

Foreword:

This Glider design was created on request by others. I do not intend to build this model myself. The details are available for free to individual builders but not to be used by commercial Kit suppliers without my written permission.

The structural design is created to achieve high degree of strength and redundancy taking the size of the model in mind. Builders with experience of this size models may want to modify some details as they see fit. Because I have no control over the building of this model by others I cannot take any responsibility for the end result and/or flying characteristic.

Due to size and weight of the model, the builder should refer to the local regulations that apply for building this size/weight of models and act accordingly.

Model specifications:

Glider type PWS-101.

Scale 50% (1:2).

Wingspan 9500mm.

Fuselage length 3635 ( with Fin-Rudder attached).

Height Fin-Rudder 890 mm.

Span Horizontal Stabilizer 1505 mm.

Flying weight 28 kg (calculated but subject to final material density used by builder).

Airfoil root section HQ3516.

Airfoil tip section HQ3510.

Frise style Ailerons.

Drawings:

The following 14 drawing are available, in DXF and or PDF format.

The end of the file names indicate the paper sheet size

Drawings/File name	Available format
ASSEMBLY-A3	PDF only
CANOPY-A2	DXF & PDF
FIN-RUDDER-A0	DXF & PDF
FUSELAGE-SIDE-3500x841	DXF & PDF
FUSELAGE-TOP-3500x841	DXF & PDF
LH-INNERWING-2300x841	DXF & PDF see note below
LH-OUTERWING-2700x841	DXF & PDF see note below
METAL-PARTS-A3	DXF & PDF
PWS-101-3VIEW-A3	PDF only
PWS-HINGES-A3	DXF & PDF
STAB-ELEVATOR-2200x841	DXF & PDF
TOW-RELEASE-A4	DXF & PDF
WING-PINS-A4	DXF & PDF
WING-SPARS-2600x841	DXF & PDF

Note print the LH Inner and Outer wing drawings mirror reverse for RH building references.

### NC-Parts files:

13 dxf laser cut parts nesting files are supplied

3MM-BALSA-NEST1

3MM-PLYNEST1

3MM-PLYNEST2

3MM-PLYNEST3

3MM-PLYNEST4

4MM-BALSA-NEST1

4MM-PLYNEST1

4MM-PLYNEST2

4MM-PLYNEST3

4MM-PLYNEST4

15MM-PLYNEST1 (1.5mm plywood)

15MM-PLYNEST2 (1.5mm plywood)

NC-4MMPLY-JIGS Note cut these parts only if suggested fuselage jigging is used

note to NC operators,  
on the NC DXF File all part names/numbers and  
other notes are in a layer called TEXT.

### Servo's:

All Servos suggested on drawings have a nominal 40x20mm body cross section

Digital servo's to be used with a minimum 10kg/cm torque. Servos shown are Tower Pro MG996R

In total 11 servo's are required

Tow release 1

Rudder 2

Elevator 2

Airbrakes 2

Ailerons 4

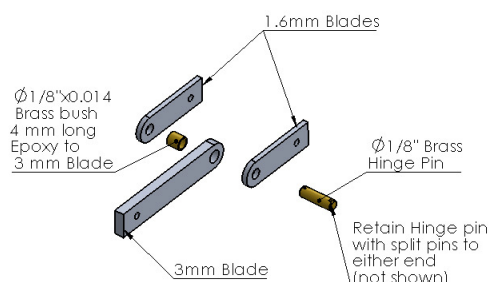
### Radio equipment:

This size model requires some redundancy. Dual battery power and dual receivers are recommended. Each servo to have each own channel. A minimum 11 channel T/X is required.

### Hinges:

The Hinges have to be fabricated. Each hinge consists of a 3 mm aluminium centre blade and two 1.6 mm aluminium side blades. The 1.6 mm blades could be made from 1.6mm PCB board with a copper surface on both sides instead.

The hinge blades shape are dictated by the location used, but the actual hinge section is the same for all. The hinge pin is a 1/8" diameter brass rod, a brass bush of 4mm long to be epoxy'd into all 3 mm blades. The 3 mm blades are located in pockets laser cut in ribs, spars or dedicated formers. The 1.6mm blades are located on either side of a 4 mm rib or former.



### Flying weight:

The computer model calculates the total weight at close to 28 kg (61Lbs)

This includes an extra estimated 25% for glue/epoxy covering and paint.

