3D LabPrint

User Guide

rev. 2021/08

Fully 3d printable

WACO YMF-5

scale 1:6.5
wingspan 1442 mm / 56.8 inch

WACO YMF-5

fully printable R/C plane for your desktop 3Dprinter

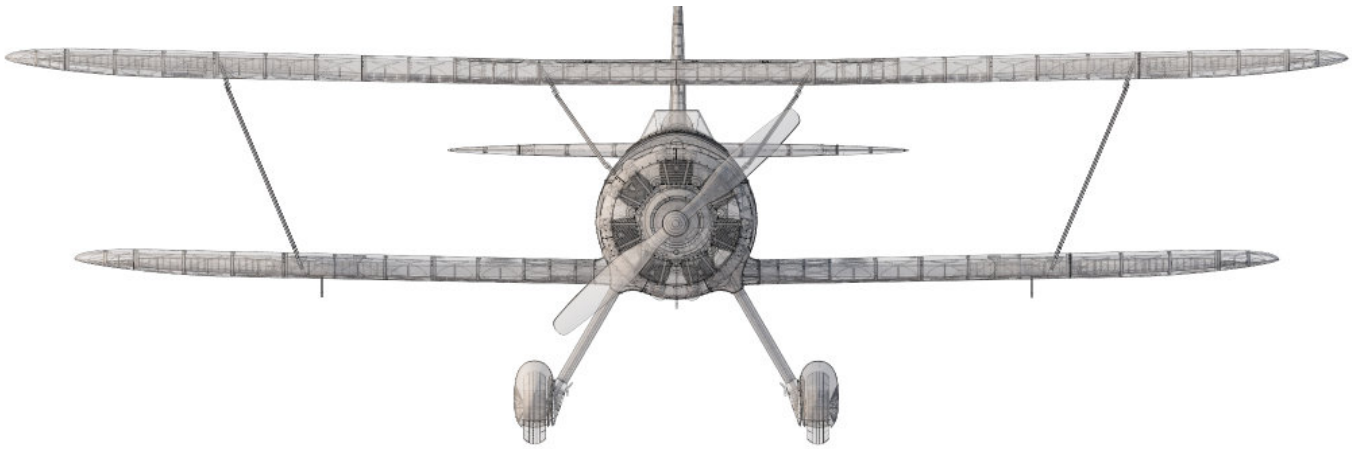
Fully 3D printable, cheap and easy to build RC model for everyday flying. Many scale details such as airframe plating or engine encourages to create realistic paint jobs. This plane has been designed for printing from PolyAir 1.0 or normal PLA filament.

The first fully printable airplanes with files prepared for your 3Dprinter, with flight characteristics, comparable or even superior to classic build model airplane.
This is not a dream, now you can print this HI-TECH at home. Simply download and print the whole plane or spare parts anytime you need just for a cost of filament.

Extensive hi-tech 3d structural reinforcement making the model very rigid while maintaining a lightweight airframe and exact airfoil even it's just a plastic. This perfect and exact 3d structure is possible only thanks to additive 3dprinting technology. So welcome to the 21st century of model flying and be the first at your airfield.

Easy to assembly, you don't need any extra tools or hardware, just glue printed parts together and make pushrods for control surfaces. The rest of the assembly is very easy. Simply add brush-less motor, ESC, servos and radio system. Don't worry, detailed step by step PDF/VIDEO is included.

You'll get a superb performing airplane with highly efficient power-plant capable of flying 7+ minutes at full throttle and speeds exceeding 65 kph. Low stall speed is achieved for easy landing on the other hand.



General specifications (HP setup):

Wingspan:	1442 mm / 56.8 inch
Lenght:	1094 mm / 43.1 inch
Height:	433 mm / 17.0 inch
Wing area:	54,5 dm2 / 7.0 square foot
Wing loading:	59 g/dm2 / 19.0 oz/square foot
Center of gravity:	120 mm from leading edge of upper wing
Airfoil:	special LHK mod. by 3DLabPrint
Print weight (PLA):	2358 g / 83.2 oz
Empty weight (w/o battery):	2800 g / 98.7 oz
Takeoff weight (6s 2700 lipo):	3230 g / 113.9 oz
Max takeoff weight:	3500 g / 123.46 oz
Never exceed speed, VNE:	100 km/h / 49 mph
Design maneuvering speed, VA:	60 km/h / 31 mph
Stall speed, VS:	25 km/h / 9.4 mph

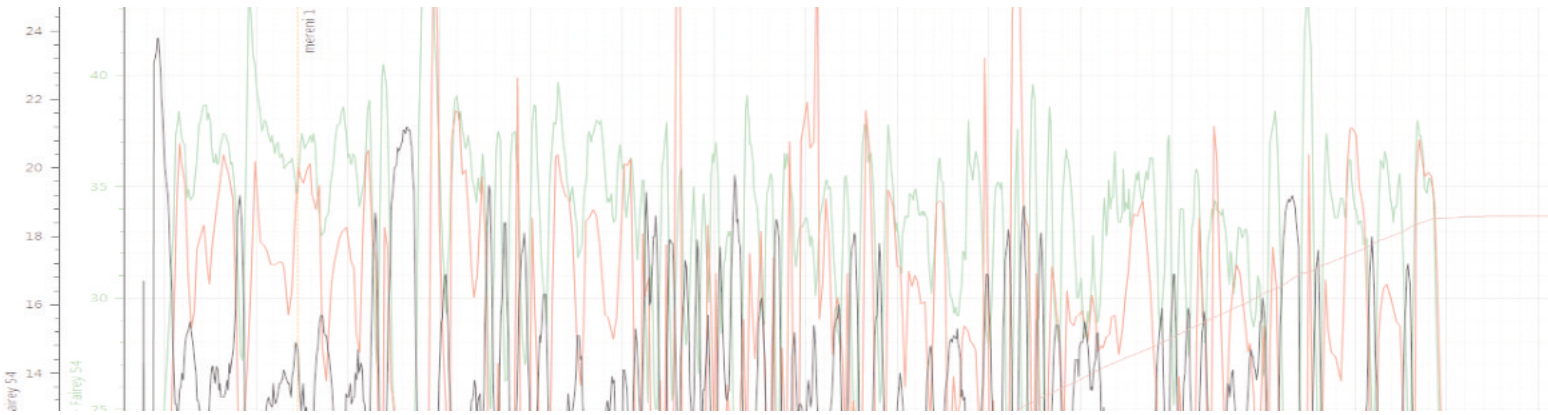
Recommended setup

Motor:	Turnigy SK3 5055 430KV (for 6S setup)
	or any 5055 430 - 380grams motor (for 6s setup)
ESC:	80A 6s with UBEC or any 6s 60-100A + connector suitable for battery.
Battery:	2700 - 3300 mAh 6S or any 6s (500-600g)
Propeller:	wooden 15" x 6"

printed PET motor mount

Performance measurement

Max speed VH (level flight):	65 km/h – 35 kn – 40 mph with wooden 15 x 6
Rate of climb:	5 m/s (960 ft/min) with wooden 15 x 6
Flight time (6s 2700mAh):	12:30 with wooden 15 x 6



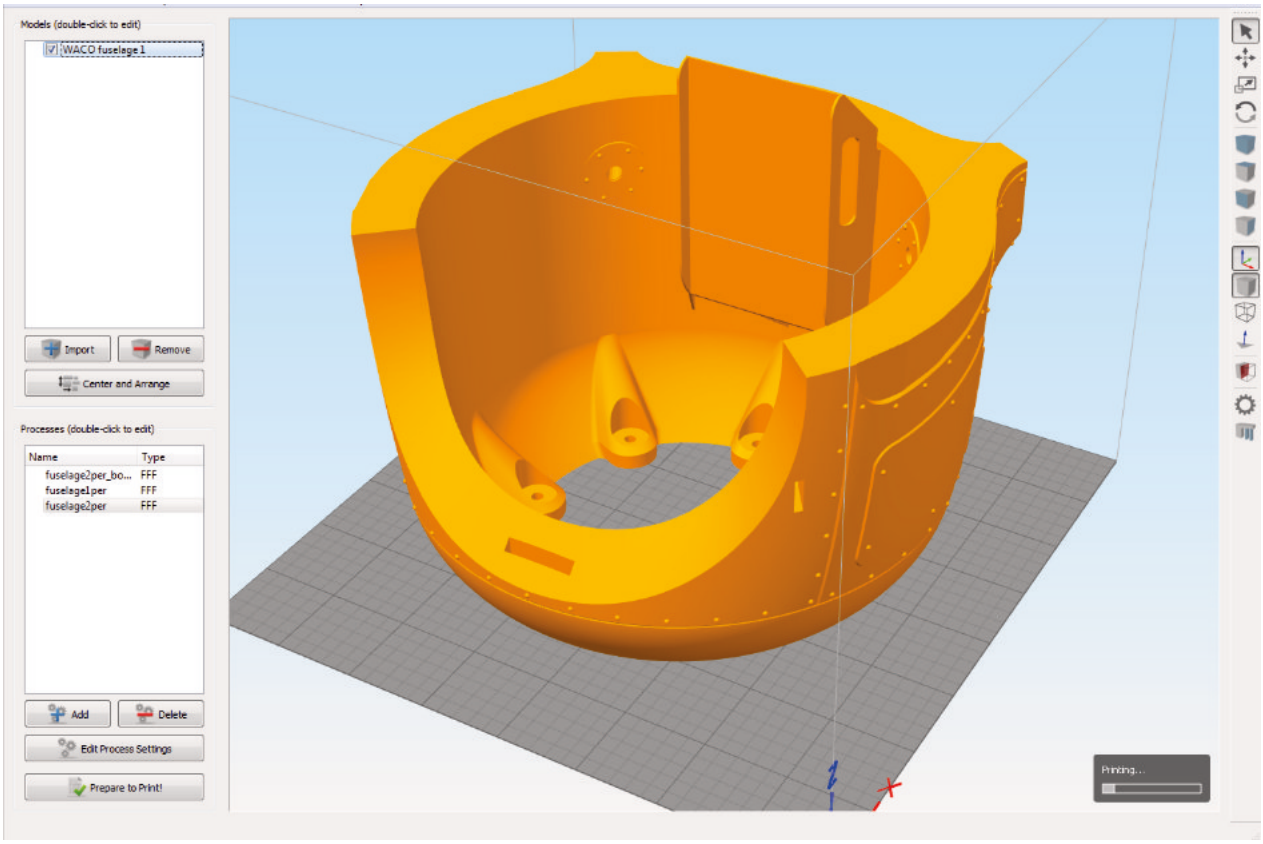
WACO YMF-5, History

The Waco Aircraft Company (WACO) was an aircraft manufacturer located in Troy, Ohio, United States. Between 1920 and 1947, the company produced a wide range of civilian biplanes. The ‚F' series was popular with private owner pilots for sporting and other uses and continued in production through the late 1930s.
The 1934 model YMF was substantially redesigned with a longer and wider fuselage, larger rudder and other structural changes, and put into production in March 1986 by WACO Classic Aircraft of Lansing, Michigan as the YMF-5. Over 150 YMF-5s were completed as of 2017 with new examples being built to specific orders.
Considerable numbers of „F" series biplanes, both original and newly built, remain in service.

