	Elevator mixing +2 to +3

Flight mode	Elevator position
Launch/start	+0.5
Speed	+/- 0
Thermal	+2

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4.3 Flying

Before the first hand launch check the C.G., control deflections and directions again. First hand launches should be performed with the elevator in the thermal setting (+2 deg)

If the C.G. is correct should perform a flat glide. If it is necessary to trim the ailerons/elevator during hand launch, the profile contour and the reflex angle should be checked and corrected as necessary. If the control deflections have been set according to the data, the following procedure for checking the stall point has been shown to work:

1. Stable and steady flight with full up elevator
2. With full up elevator, put aileron in the opposite direction
3. Rapid, corrective reaction means C.G. is too far forward.
4. Slow corrective action C.G. O.K.
5. No, or opposite reaction, C.G. too far back

Depending on the weather conditions and the desired reaction speed the C.G. can be optimised to give the maximum performance.

4.4. Bungy Launch

After initial trimming with hand launching, the elevator neutral position is reduced to 0.5mm for bungy launches. For the first attempts the hook should be set so that it is approx. 5.oommin front of the C.G. during further flight tests and for optimum launches the hook position can be moved gradually backwards. Optimum launch heights can only be attained when the hook is behind the C.G. If the hook is more than 2mm behind the C.G. the launches are still safe, but significantly more control inputs are required.

As usual with RES aircraft, the Dart is thrown upwards at the start of the launch.

(See video https://vimeo.com/161731682

Have fun building and flying the Dart RES

These notes were formed around a translation of the original German build manual and rather than the literal meaning of some phrases, changed into 'modellers speak' during the actual build process. The glue used was predominantly De-lux materials Super'Phatic, with only small amounts of Cyano for specific applications. Great if one is allergic to Cyano!