



MiniMax a 220mm 3D printed One Design RC Model Yacht

Designed by myself, Brett McCormack, A model/RC sailing enthusiast for more than 40 years. I have successful designs in the IOM class and Footy class and co authored the Footy Class rules.

A 3D printed one design is a logical evolution for the modern world and I wanted to push the envelope to a truly inexpensive yacht and also push the size even smaller than previously possible. I would also like to credit Joel Anderson who got me into 3D printing and has helped enormously with the post hull design CAD work.

The idea was to produce a yacht that could be produced in one piece on most home 3D printers. Use inexpensive rc equipment and be as easy as possible to build. Another consideration is the cost of sending kits etc around the world. Minimax fits into a small box and is economical to ship.

Lastly the idea was that home builders can build their own boats or purchase kits and finished boats. Licensed kit/boatbuilders could operate locally and the class can grow easily with such a framework if there is demand.

If the class gets some momentum then a class rule, racing guidelines etc will follow.

This document will help you build your own MiniMax!

Electronic parts required

The following electronics are what I have used and tested on MiniMax, there are other small radio systems which may be suitable, the standard 2 gram servos with 1.0mm JST connectors are not negotiable due to the weight and fitment within the model.

The parts I recommend are as follows and can be sourced from

www.MinimumRC.com

Andromeda tx and rx

2 x 2 gram servos (The servos measure 16mm x 8.2mm and are 20mm o/a high)

1 or 2 3.7v 1 cell lipo(120-180 mah)

charger for lipo

alternatively the 12n1 RX from Minimum RC if compatible with existing TX

or any other lightweight rx that will accept JST1.0mm connectors

typical radio parts weigh around 11 grams total and can be increased slightly with larger battery.

I have been typically getting around 1 hr sailing time with a 120mah battery(3 grams)

I have paired the 12 n 1 rx with my flysky Tx and found it most satisfactory.

If you are starting from scratch and do not have a transmitter then the Andromeda TX/RX is a good place to start.

Spars and ballast

100 -150mm M12 S/S bolt for ballast..cut smooth part to 47mm long

3 mm carbon rod 250mm mast

3 mm carbon rod 37mm Rig Jointer

2 mm carbon rod 154mm Boom

2 mm carbon rod 33mm Rig Pivot

2 mm carbon rod 78mm keel stiffener

2 mm carbon rod 32mm rudder stock

1 mm carbon rod 51mm rudder linkage with MinimumRC clips

8-10lb breaking strain fishing braid for all ropework

Printed Parts.

The hull is 220mm long and is the largest part and prints standing up on the transom with no supports. It could be possible to print the hull on an angle with supports, I have not tested this. Check your printer's Z axis height. I print my hulls with 0.4 nozzle, 2 walls with 0.16 layer height.

I construct all the parts from PLA+ filament and have no issues with watertightness. The parts can be sanded and painted if you like. Just be careful of weight gain

Good printer settings are important to get a good outcome.

The keel and bulb are printed on the 45 deg joint, this gives excellent strength for the fin and enables a good join for the bulb. The fin and bulb should be printed solid.

I have printed the rudder successfully both on its trailing edge and standing upright. Both with a brim.