Included:

1. STL 3d files

Universal STL files designed to be used with desktop FDM 3d printers and slicer software as Simplify3D (recommended), CURA or MatterControl



2. Factory files for Simplify3D slicer - preffered

contains all the necessary settings to slice the models along with suggested bed layout. We're using PRUSA i3 ORIGINAL printers so you may need to adjust the basic printing parameters to match your printer or use these files as a start point for you. Please check the Simplify3D

3. Step By Step PDF/VIDEO userguides

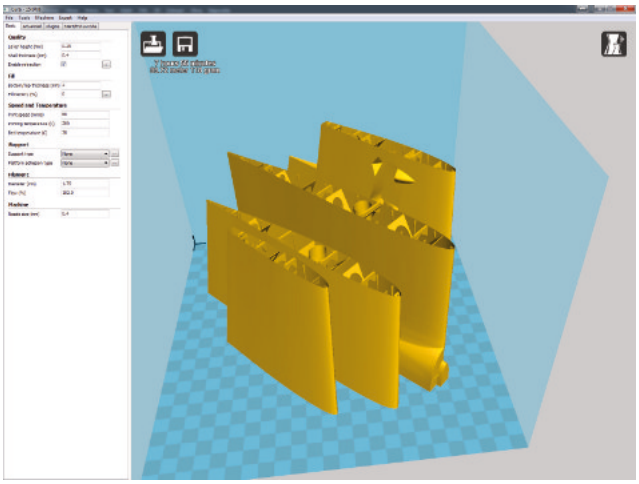
Apart from this userguide, please see the Printing Guide to find some Tips and Advice for airplane printing (Thin Wall Printing).

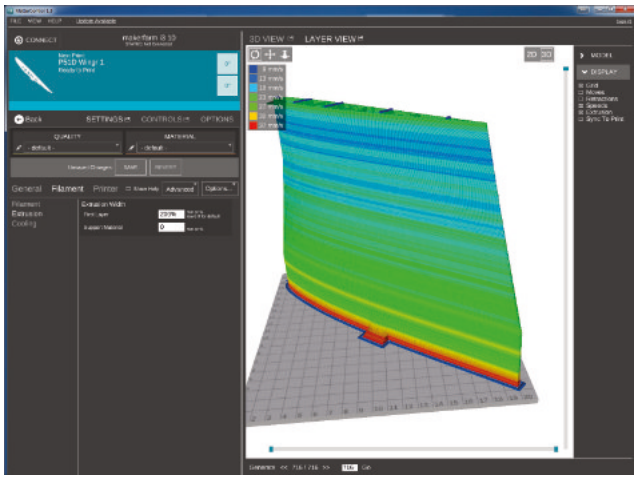
4. Gcodes

Basic Gcodes prepared for direct use, as universal as possible. Should work on i3 style printers with direct-drive extruder. Give it a try, but we can't guarantee it will work on your printer.

5. Slice on your own with CURA or MatterControl slicers

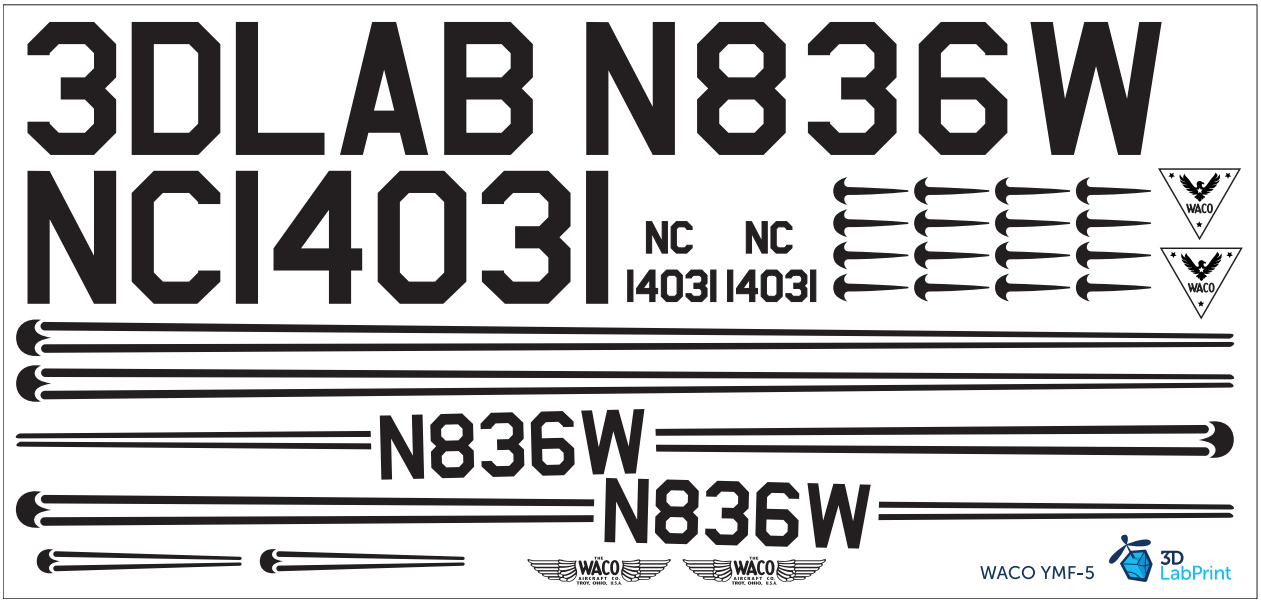
If you for any reason don't like Simplify3D, there is always option to use another free slicer Please follow our Cura guide in the Help section of the website where you can find the basic single-wall profile.

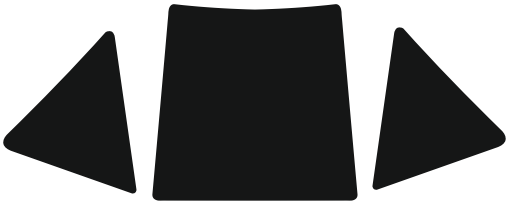




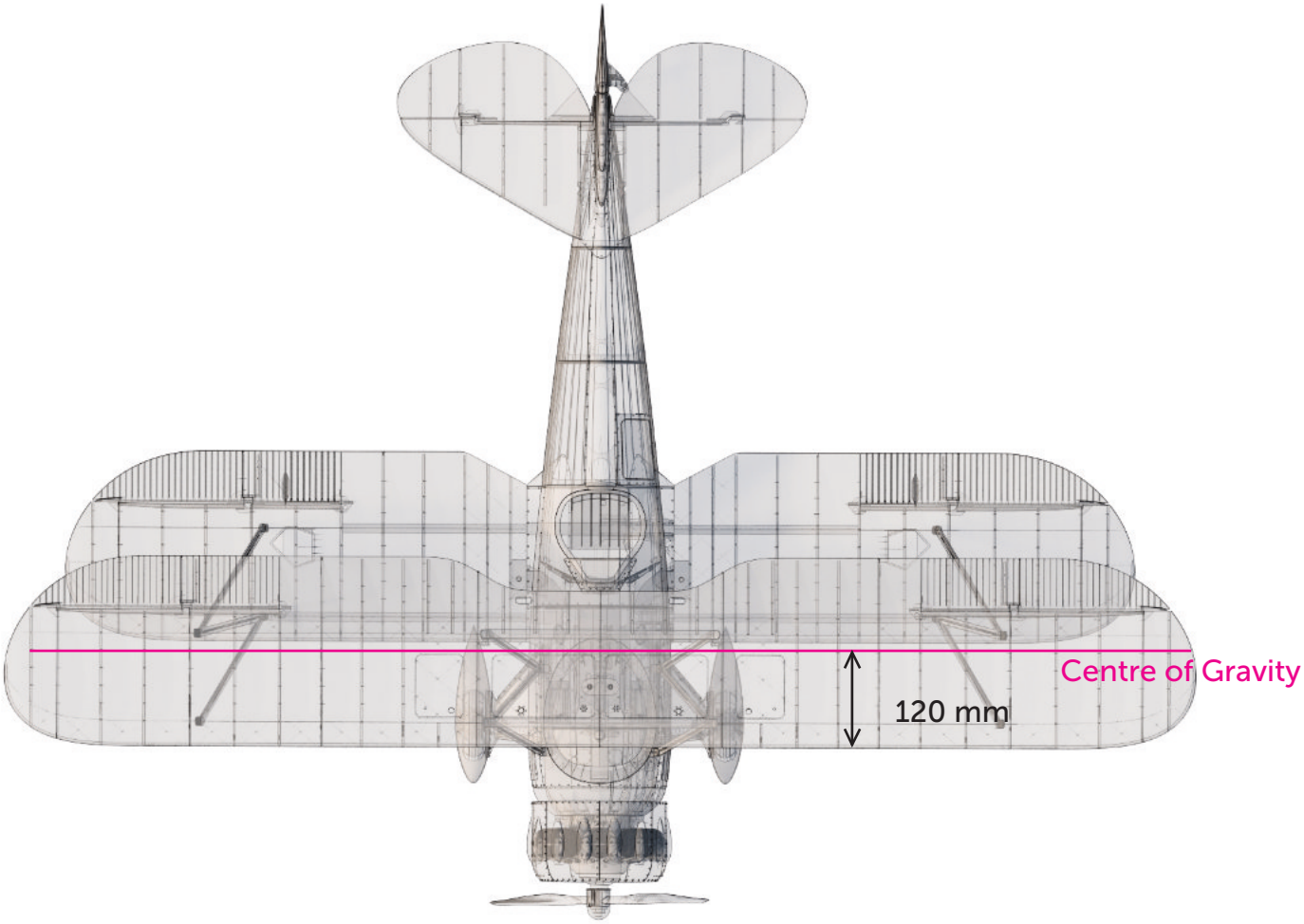
6. Scale markings PDF

You can cut the decals from a self adhesive vinyl foil, create stencils or use any other favorite method of decorating the model.