The following is a list of the maximum finished building target weights for each assembly.

Fuselage	6280 gr
Horz/stab-elevator	1500gr
Fin/rudder assembly	720gr
Inner wing section	4120gr each
Outer wing section	2500gr each
Canopy	525gr
Nose ballast	4300 gr with C.O.G as shown on 3 view drawing
TX and batteries	500gr
Wing joiners	480gr
Wire harness	400gr

### Drawing conventions:

A B.O.M is included in the total package. On the drawings only part codes/numbers are shown

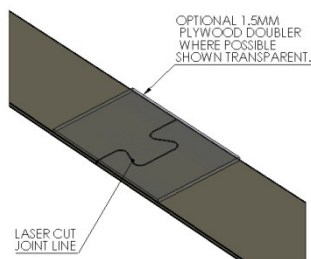
Refer to the B.O.M for part material, required quantity and manufacturing process

Where required some parts details are shown on separate drawings.

### Part joints:

Due to the size of the model some plywood parts are too long to be cut in one piece.

Special joints are laser cut in these items as shown on picture below. All these items to be joined prior to building the assembly where they are used. Make sure they are flat when joined. Where physically possible it is recommended to add a 1.5 mm plywood doubler for additional strength.



### Building order:

It is recommended to built the horz/stab-elevator and Fin-rudder assemblies first before building the fuselage. This way one can check and adjust the fuselage if necessary to make sure both horz/stab and fin are horizontal and vertical respectively. With the laser cut items all hardware like pins and bushes should fall in place at the correct location and or angle. But no harm in checking before fixing in place permanently. Some structures do interlock with tabs and notches. Dry fit these items to check the fit and even more important in what order they need to be fitted to get the required result.

#### Horz/stab-elevator:

Conventional spruce, balsa plywood construction. All planking and cap strips are 0.4mm plywood. The main stab spar is a pre-assembly of three parts(SSC and 2x SSB) with joints as mentioned above. The main spar and some ribs have tabs to be used to built the stab on a flat surface. Remove tabs only after the top planking has been fitted. Each elevator has its own servo . Driving the elevator with a push rod inside the stab and elevator body. One can extend the elevator horns but would not be to scale. The elevator horn is part of the first hinge blades (HG1) . Builder to provide access covers to servos if deemed required.

The elevators to be built with the spars flat on a building base. The elevator L/E is 0.4mm plywood wrapped around formers A#. The radius is large enough for the ply to follow. At the hinge locations balsa blocks are fitted to continue the L/E shape.

All push rods throughout the glider are made from 4-40 steel rod with a  $\phi 4 \times \phi 3$ mm carbon tube around the rod kept in place with epoxy. This will prevent bending the rods under load conditions. I do speak from experience here.

The complete assembly is held in place on the fuselage with three (3) M5x90 mm socket head bolts and washers. The stab-elevator assembly must be fitted to the fuselage prior to fitting the Fin-rudder assembly.

#### Fin-Rudder assembly:

Conventional spruce, balsa, plywood construction. Planking and rib cap strips are 0.4mm plywood. All laser cut parts will slot together and should not be difficult to put in place. L/E of the rudder is solid balsa sanded into the required shape. The Fin spar at the bottom will rest and kept in place when fitted to the fuselage. The fin is retained in the fuselage with two (2)  $\Phi 8$ mm carbon rods. A M4 socket head bolt in the fuselage will keep the fin secured in place

Builder to choose a way to fit the pull-pull rudder cables at the field in a secure way. The fin rudder assembly to be fitted at the field after the Stab-elevator assembly is in place. The small tab at the bottom/front of the fin L/E must fit into a slot laser cut in part P4 in the horizontal stab to give an extra way of securing the fin.

### Fuselage:

Conventional spruce,balsa, plywood construction.