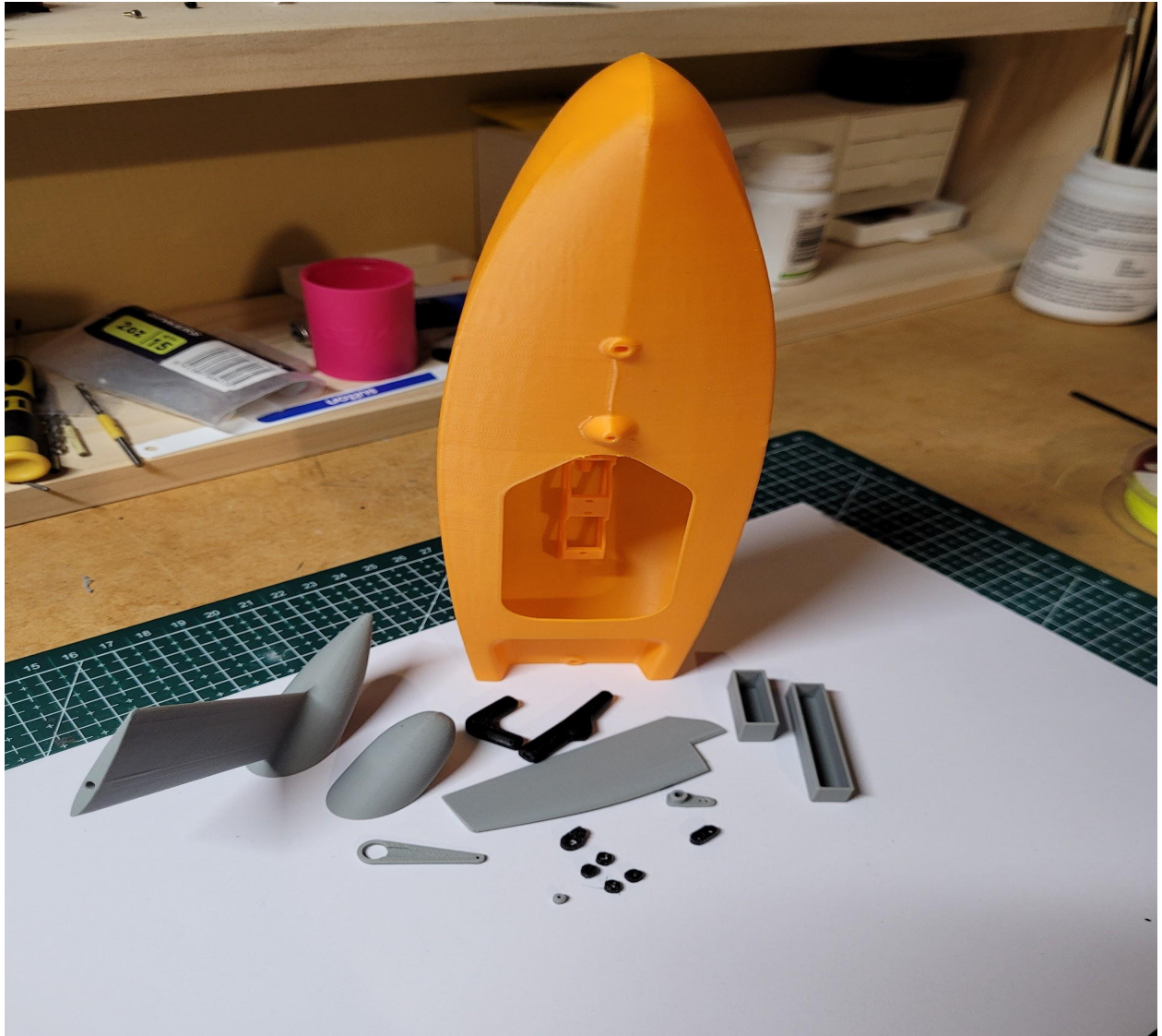
The larger rig parts print on their side and everything else should be pretty straight forward.

List of printed parts

Hull
Fin and Bulb
Bulb Front
Rudder
Sail arm
Tiller
Battery box (either size for your battery)
Masthead fitting (TPU)
Mast Joiner elbow
Boom Pivot fitting
Sheet fairlead
4 x Boom Bands (TPU)
Sheet Toggle
A rig sail template
B rig sail template
3 x sail corner templates
Stand (print 2)