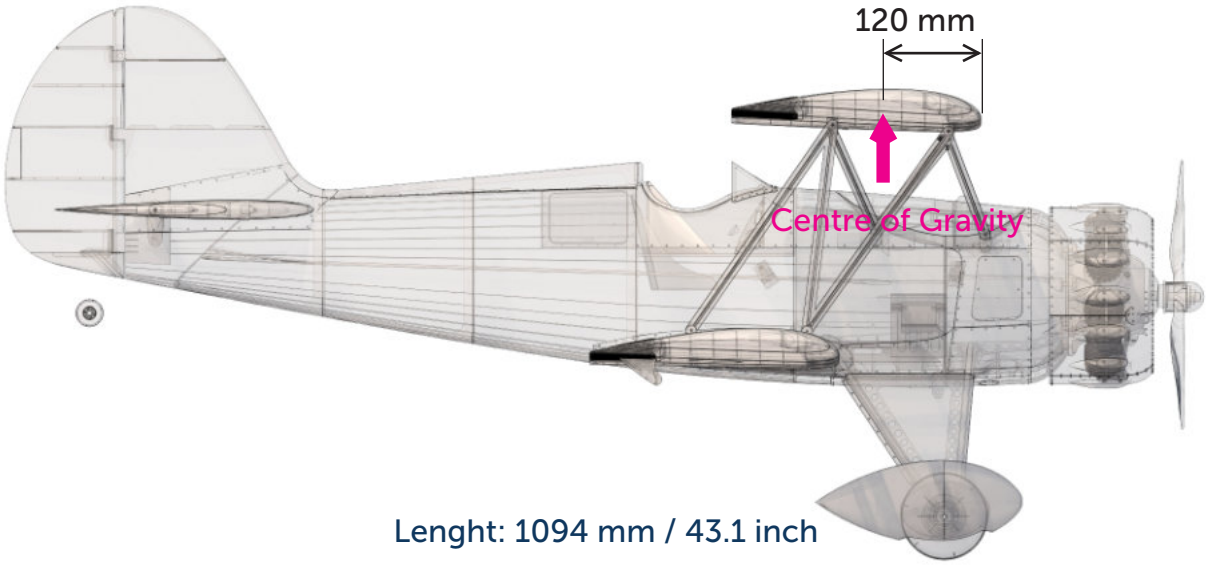




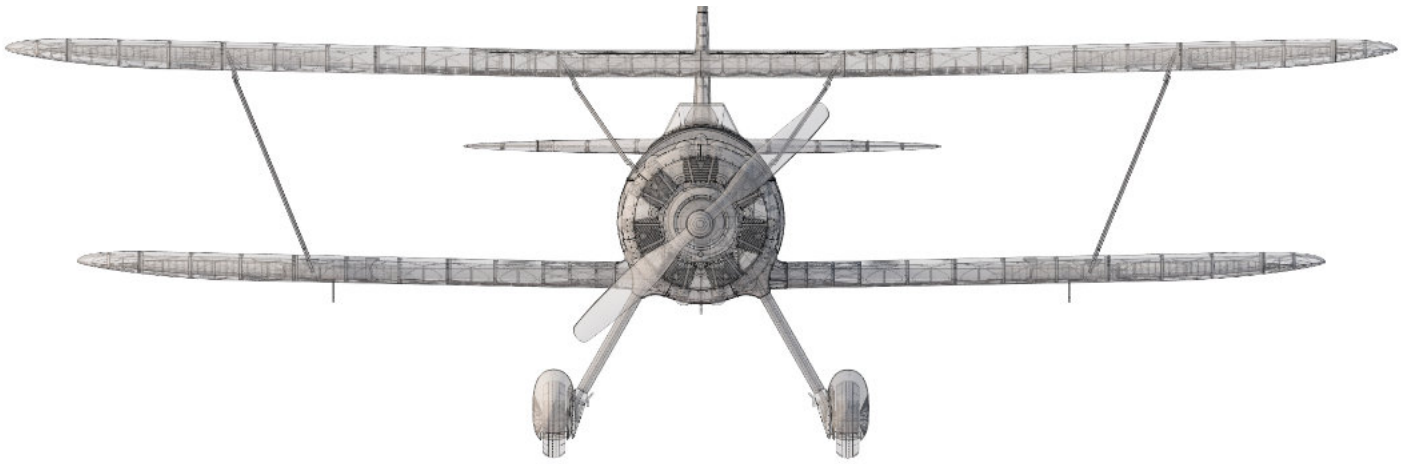
WACO YMF-5



Wing area: 54,5 dm2 / 7.0 square foot



Lenght: 1094 mm / 43.1 inch



Wing span: 1442 mm / 56.8 inch

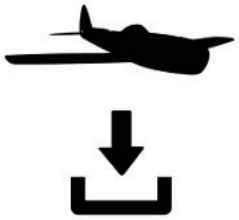
Step By Step PDF/VIDEO userguide

1. Choose airplane at www.3Dlabprint.com, visit our Facebook for latest info.

Basic requirments for WACO YMF-5 are 195/195/195 mm volume, nozzle 0.4mm recommended (0.35 or 0.5mm alternativelly). Heated bed recommended. Designed to be printed with PolyAir 1.0 (recommended) or regular PLA filament.
Contact: support@3dlabprint.com

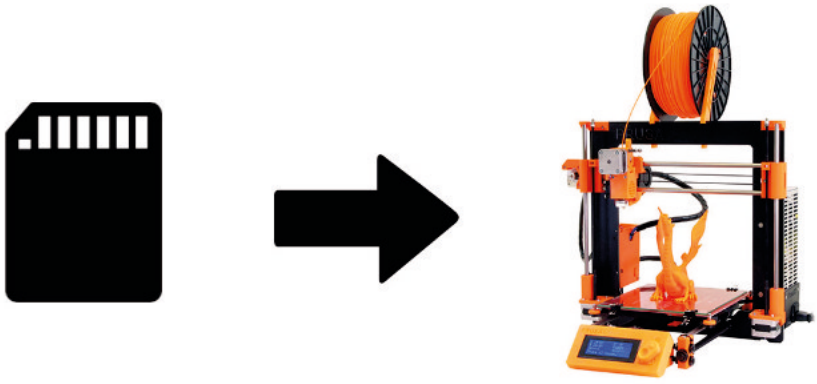
2. Create account, download

You will receive download link to all the zipped files to your email (please check your spam folder if not) or you can log in to your account and download directly from our websites.



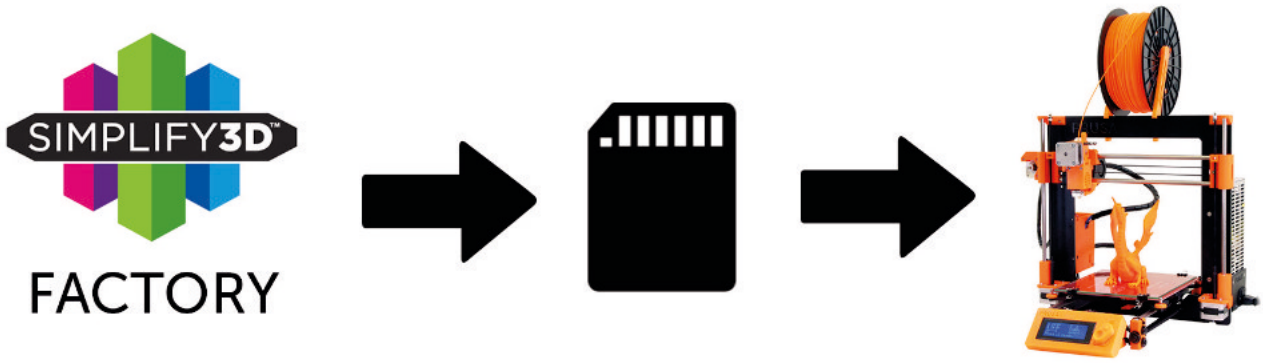
3. Gcodes preparing

option A Gcodes:
if your printer is i3 comptatible you can use prepared gcodes directly. Just save them to the SD card and let the 3d printer do it's job. HE temperature is set to 230°C so the layers fuse together well, you can adjust speed and temperature only through your printer's LCD. If these Gcodes does not work for you, please proceed to the next options.



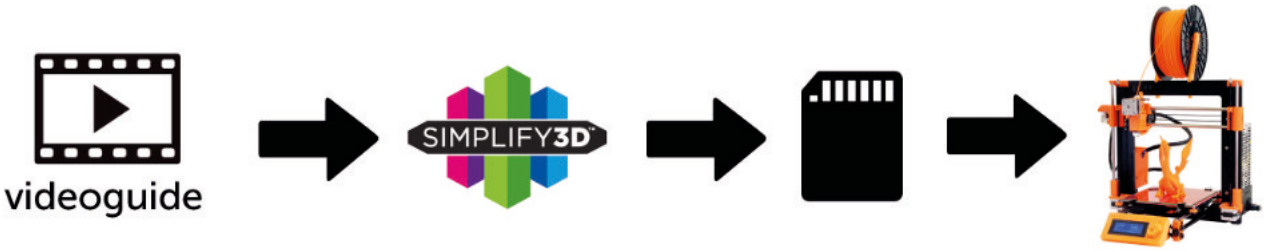
option B Factory files Simplify3D (recommended):

We prepared all you need in these files (FFF process settings, parts layout on bed, etc...)
You can use these settings as a start point. Adjust according to your need (adapt for your printer), print single parts and so on... Most 3d printers should work just with these settings, but please go through the settings and amend if necessary, we are not liable for any damage resulting from using our settings. If this still does not work for you, please proceed to the next option.



option C Simplify3D manual setting (watch and learn):

Use our Simplify3D reference guide for proper setting... this is very good option and you will learn a lot about Simplify3D and become an 3d printing expert.

