... print your plane | www.3DLabPrint.com





rev. 2017/09

() D

Fully 3d printable

Supermarine Spitfire Mk IX

scale ~ 1:6.6 wingspan 1.7m/67in



Supermarine Spitfire Mk IX – fully printable R/C plane for your desktop 3Dprinter

Future of flying - Print your own plane. Flight video

We still trying move things further, so this biggest project so far is again full of other improvements for better durability, easier assembly, better geometry solution and so on..., we hope you enjoy it, although this print may test your competencies to and quality of your printer (welcome to the thin wall printing)

The first fully printable airplanes with suitable files prepared for your 3Dprinter. Flight characteristics are comparable or even better than classic build model airplane. Simply download and then print it anytime you need only for \$35 (filament cost - 2100g/74 oz). This is not a dream. Now you can print this HI-TECH at home, print spar parts, and so on...

Extensive hi-tech 3d structural reinforcement which makes

the model very rigid while still maintaining a lightweight airframe and exact airfoil even when it is made only from plastic. This perfect and exact 3d structure is possible only due to additive 3dprinting technology. So welcome to the 21th century of model flying. Be the first at your airfield.

Easy to assemble, you do not need any extra tool or hardware, you only need to glue printed parts together and make pushrods for control surfaces. The rest of the assembly is very easy.Simply add brushless motor, ESC, servos and radio system. Don't worry, detailed step by step PDF/VIDEO is included. You will get a superbly performing big warbird RC plane.





General specifications:

Length: Wingspan: Wingspan (clipped wing): Height: Wing area: Wing loading: Center of gravity:

Airfoil: Weight of all printed parts: Takeoff weight (6s 4500mAh Li-Pol): Max takeoff weight: Never exceed speed, VNE: Design maneuvering speed, VA: Stall speed, VS(full flaps): 1488 mm / 58,6 inch 1700mm / 66.9 inch 1505mm / 59.3 inch 510 mm / 20.1 inch 51.4 dm2 / 5.53 sq ft 71.9 g/dm2 / 23.6 oz at sq ft 102mm / 4.01 in from LE See CG tags on wings... 3DLabPrint SPT02 2060 g / 72.7 oz 3700 g / 130.5 oz 4200 g / 148.2 oz 160 km/h / 99.4 mph 120 km/h / 74.6 mph 38 km/h / 23.6 mph







Performance measurement:

Max speed VH (level flight):	140 km/
Rate of climb:	28 m/s

140 km/h – 75.6kn – 87.0mph 28 m/s (5 500 ft/min)

Flight time (6s 4500mAh):

10:00 min (+30% reserve)









Supermarine Spitfire, History

The prototype of the Spitfire, designated Supermarine Type 300, took to the air for the first time on 5th March, 1936. The fighter was designed with a maximum accent on the aerodynamic cleanliness - its Chief designer, Mr. Reginald Joseph Mitchell utilised the experience gained during the design and development of the racing seaplanes. The fact that the experience paid its dividend has been proven by altogether 24 versions produced and with a total of 22 000 machines manufactured within following thirteen years...



Mk IX

In the early months of 1942, with the clear superiority of the Focke Wulf Fw 190 over the Spitfire VB, there was much pressure to get Spitfires into production using the new two-stage supercharged Merlin 61 engine. In September 1941 the Spitfire Mk III prototype N3297 had been converted by Rolls-Royce at their Hucknall plant to take a Merlin 60, which had been specifically designed for use in the Wellington Mk VI high altitude bomber.

The performance increase was described by Jeffrey Quill as a "quantum leap" over that of the Mk VB and another Spitfire airframe, R6700 was modified to take the new engine. Although design work on the Mk VII and VIII series was under way, these would take over a year to get into production and a counter to the Fw 190 was urgently needed.



Included:

1. STL 3d files

Universal STL files designed for use with desktop FMD 3d printers and slicer software such as Simplify3D (recommended) CURA or MatterControl (these STLs are not compatible with Slic3r or Makerware slicers).



2. Factory files for Simplify3D slicer

with all our settings, these Factory files include all you need. Note: we use PRUSA i3 ORIGINAL printers so you may need to adjust the basic printing parameters to match your printer or use it as a starting point for you. Please look at <u>Simplify3D</u>



3. Step By Step PDF/VIDEO userguides

Apart from this userguide, please look at the Printing Guide with some Tips and Advices for airplane printing (Thin Wall Printing).



4. Gcodes

Basic Gcodes prepared for direct use, as universal as is possible. Should work with i3 style printers, you can try it out, but We cannot guarantee that it will work with your printer. 100% works with PRUSA i3 ORIGINAL 3d printers.

5. Prepared settings for CURA and MatterControl slicers

If you don't like Simplify3D for any reason, there is always the possibility to use another free slicer. You can use our basic setting (setting files) as a start point and edit it as you need.