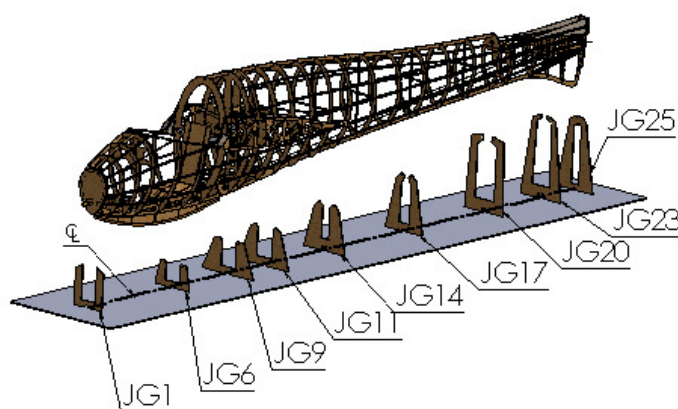
A file is available for 3D printing the Nose cone. Nose Cone to be fitted with lead inside. 4.3 kg of lead is estimated to be required. If nose cone space is not sufficient more lead to be fitted as far forward as possible in the nose area well secured to prevent walking around in the fuselage.

A separate NC laser cut file is supplied to cut jig plates. The jig plates are shown in picture below. The jig plates are numbered with the same number as the formers they are bolted too. Bolts used are M3. Holes in formers and jig plates are laser cut and should locate the formers in the correct location. Secure the jig plates with some aluminium angles on your base board. The centre line mark is embedded in the bottom edge of the jig plates. Together with the laser cut parts K1 and top & bottom stringers this setup makes the fuselage self rigging.

If the builder prefers an other rigging method the jig plates are not required.

The planking shown on the drawing is 3 mm strip balsa sanded smooth then glassed with 80gr/m2 glass and resin. My experience on a 1:3 scale model is that it will result in a strong and dent resistant surface. Plywood planking in sections is an option. In that case 0.6mm ply at the tail increasing to 1mm at the nose is suggested. It will result in a slightly smaller cross section fuselage but should not be noted at this scale. The wing stubs should be planked with 3mm balsa in any event. The wing stub planking to be fitted first supported inside of the fuselage by balsa items RRT and RRB then the fuselage planking can be added. A mix of micro balloons and resin is applied to created a variable fairing radius between wing stubs and fuselage surface. Radius shown on the drawings is only for reference. Before final assembly of parts do dry fit all items, and determine the order they need to be fitted. Some pre-assemblies of formers and parts are recommended.

The skid body is in-cooperated in the bottom of the front formers. The original must have been equipped with rubber blocks but are not visible because they are obscured with a fabric liner at the side of the skid. It is suggested to fill the skid space between formers with solid balsa, for extra strength. The skid itself is made of layers of 2 mm plywood laminated together . A thin steel liner or strips could be fitted for extra wear protection. All metal parts to be fitted with epoxy and bolts when shown. A fixed window behind the canopy opening is fitted to scale. The canopy vacuum plug provided has this fixed window included so the curved window surface matches the fuselage contour. When the fin/rudder assembly is fitted for the first time locate and glue F25A to the fuselage. Use bottom end of part FS of the Fin assembly as guide.. This will give the fin more stability



### Inner wing sections:

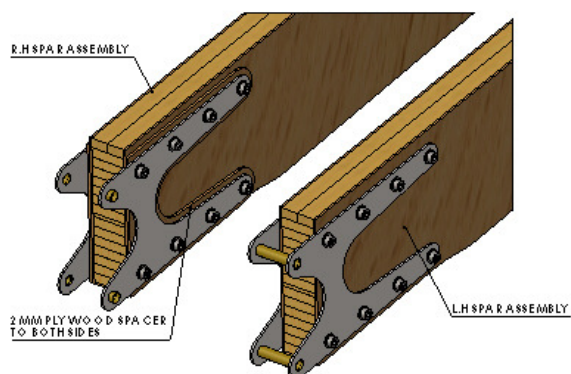
The inner wing sections are again traditional spruce, balsa, plywood construction. The main spar assemblies need to be built first and are shown on a separate drawing. If you have the work place space the inner wing main spar and outer wing main spar could be built in one session so one can check if they line up.

The width of the main inner spars is constant from root to the end where it joins the outer wing sections. They are a box section with spruce members to top & bottom and 1.5mm plywood sides with some internal stiffeners. The LH spar and RH spar are identical with the exception that the RH spar has 2 mm plywood spacers so the steel bracket can slide past each other see picture below . RH and LH is not critical The RH spar configuration can be used for the LH wing with the LH spar in the RH wing. Builder can add some carbon ribbon on the inside if deemed necessary. Builder to erect a frame to support the back of the main spar horizontally. The rib locations to be marked on the main spar and the ribs shifted in position on the spar from the outer end. If ribs are too tight on the spar then sand the front and or bottom surface of the spar assembly only. Do not attempt to open the rectangular holes in the ribs. The Spar support frame to support between the ribs say every 5 ribs. Assemble the wing together as much as possible before removing from the frame

The LE is an assembled plywood item that slots in to the ribs. The main ribs have the full contour and balsa blocks are fitted between the ribs, sanded into shape to support the Plywood planking. On the top & bottom of the main spar a minimum 12mm wide (1/2") balsa strip is fitted between the ribs to fill the gap between the main spar surface and underside of plywood planking.