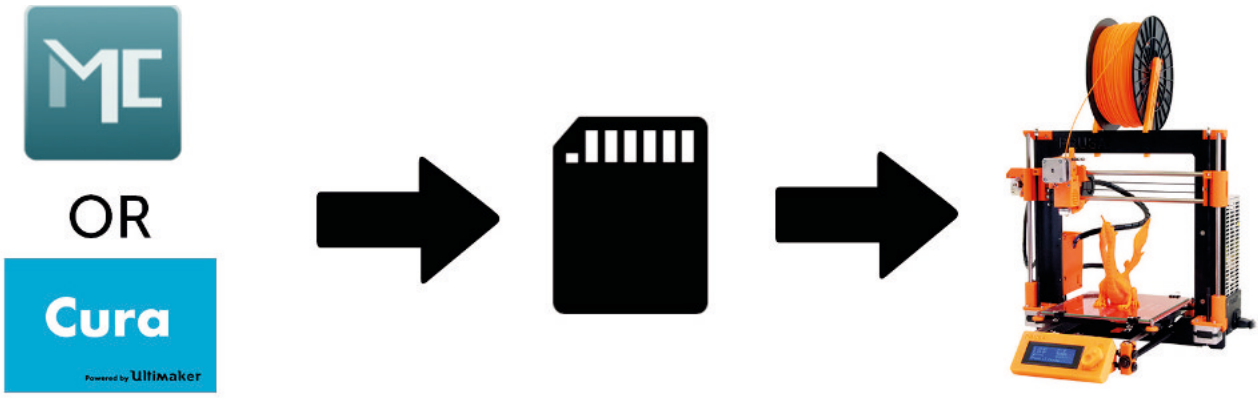


option D CURA

CURA is a free software and provides similar results. Expect a steeper learning curve, as you need to figure out the settings for your printer.

Please check our CURA guide on the website for the latest basic profile. Please visualise our presliced gcodes to see how the result should look like and try to achieve the same in your slicer.

Please try to find the best extrusion multiplier and temperature for good weight and best possible layer bonding. Consult the parts weight list for proper multiplier settings.
As a starting point you can use our predefined CURA profile available in the Help section on the website. Always adapt for your printer, change build volume, filament diameter, etc...

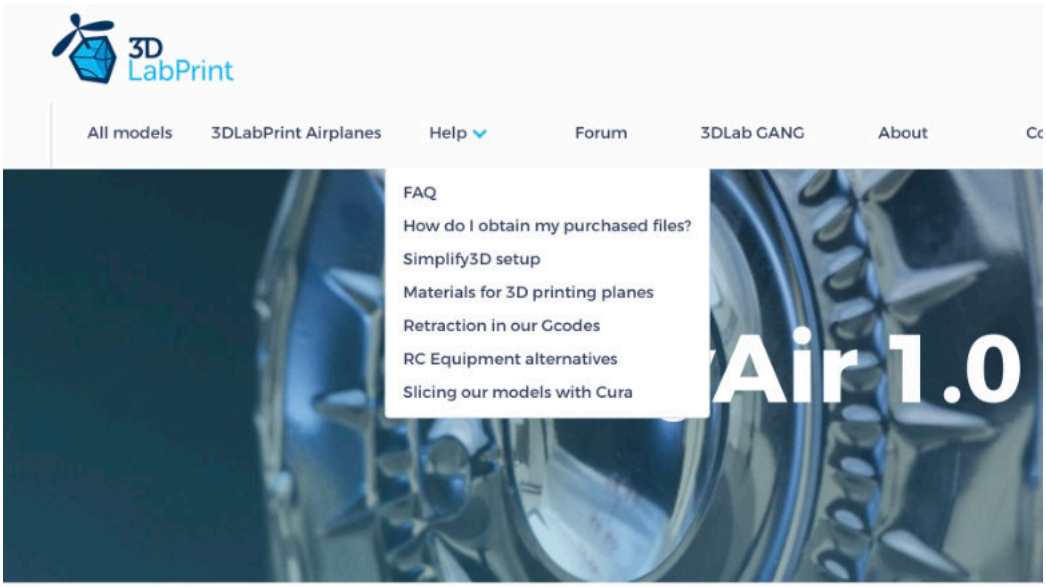


4. Print it

Save the Gcodes to the SD card and insert into your printer. Prepare your printer and start printing, we prefer to use SD card rather than direct USB connection. Scaling the model will lead to unusable result!

you will need: Polyair 1.0 or any PLA filament
3DLac, Strong hair spray, PEI or your favorite adhesive bed surface
Razor blade

Please see the Help section at 3dlabprint.com:



WACO YMF-5 weights of printed parts (PLA)

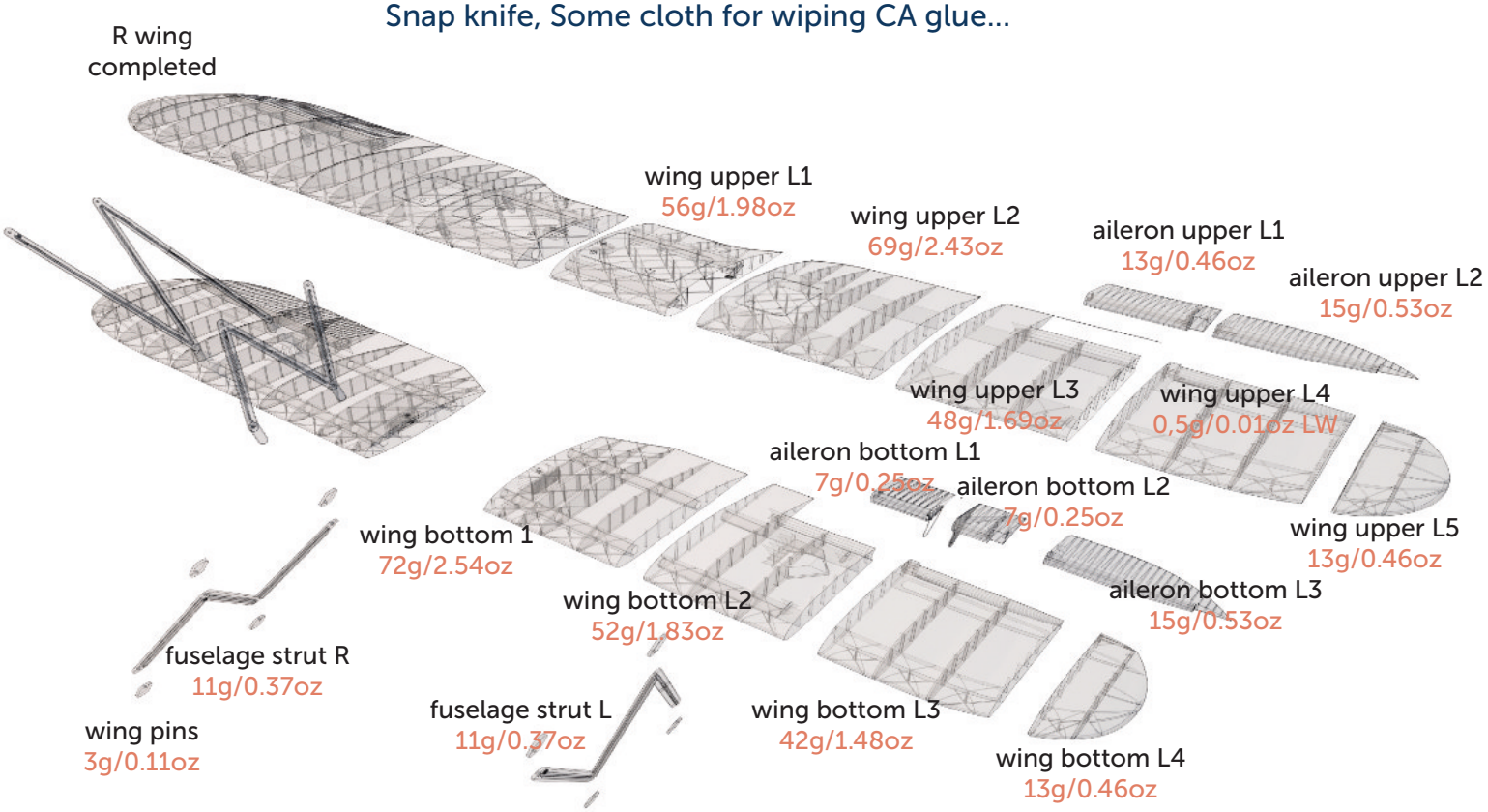
fuselage		
F1	124 g	4,37 oz
F2	138 g	4,87 oz
F3	119 g	4,20 oz
F4	78 g	2,75 oz
F5	55 g	1,94 oz
F6	73 g	2,57 oz
fuselage cover 1	13 g	0,46 oz
fuselage cover 2	22 g	0,78 oz
fuselage cover lock	4 g	0,14 oz
fuselage engine cowl	55 g	1,94 oz
engine case	75 g	2,65 oz
engine valves	80 g	2,82 oz
fuselage struts (pair)	21 g	0,74 oz
fuselage pins	5 g	0,18 oz
wings		
wing upper L1	56 g	1,98 oz
wing upper L2	69 g	2,43 oz
wing upper L3	48 g	1,69 oz
wing upper L4	42 g	1,48 oz
wing upper L5	13 g	0,46 oz
wing upper R1	56 g	1,98 oz
wing upper R2	69 g	2,43 oz
wing upper R3	48 g	1,69 oz
wing upper R4	42 g	1,48 oz
wing upper R5	13 g	0,46 oz
wing bottom L1	72 g	2,54 oz
wing bottom L2	52 g	1,83 oz
wing bottom L3	42 g	1,48 oz
wing bottom L4	13 g	0,46 oz
wing bottom R1	72 g	2,54 oz
wing bottom R2	52 g	1,83 oz
wing bottom R3	42 g	1,48 oz
wing bottom R4	13 g	0,46 oz
aileron upper L1	13 g	0,46 oz
aileron upper L2	15 g	0,53 oz
aileron bottom L1	7 g	0,25 oz
aileron bottom L2	7 g	0,25 oz
aileron bottom L3	15 g	0,53 oz
aileron upper R1	13 g	0,46 oz
aileron upper R2	15 g	0,53 oz
aileron bottom R1	7 g	0,25 oz
aileron bottom R2	7 g	0,25 oz
aileron bottom R3	15 g	0,53 oz
wing struts (pair)	40 g	1,41 oz
wing pin	3 g	0,11 oz
tail		
horizontal stabiliser L1	22 g	0,78 oz
horizontal stabiliser R1	22 g	0,78 oz
vertical stabiliser 1	11 g	0,39 oz
vertical stabiliser 2	6 g	0,21 oz
elevator L1	19 g	0,67 oz
elevator L2	11 g	0,39 oz
elevator R1	19 g	0,67 oz
elevator R2	11 g	0,39 oz
rudder 1	7 g	0,25 oz
rudder 2	5 g	0,18 oz
rudder 3	15 g	0,53 oz
rudder 4	9 g	0,32 oz
rudder 5	2 g	0,07 oz
gear		
gear legs cover (pair)	51 g	1,80 oz
gear center head fairings (pair)	40 g	1,46 oz
gear junctions (pair)	30 g	1,06 oz
gear pants (pair)	60 g	2,12 oz
gear disc (pair)	32 g	1,13 oz
gear tyre (pair) FLEX	114 g	4,02 oz
tail wheel disc	1 g	0,04 oz
tail wheel tyre FLEX	4 g	0,14 oz
accessories		
motor mount	25 g	0,88 oz
instrument panel	5 g	0,18 oz
wind shield	4 g	0,14 oz
printed weight	2358 g	83,18 oz