Tools to assemble your MiniMax

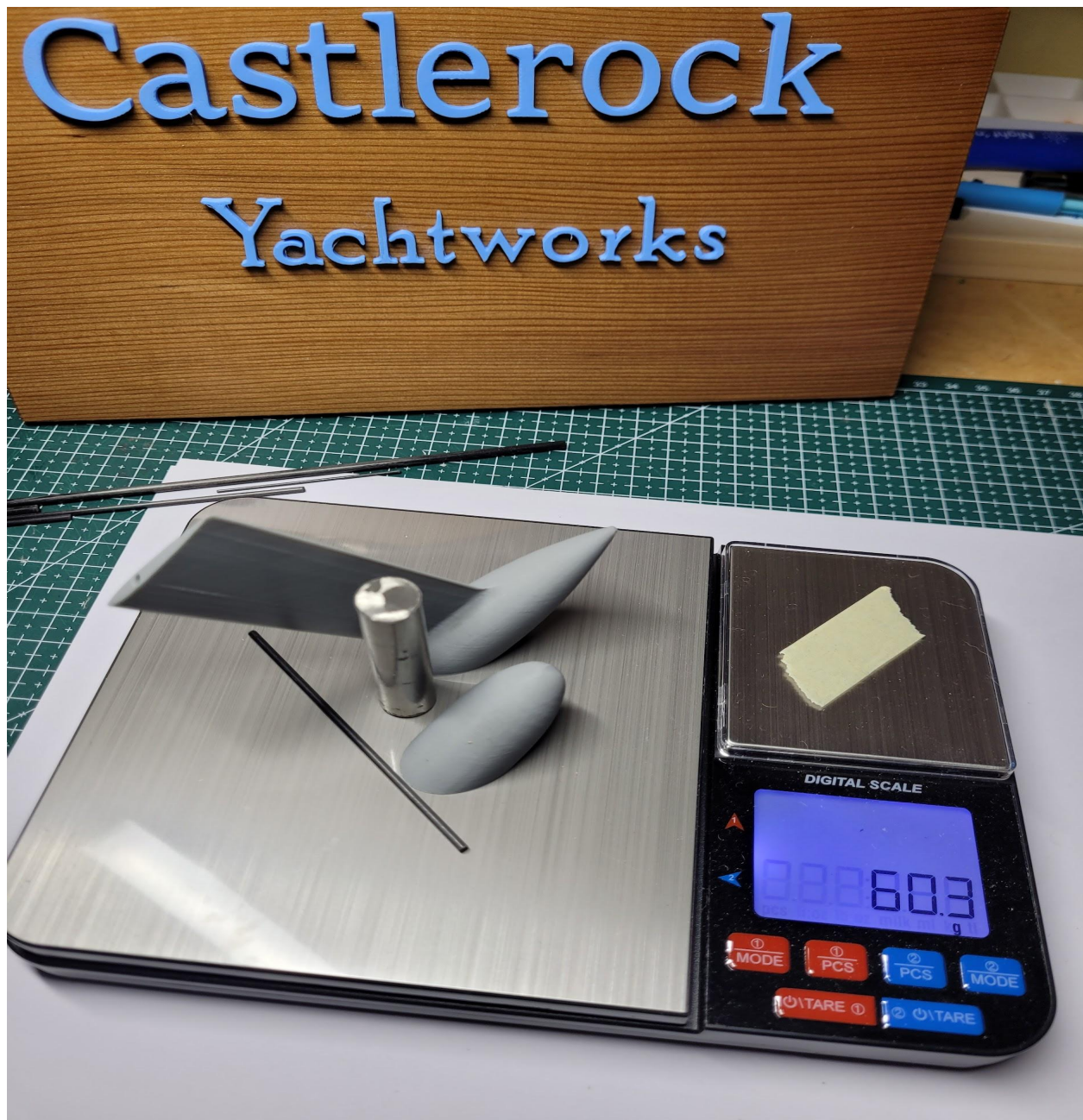
Hacksaw (cutting the s/s bolt or rod)
File (To clean up the s/s cut)
Jnr Hacksaw (cutting the carbon rods)
Tweezers (yip you will use them installing the radio, sheets and working inside the hull etc)
Hobby knife (cutting the thread etc)
Jewelers screwdrivers for installing servos
assortment of small drills..1 to 3mm (Cleaning out the holes in the printed parts)
sandpaper (de burring carbon etc, 120 grit)
accurate scales are handy (Weigh everything!)
Good quality CA glue or epoxy (keel and rig assembly)



Picture above shows print orientation for the hull and keel parts



Cut the S/S bolt to 47mm



Ensure it all weighs around 60g, Keel and bulb print 18-19 grams
S/S rod 41-42 grams plus the carbon rod.
Glue the rod and front of the bulb to the keel
Glue the assembled keel into the hull.