6. Scale markings PDF

Cut this PDF from thin self tape advertisement foil and place it on the model as needed.



page 6





Wing area: 51.4 dm2 / 5.53 sq ft



Lenght: 1488 mm / 58.6 inch



Wing span: 1700mm / 66,9 inch







Wing span: 1505mm / 59.3 inch (clipped wing version)

Supermarine Spitfire Mk IX "clipped" wing

Now We offer also "clipped" wing modification. Just use wing_RL_6 part instead the deafult. These files are located in basic folder (Spitfire_MkIX_S3D_Factory_Userguide.zip). Please use our Gcodes, Factory files or your own "thin wall" setting. Setting changes for this part: Layer height 0.18mm

Top layers 4-5

Cooling 50% from 40th layer

Note:

This is only basic setting, for further info please open our prepared Factory file or proceed the same way as with other wing parts.



Step By Step PDF/VIDEO userguide (please look at all videos)

1. Choose airplane at <u>www.3Dlabprint.com</u>. Our <u>Facebook</u> for live information.



Basic requirements for Spitfire is 195/195/150mm build volume. Nozzle 0.4mm recommended (0.35 or 0.5mm alternativelly). Heated bed recommended.

PLA filament (or PETG, APLA, htPLA, PC-max.... not ABS) and some flex for tires...

If you feel a little bit confused you can download test part from our <u>FORUM</u> (usualy the biggest part)

2. Create account, download

You will get the download link for all files sent to your email (zipped) or you can log in to your account and download directly from our websites. (account should be created automatically after checkout)



3. Gcodes preparing

option A Gcodes:

If your printer is i3 compattible you can directly use the prepared gcodes. Simply save each to an SD card and let 3d printer do his job. The HE temperature is set to 230°C for the best layer bonding. You can edit speed and temperature on your printer LCD only. If Gcodes does not work please proceed to the next options.





option B FACTORY files for Simplify3D (recommended)

We prepare all you need in thess files (basic FFF, parts arranged and so on...)

You can use our setting as a starting point and edit it as you need (adapt it for your printer), print only parts you need and so on... On most 3d printers it should work as it is, but please look at the settings and edit it if it is different for your printer. We are not liable for damages resulting from the use of our settings. If this does not work please proceed to the next option.



option C Simplify3D manual setting (watch and learn)

Use our <u>VIDEOGUIDE</u> for proper setting. This is a very good option and you will learn a lot about Simplify3D and become a 3d expert. Of course you spend a lot of time and the you-tube pause button will become your friend. For simplification we show only our basic setting (wings and fuselage), please look in our prepared Factory files with setting for rest of parts.



AND... please look at VideoGuides:

video 2 Simplify3D setting

video about Thin Wall Printing



option D CURA or MatterControl (but note: we recommend Simplify3D)

MatterControl and CURA are free :-) and can give very good results and the airframe is still strong enough. The slicer setting is very easy.

Please try to find the right extrusion multiplier and temperature for good weight and best layer bonding. Look at parts weight list for proper multiplier settings.

You can also use our predefined CURA or MC slicer setting file included in the package (always adapt it for your printer, change build volume, filament diameter and so on... depends on your printer!!!) for some thick part you will need use of support structure:

CURA_wing_fuse.ini CURA_ailer_elev.ini CURA_thick.ini OR MC_wing_fuse.slice MC_ailer_elev.slice MC_thick.slice (wing and fuselage parts) (only ailerons, elevator and rudder parts) (motor mount, landing gear...)

(wing and fuselage parts) (only ailerons, elevator and rudder parts) (motor mount, landing gear...)



AND... please look at VideoGuides:

video CURA slicer setting

CURA 2.3.1 import setting an newest



video CMatterControl slicer setting





4.1 Print it

Save generated Gcodes and insert SD card to your printer, prepare your printer and start printing. We prefer to use SD rather than a direct connection via USB Note: ABS filament is not suitable for this. Scaling the model will lead to unusable result! Note: ninja flex or simmilar fillaments can glue very hard to PEI based surfaces be careful...

You will need: PLA filament - good quality (we need good layer bonding) Strong hair spray (or your favorite adhesive bed surface) Razor blade (disregard with PEI or simmilar bed surface, Mk2...)

AND... please look at VideoGuides:

video printing guide #3



Spitfire Mk IX - parts diagram:





Basic Tips and Advice

Please experiment with your extrusion multiplier if not the same parts weight is achieved. HotEnd temperature is very important for a strong result. Please try increasing the temperature to find the best value (215° up to 260° Celsius).

Turn OFF cooling fan for better layer adhesion (HE fan of course ON). We don't need it for our thin wall printing. You can use cooling fan for thick parts...

Heated bed is very recommended, 50-60° Celsius (print without warping ends).