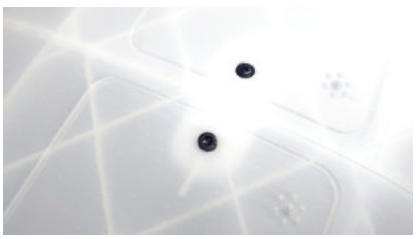
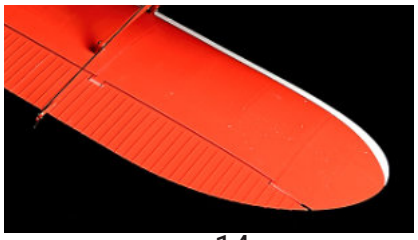
5. Assembly of printed parts
5.1 Wing assembly WACO YMF-5

Glue wing parts L1-L5 perfectly together. The new 3DLabPrint joint system will help you. Repeat for the right side. Repeat it for bottom wing the same. Use the thin CA glue, and use activator to speed up the glue curing. On a flat surface glue the ailerons L1-L3 and repeat for the right side. Use a suitable 1,2 mm - 1,5 mm carbon rod or wire as a hinge for the ailerons. Wings are fitted on 10 mm diameter carbon fibre tubes, top wing 2x 780 mm, bottom wing 2x 610 mm. Press M3 nuts into the top wing safety pin and fit them to the wings in a right position. Glue the pins after you check the proper alignment.

See video guide Wing Assembly

you will need:
CA Glue medium viscosity + activator
1,2 - 1,5 mm carbon, fiberglass or steel wire for aileron hinge
2pcs of 10 mm carbon tube 780 mm (upper wing)
2pcs of 10 mm carbon tube 610 mm (bottom wing)
3x M3 nut, 3x M3x20 screw + 2mm self screw
Snap knife, Some cloth for wiping CA glue...



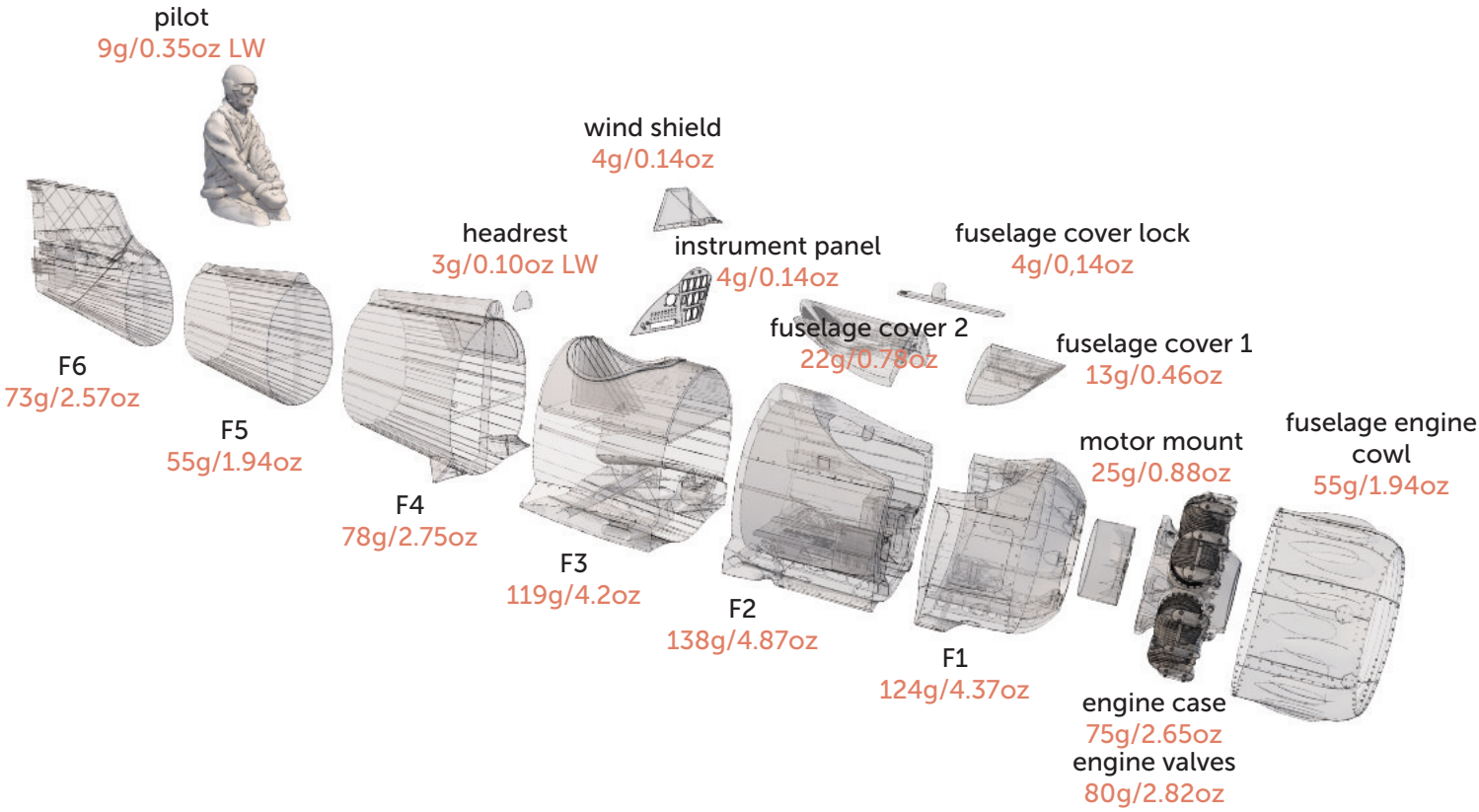




5.2.1 Fuselage assembly WACO YMF-5

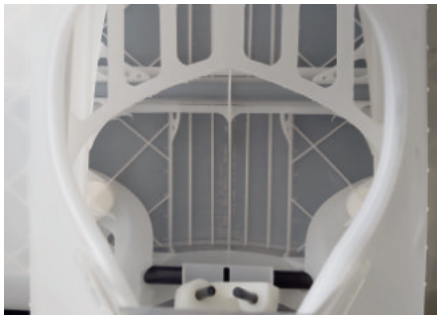
You can use snap knife for cleaning the surface of printed parts, but mostly it is not necessary. Glue fuselage parts F1-F6 with thin CA glue together. The new 3DLabPrint joint system will help you. Check the perpendicularity of part F6 to the wing mounting carbon tube in the parts F2 and F3 before gluing.
For fuselage cover lock use a ball pen spring. Put it to the part 2 and glue with part 1 together. Assemble the scale engine replica. Slide a cowling onto cylinders and glue the assembly. The scale engine replica is fitted with M4x20 bolts and nuts. Fit the optional scale accessories, such as seat, headrest, instrument panel, windshield, pilot, ...

See video guide Fuselage Assembly

you will need: CA Glue medium viscosity + activator
Snap knife or Sandpaper
1x ball pen spring