The recommended ply wood planking is 0.6 mm, including cap strips. The top & bottom of the D-box should be planked in one go by folding the ply over the balsa LE. Do not attempt fitting ply sections of more than three (3) rib spacing's wide. A scarf joint in line with the 12mm wide balsa on top and bottom of the spar is required to continue ply planking to the rear where applicable.

All metal parts to be fitted with epoxy and bolts where bolt holes are provided in the laser cut items. Both top and bottom air brakes are both actuated by the same servo. If the layout is built as per drawing both air brakes will hinge at the same time with only a 1 degree difference at the maximum deflection of 60°. The RH inner wing assembly is mirror reverse except for the root end of the main spar as mentioned above



### Outer wing sections:

The outer wing main spars to be built first. The LH and RH are mirror reverse and cannot be switched to the opposite wing as with the main inner wing spars. With a span 2.5 m on the outer wing sections a 15mm carbon joiner is sufficient. The glass sleeves for the joiners to be made by the builder, both for inner and outer spars. The ply wood stiffeners inside the spar have little holes laser cut. This hole indicates the top side of the stiffeners only, the same goes for the stiffeners in the inner wing spars. As shown on the spar drawing the height of the spar top and bottom is reduced from 1/4" to 3 mm starting 990 mm from the spar end.

Building the outer wing is the same as the inner wing on a frame supporting the spar and sliding the ribs in place. The ailerons are Frise style as per full scale glider. This will take some building time but is worth the trouble on a model of this size. The idea behind Frise style ailerons is that by an up deflection the LE of the aileron moves below the wing bottom surface creating a bit more drag. The extra drag will help to turn the plane with less rudder deflection required.

The RH wing section is mirror reverse to the LH wing section

### Canopy:

A computer file to NC machine the plug required to vacuum form the canopy is available. As mentioned before this plug includes the fixed rear windows in the fuselage.

The canopy frame is made from 4mm plywood laser cut parts.

The frame on the canopy is simulated with 0.4mm plywood strips. The canopy frame should be built in the already available fuselage as template. There is only one picture I know of the original that shows the glider without the canopy. This suggests that the canopy was take off to get inside and was not hinged to the fuselage

Any retaining of the canopy to the fuselage is to the builders preferences.

### Rigging at the field:

An assembly drawing showing the rigging parts is included. The wing spar slides inside the fuselage and over fixed pins in the fuselage wing stubs. Floating incidence pins are required at the back. The Main spars are held together with two (2)  $\Phi 1/4"$  steel pins. Two (2)  $\Phi 1/4"$  shorter pins are inserted at nose of the wings inside the fuselage. There is no data how the full scale wings were attached but this setup was used on later gliders I am familiar with and should work well. On this size of model elastic bands are out of the question. The outer wing is fitted with a  $\Phi 15$  mm carbon joiner and two (2) incidence pins. Two (2) aluminium brackets slide into the outer wing and are then secured with M4 bolts in the bottom of the outer wing

As per golden rule of the full scale business, the horizontal stab/elevator is not fitted before the wings are fitted. The horizontal stab is secured in place with three (3) M5x90mm socket head bolts and washers, then the fin/rudder assembly is fitted with two (2)  $\Phi 8$ mm carbon rods and held in place by a M4 bolt in the fuselage. The pull-pull rudder cables to be fitted last.

Conclusion:

This is not a beginners model and will take some building time. Because of the size and weight of the model it can cause serious damage in case of a mishap. No short cuts on the construction during building to save time or money are worth the trouble.

An effort was made to create a complete as reasonable drawing set and instructions.

If the builder has a question or notes a mistake please contact me by e-mail only on

[jillessmits@gmail.com](mailto:jillessmits@gmail.com)

Jilles Smits

March 2018