Looks like any standard quality PLA is perfect for our planes, but it always depends on combination PLA vs. Extruder vs. HotEnd.

We find that some color of filament has lower layer adhesion also.

Nowadays there are a lot of 3dprinters on the market, most of them are OK for printing our aircraft (specific thin wall printing...) sufficient volume, heated bed, 0.4 mm nozzle.

Please look at FAQ and our Forum for next information:

or <u>RCGroups 3Dprinted planes Forum</u>





Some advice for rubberlike fillament printing (printable tyre): it is a good IDEA to use some adhesive tape or foil... first layer bonding could be too strong or on the other hand too weak depends what filament do you use... (picture:RubberJet -TPE32 245/30 print temperature)

After printed, heat up bed to 80 Celsius and remove tape with printed tyre, clear the bed with isopropylalcohol...





5. Assembling printed parts

5.1 Wing assembly

Glue wing parts L1-L5 and R1-R5 with CA glue together (position locks will help you), use activator, then glue flaps and ailerons parts together and install it to the wing before RL6 wing part (other way instalation of ailerons will be very complicated). You can also glue additional flaps holder.

NOTE:

1.Don't glue RL6 parts before you add Ailerons

Proceed the way shown in videoguide: See video guide #5.1

you will need: <u>CA Glue - medium or similar medium viscosity CA glue</u> <u>Activator for CA Glue</u> or similar, but gas presurized aerosol is better Snap knife





5.2 Fuselage 1 - motor mount options

It is a good Idea now to make decision about your preferred setup and way for motor mount. We offer two option - back (rear) or front montage.

The best way is to try it before you proceed to the next step of gluing Fuselage (or dont glue Fuselage 1 part yet).

You can also tune gap between spinner and fuselage with two fuselage lengths and three spinner with different lengths.

NOTE:

1.USE ANNEALING for front mount part just heat it for 30+min. in owen or boiling water, it increase thermal resistance of this part (heat from motor). <u>see this video</u>

2.Don't use overloaded setups with low efficiency which can overheat and melt printed parts.3.USE NYLON WASHERS to avoid the heat will go directly to the printed parts.

4.If you find your setup is still to hot, USE STRONG PLYWOOD instead printed or aluminium motor mount part. DWG drawning for front mount included.

For more info: See video guide #5.2

You will need: 4x nylon washers with aprox 4mm inner hole 4x steel washers with 4mm inner hole (for front montage only) 4x 4/12mm screew (for front montage only) 4-6x 4/30mm self tapping screw

fuselage 1



fuselage 1+7mm,suitable for longer motor

motor mount (for front montage) 3bl. spinner long only

3bl. spinner

3bl. spinner

short only

(back montage)

(front montage)





5.3 Fuselage assembly

Glue fuselage parts F1-F11 with CA glue together (position locks will help you). You can use snap knife to clearing shape of printed parts, but mostly it is not necessary. Insert pen spring to canopy part, insert canopy lock, glue both canopy parts together and test a canopy lock functionality. Glue battery holder to fuselage. Cut and remove plastic from down side of fuselage.

NOTE:

1.Don't glue the next tail parts yet !!! (for rudder, elevator and horizontal stabilizer proceed to next step)

2.Don't use activator for gluing splitted parts F5A/B F6A/B !!! (or gluing it to F4 and F7 parts will be very complicated)

Proceed the way shown in videoguide: See video guide #5.3

You will need: CA Glue - medium or similar medium viscosity CA glue Activator for CA Glue or similar, but gas presurized aerosol is better 1x ballpoint pen spring (a spring from old ballpoint pen will work fine) Snap knife Soldering Iron or any hot tool





5.4 Fuselage tail - rudder, elevator pushrods and servos

Now is good time for install tail stabilizers, elevator, rudder and pushrods. You can use snap knife to clearing shape of printed parts. Glue (just separately yet) rudder parts, horizontal stabilizer and elevator.

Use 1 mm / 16AWG pushrod wire for elevator pushrod. Make Z bend or use your liked pushrods attachment. We like this <u>Pushrod Keepers</u>.

NOTE: Proceede exactly as shown in video, dont glue stabilizers to the fuselage before rudder and elevator. If you glue stabilizers to the fuselage before/without rudder and elevator you wont be able to finish the tail part.

Proceed the way shown in videoguide: See video guide #5.4

You will need:

<u>CA Glue - medium viscosity CA glue</u> <u>Activator for CA Glue</u> or similar, but gas presurized aerosol is better 1.2 mm /16AWG steel pushrod wires Wire cutter, Z bend pliers or pliers. Snap knife





6.1 Servo installation

Our Spitfire Mk IX was designed for 6pcs of mini servos 30x30x12mm. Mount two servos to fuselage. Make Z bend at correct legth of pushrods or use your liked pushrods attachment. For wings use servos with extension cables.