fuselage cover with installed lock

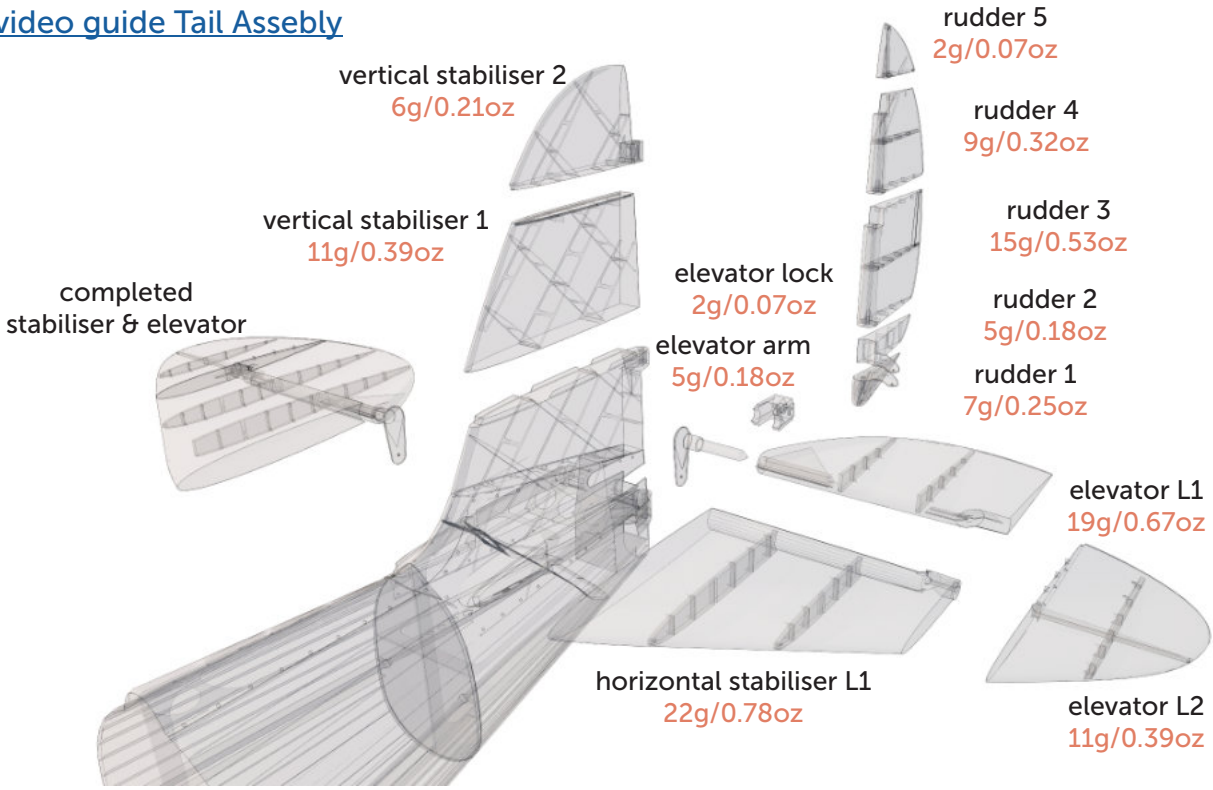


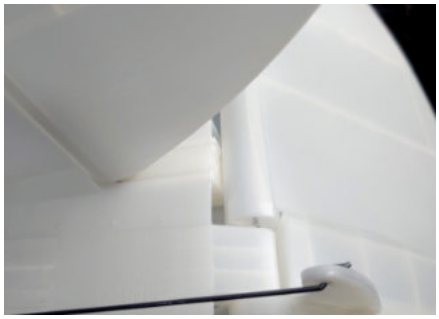
5.2.2 Fuselage tail - elevator pushrods and servos

Glue vertical stabiliser 1 & 2 to the fuselage. Glue all parts of rudder together. Glue L1 and L2 parts of the elevator. The profile is symmetric, so the left and right sides are identical. Glue elevator arm together and smooth the surface with sand paper (you can use drill). Glue the horizontal stabilizers perfectly perpendicular to the fuselage. Make a Z bend on the elevator pushrod wire. Repeat it for rudder pushrod wire. Mount the elevator assembly to the stabilizer using the 1,2 - 1,5 mm carbon rod or steel wire. Glue elevator lock to the fuselage. Mount the rudder assembly to the vertical stabilizer using the 1,2 - 1,5 mm carbon rod or steel wire. Elevator and rudder should move freely controlled by the pushrod and servo. Check the functionality of the elevator and rudder assembly.

you will need: CA Glue medium viscosity + activator
1 - 1.2 mm steel wire for elevator and rudder pushrod
1,2 - 1,5 mm carbon or steel wire for elevator and rudder hinge
Snap knife

See video guide Tail Assebly





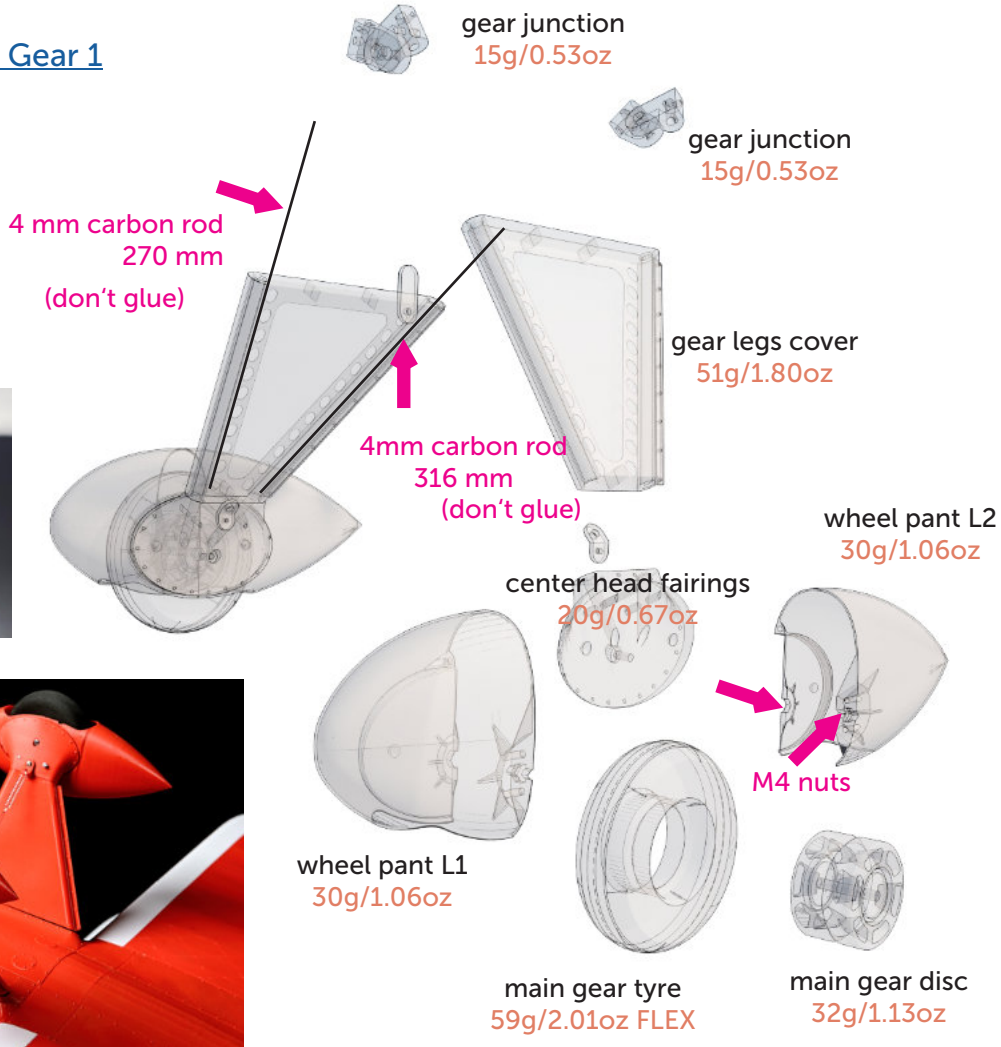
5.2.3 Fuselage gear

The landing gear is designed as dry assembled system consisting of 4mm carbon rods. In case of mishap during landing, the damaged parts can easily be replaced. Insert M3 nut in between the wheel cover parts and glue them together. You can use toothpicks for proper alignment. Insert M3 nuts holding the wheel axle and glue center head fairings to assembled boots. Slide the assembly onto 4 mm carbon fibre rods lenght 316 mm and 270 mm along with gear legs covers into the fuselage. Don't glue the rods into the fuselage. Secure the carbon rods with screws, fit and assemble the holders. Assemble the wheels discs and tyres and secure them inside boots using M3x30 bolts. You can add a scale wire spring system, but it's not necessary for correct function.

you will need:

CA Glue medium viscosity + activator
4 mm carbon rod, 2pc 316 mm, 2pcs 270 mm
2x M3x30mm screws
6x 3x20mm self tapping screws
4x M3 nuts
optional: spring and wire or rubber band

See video guide Landing Gear 1

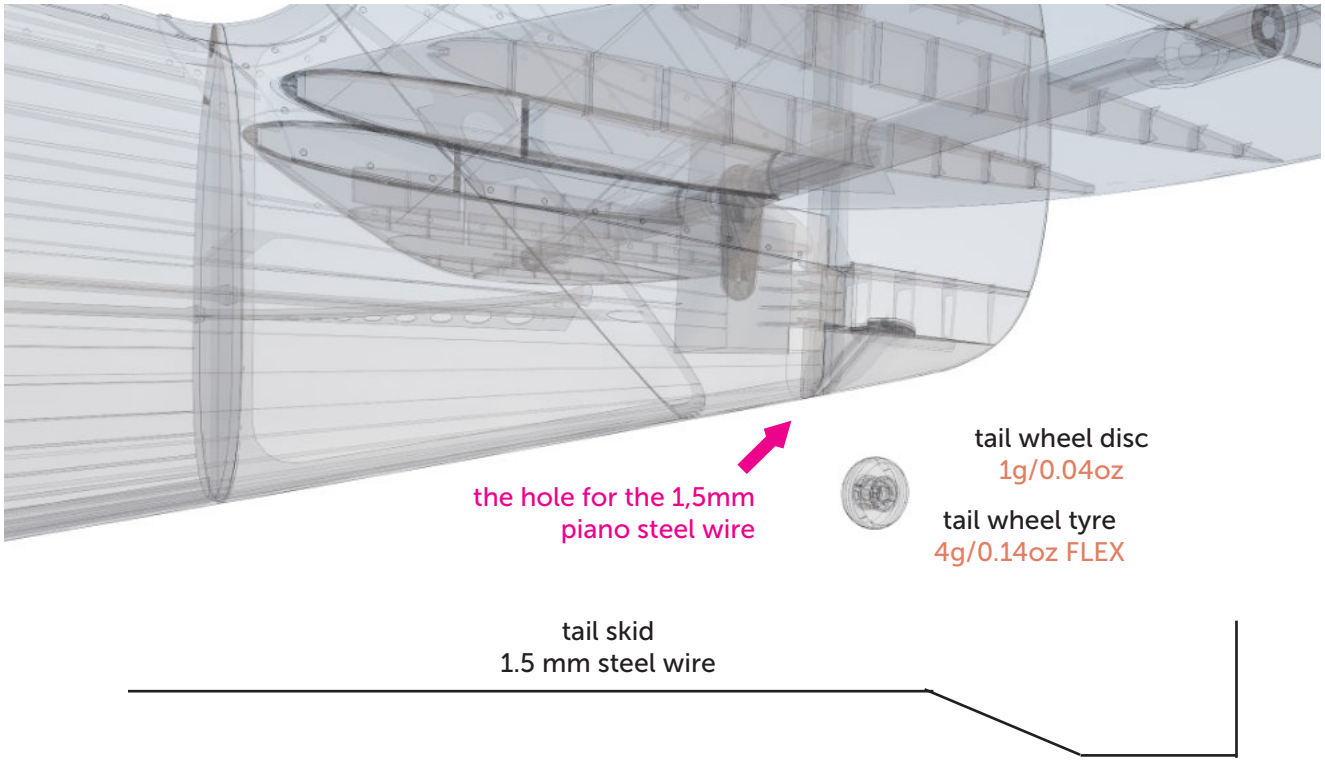


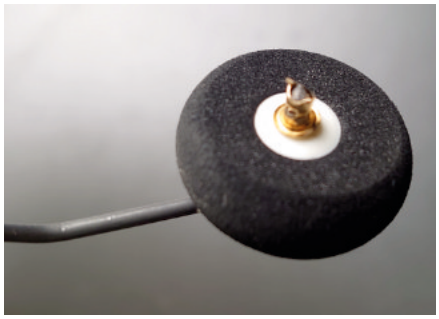
5.2.4 Fuselage tail wheel

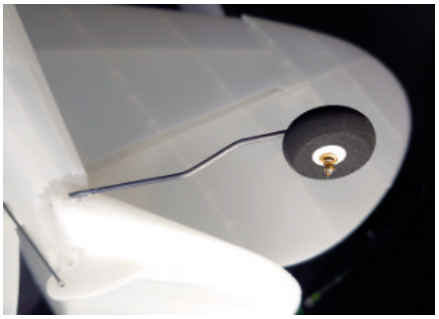
The tail gear is just a simple tail-drag assembly consisting from 1.5-2 mm piano wire bent to a shape and printed wheel. Use pliers to bend the piano wire to a desired shape. Secure the wheel using a collar. Insert the assembly into the hole in the rudder. Bend the wire to the rear and make sure the wheel is aligned with the rudder. Glue the wire into the rudder well.

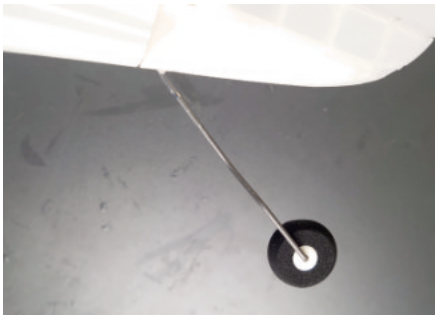
you will need: 1.5-2 mm piano steel wire ~150mm
Pliers
Any small wheel

See video guide Landing Gear 2









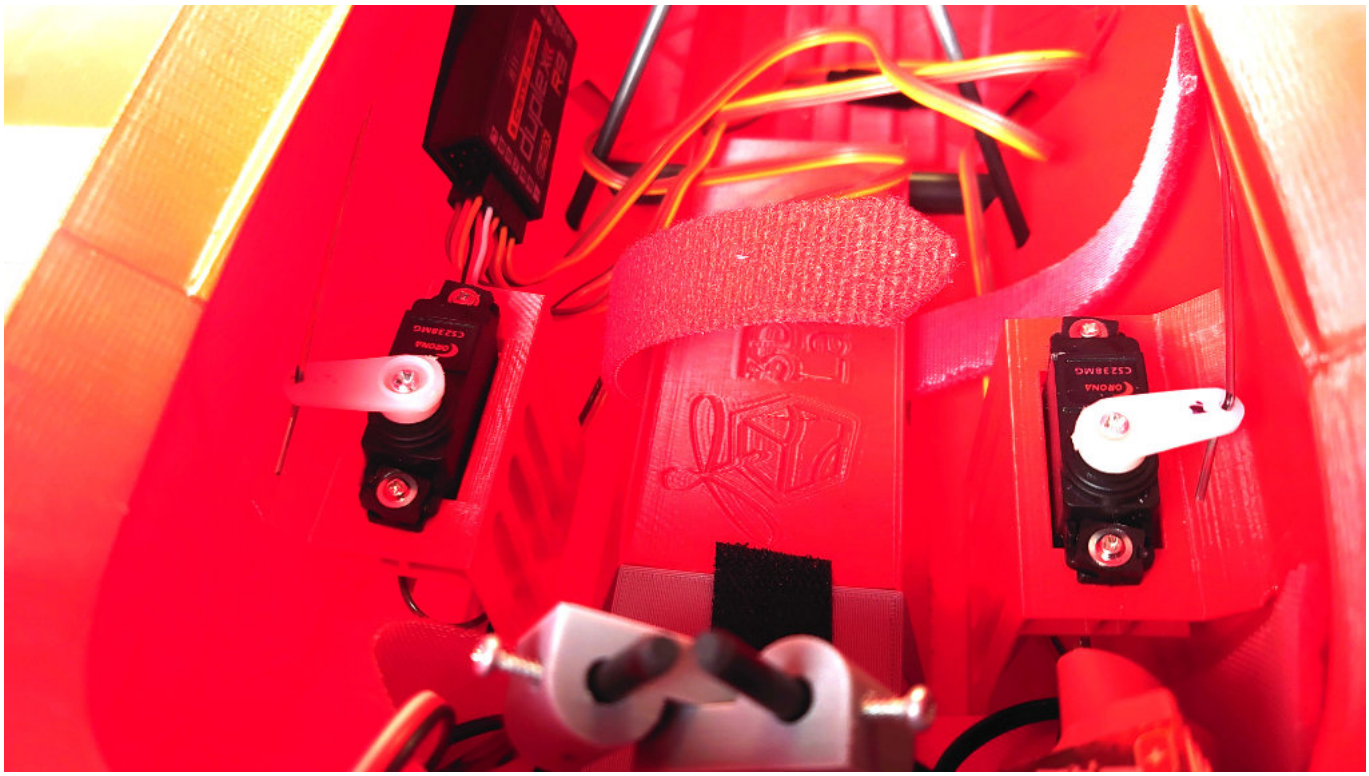
6. Servo installation

Install the prepared servos to the wing servo bays. Use a 1.2 mm steel wire with Z bends as a linkage between the servos and aileron control horns. Elevator and rudder servo will be fixed directly to the fuselage by included screws.

See video guide Servos installing 1
See video guide Servos installing 2

you will need:

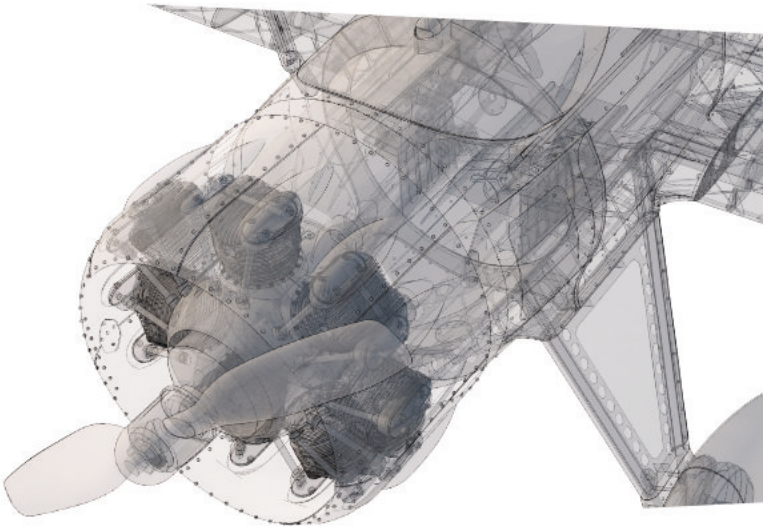
4x Hitec HS-82MG or Corona CS-238MG
or any similar sized servos
30x12x30mm (1.17 x 0.47 x 1.16 inches)
2x servo extension cables 300mm / 12 inch
Snap knife, Z pliers
1.2 mm steel wire



7.2 Fuselage - motor mount & ESC & battery holder

The scale engine replica must be mounted in a certain position marked with TOP mark. Assemble the printed motor mount (16 x 19 mm) with motor, propeller. Mount the motor using 4x M3 screws and nuts to the printed universal motor holder. For long motors you can flip the holder to the front (as at picture). The whole set push to the fuselage, check the gap between fuselage cowl and propeller. Simply glue it from back side. Glue universal motor mount with motor into the fuselage in right position. Fix the battery (400g+ pack needed) by velcro tape and mount it in the front of the fuselage, find the perfect balance and CG position by moving it.
See video guide Motor Mount

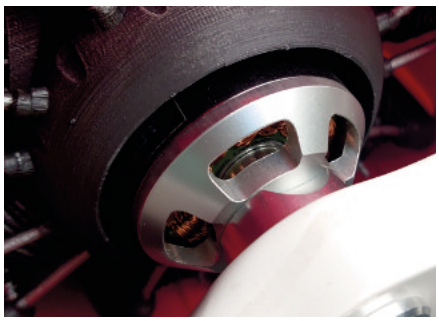
you will need: CA Glue medium viscosity + activator
4x M3 screws and nuts
7x self tapping screws 3.5/15mm



WACO setup - (1000W)