Proceed the way shown in videoguide: <u>See video guide #6.1</u>

You will need: 6x Hitec HS-82 or similar, <u>size: 30 x 30 x 12mm servos</u> <u>servo extension cables 300mm / 12 inch</u> 1.5 mm /14AWG pushrod wires for ailerons 1.2 mm /16AWG pushrod wires for flaps Wire cutter, Z bend pliers or pliers.







If you use a printed front style mount, We suggests the it be annealed, you can use this way, submerge in water or cook it in owen.



7.1 Landing gear

Glue main wheels and tail leg together. Install retracts, legs and wheels. Glue housing in to fuselage and insert tailwheel suspension, you can use OIL for better suspension friction, then link it with rudder - use spring and wire/string (a spring from old ballpoint pen will work fine)

Proceed the way shown in videoguide: See video guide #7.1

You will need: 2x <u>Turnigy 90 Degree All Metal Servoless Retract Unit 90 Size</u> 1x <u>Turnigy 60~90 size Alloy Sprung Oleo Strut with Trailing Link (110mm)</u> or option 2: 1x <u>Servoless Retract with Metal Trunion 44mm x 41mm Mount</u> 1x <u>Alloy Oleo Strut 115mm Straight Mains for 40~60 Class</u>

> 8x 4/30mm self tapping screw 2x ballpoint pen spring (a spring from old ballpoint pen will work fine) or any thin rope or wire





wheel disc (two parts) 12g/0.42oz

main tyre 33g/1.16oz





8.1 Decals/Painting

Cut decals from thin adcvertisement foil or use any advertisement or graphic company around you for make it. Glue it at your model by your choice.

For painting this aircraft you can use any waterproof colors, so far all kinds worked.

9.1 Motor Setup installing

Please refer to 5.2 Fuselage 1 - motor mount options

Important:

For motor mount use only PLA after anealing or strong plywood. PLA printed parts can NOT withstand heat from motor.

See video guide #9.1

Some tested setups:

SETUP A)

Motor:	<u>AXI 4120/20 GOLD LINE V2 465KV</u>
ESC:	MEZON 120 lite or similar at leats 70A/6s
Battery:	ZIPPY Compact 4500mAh 6S 35C or similar 6s weight approx 700g
Propeller:	Turnigy Type A Beech Wood 3-Blade Propeller 15x8
	alternatively Turnigy Beech Wood Propeller 15x8

SETUP B)

Motor:	Turnigy Aerodrive SK3 - 5055-430KV or similar with same KV and weight
ESC:	HobbyKing 70A BlueSeries or similar at leats 70A/6s
Battery:	ZIPPY Compact 4500mAh 6S 35C or similar 6s weight approx 700g
Propeller:	Turnigy Type A Beech Wood 3-Blade Propeller 15x8
·	alternatively Turnigy Beech Wood Propeller 15x8

SETUP C)

Motor:	LEOPARD LC5065-7T 380KV or similar with same KV and weight
ESC:	HobbyKing 70A BlueSeries or similar at leats 70A/6s
Battery:	ZIPPY Compact 4500mAh 6S 35C or similar 6s weight approx 700g
Propeller:	APC <u>15.5x12-4 Blade Propeller</u>

Important:

check motor mount and screws before each flight, don NOT use PLA motor mout without annealing or use strong plywood (use DWG or copy the PLAprinted one). If using back mount use nylon washers and check both screws also!!!



9.2 Final completion and setting

Install your receiver, connect battery, setup servos and etc. with your trasmitter, check servo position. Set recommended deflection from videoguide. Check CoG point (see CG- marks on wings). As the last step install propeller.

Make sure that the battery is placed properly and secured. If battery moves during flight it can shift the center of gravity backwards and aircraft will be uncontrollable!

See video guide #9.2

You will need:

your own Rx/Tx system, 9channel (at least 6ch) <u>nylon nuts</u> and <u>screws</u> or any 5-6/60mm adhesive velcro strip for Li-Pol battery, ESC and Receiver battery strap some gauge (f.e. ruler)







10. Pilots Please Attention!

For the first flights we recommend to increase expo settings on your transmitter for elevator and aileron to 60 % (this calms response from your stick inputs) and you can decrease elevator and ailerons deflection a bit.

Make sure the battery is well fixed in proper position. If it moves during flight it will cause the CoG move aft and can lead to uncontrollable flight behavior.

Check motor mount and screws before each flight... Do NOT leave this PLA plane on direct summer sun or in car. (max. PLA temp is about 60C)

Spent at leats 10 hours with RC flight simulator before you go out for the first time.

Flight Video

Recommended:

Flite test: RC Planes for beginners

Basic to advanced ground handling take-off's and landing for warbirds

Never fly aft positioned Center of gravity.

Please, use these files only for your own purpose, do not send it further. Thank you very much. Enjoy your flight.