Motor: 5055 430KV , or any 5055 430 - 380grams motor (for 6s setup)
ESC: 80A 6s with UBEC or any 6s 60-100A + conector suitable for battery.
Battery: 3300mAh 6S or any 6s (500-600g)
Propeller: wooden 15"x8", 14"x8"
printed PLA or PETG mount 16 x 19 mm

motor mount
25g/0.88oz
PLA or PETG

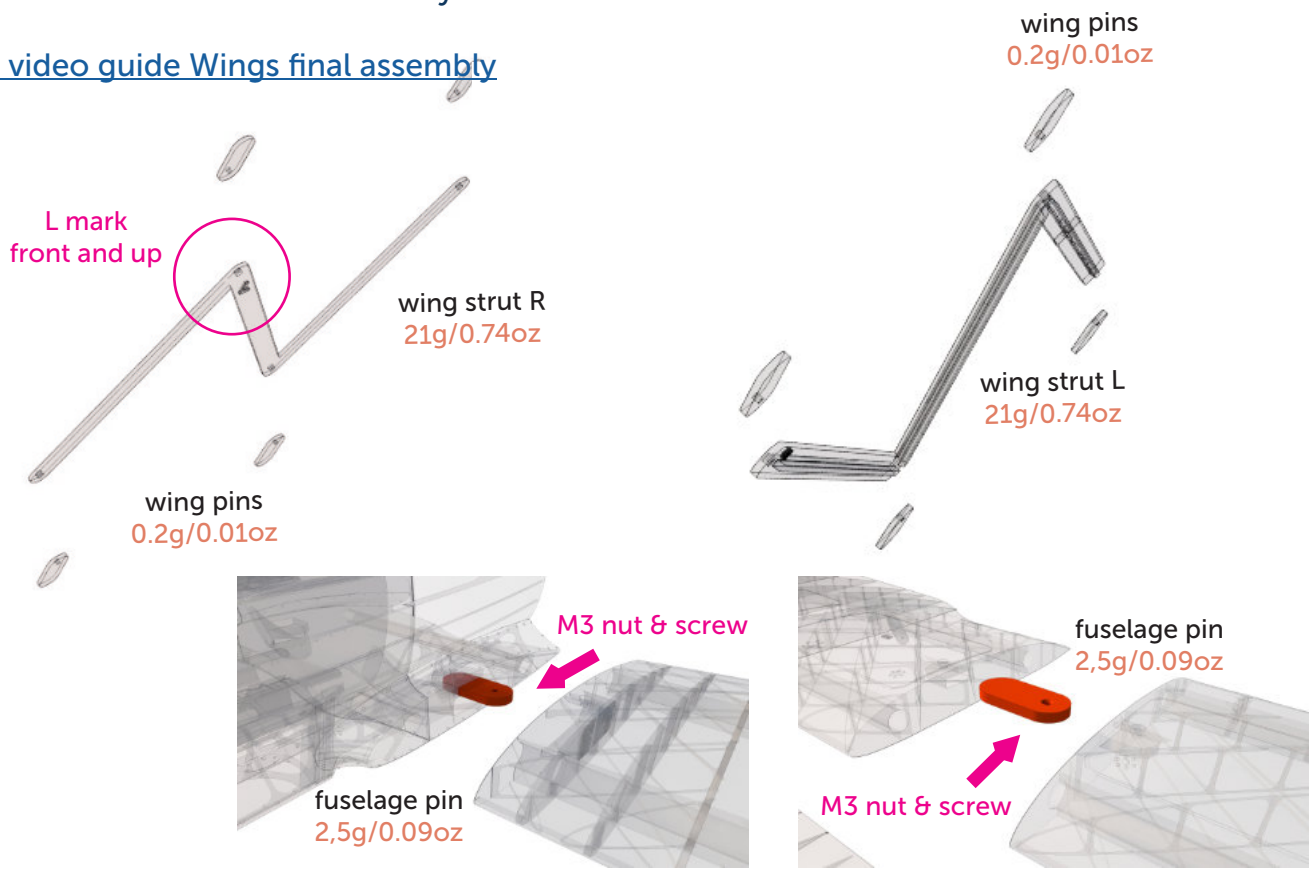


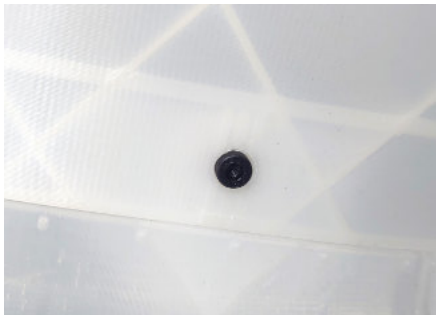
7.3 Fuselage and Wing struts - Final assembly/setting

Mount all pins at fuselage and wing struts. All pins are the same. Use 2 x 8 mm screws. You can find good screws in each HXT900 servo package. Push M3 screw to the prepared slot in the wing pins. Fit the mounting pins to the bottom wings using M3 bolts. Slide the bottom wings onto the carbon tubes into a correct position. Glue or fix with a hot wire the mounting pins inside the fuselage in correct position. Make sure the bolts and nuts are aligned properly before glueing for good. Repeat the same for the upper wing. Left and right wing struts are symetrical and marked by L nad R letters. Fuselage struts are marked by L and R letters. Letter must be visible in front and up after fuselage montage. Push completed struts with pins to the fuselage and wings. Double check the wing and fuselage position and glue all pins by thin CA.

you will need: 14pcs 2x8mm screw
1x M4 nut & nylon screw M4

See video guide Wings final assembly



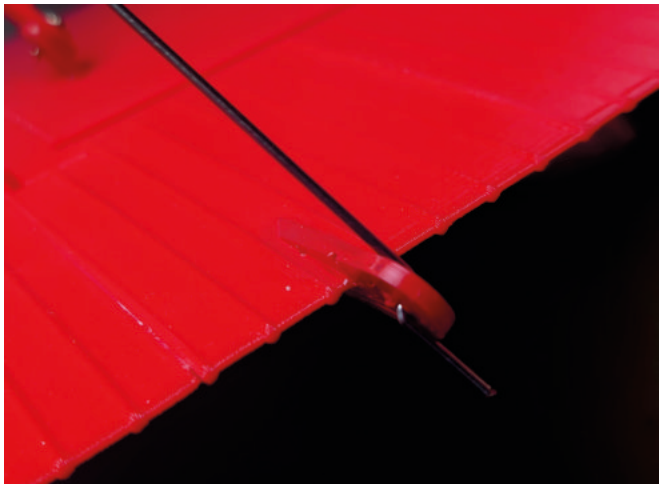


7.4 Aileron mounting

Glue the horns on ailerons and use a piano wire with Z bends as push rods.

you will need: 1,2mm steel wire

See video guide Wings final assembly



8. Final setup & Painting/marking

Paint it to your favourite marking. You can use our scale PDF for make painting mask and easy paint job.

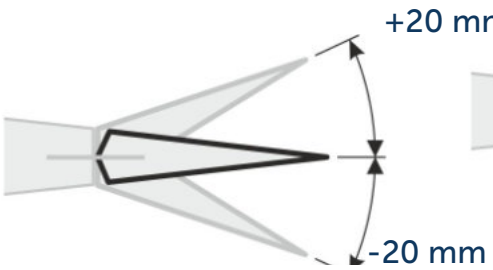
Refer to your R/C system userguide for setup information.

Install your reciever, connect battery, setup servos and etc. with your trasmitter, check servo position, then install propeller. Make sure the battery is positioned properly and secured with wing battery holder, if battery moves during flight it can shift the center of gravity backwards and aircraft will become uncontrollable! Never set ESC with propeller installed, this could be very dangerous!

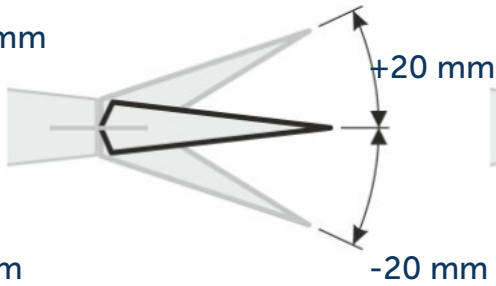
you will need: Your own Rx/Tx system

See video guide Final Setting

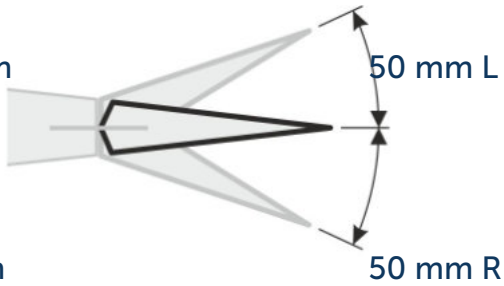
aileron



elevator



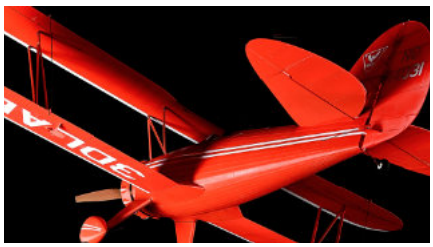
rudder



9. Go flying

Pre-flight check center of gravity is very important (move it 5mm forward for the first flights), battery properly charged, ailerons and elevator deflection check, your own flying skills or RC simulator training ...

Flight video of WACO YMF-5



10. Pilots Please Attention!

For the first flights we recommend setting the center of gravity to around 5 mm forward of the CG tag - nose heavy, this increases the stability (you can use heavier battery). Increasing expo settings on your transmitter for elevator and ailerons to 80 % calms response from your stick inputs. Also you can decrease elevator and ailerons deflection to calm down the plane. Make sure the battery is well fixed in proper possition. If it moves during flight it will cause shifting of CoG aft and will result in uncontrolable flight behavior.

After gaining some confidence you can balance the plane to the Center of Gravity marks and set Expos to 60 % as shown in the video/instructions... this gains back extra maneuverability.

Never fly aft positioned Center of gravity.

Please, use these files only for your own purpose, do not redistribute or publish. Thank you very much. Enjoy your flight.

Shopping list

Printing material:	2,5 kg of Polyair 1.0 a little piece of PETG for motor mount
Motor:	any motor 5055 size for 6S Li-Pol with weight up to 450g
ESC:	80A 6s with UBEC or any 6s 60-100A + conector suitable for battery
Propeller:	wooden 15 x 6 inch
Battery:	2700-3700mAh/6s weight around 400-600g
Servos:	4x Hitec HS-82MG or Corona CS-238MG 30x12x30mm (1.17 x 0.47 x 1.16 inches)
Glue:	fresh!!!CA Glue medium viscosity + activator
Other:	2x servo extension cables 300mm / 12 inch 2pcs of 10 mm carbon tube 780 mm (upper wing) 2pcs of 10 mm carbon tube 610 mm (bottom wing) 2pcs of 4mm carbon rod 316 mm 2pcs of 4mm carbon rod 270 mm 3x 1m of 1 - 1,2 mm / 14 AWG pushrod wire or carbon rod 6x M3x20 screws and nuts 6x M3x30 mm screws 20x 2x8 self screws 7x 3.5x15 self screws