Install the servos and battery box as shown. Take note of the servo orientation. Glue the battery box to the side of the servo mounts



Glue the carbon rudder shaft to the rudder and install the rudder into its trunking
 Press fit the tiller on top(glue if its a loose fit)
 Ensure you have the clearances just right,no binding but not sloppy either
 The tiller should be at 90 deg to the rudder.
 You will need to open up the hole a little where the push rod exits the hull.
 I run a 2mm drill through.
 I use a 1mm carbon rod with the wire clips from MinimumRC

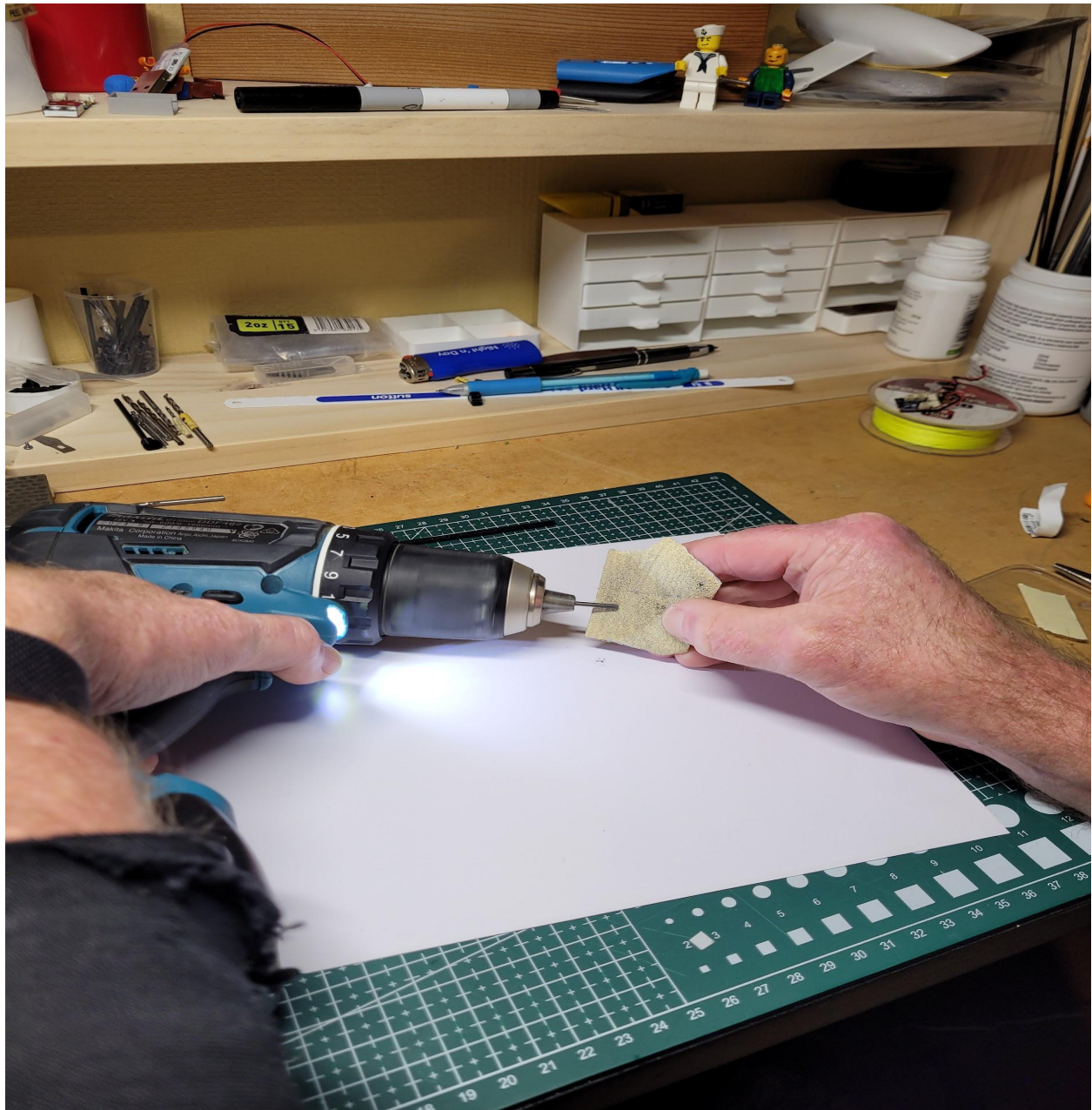
Glue the sail arm onto a servo horn.

Run the sheet rope through the deck fairlead and tie it off to the sail arm.

Have the sail arm in the fully in position angled towards the stern a little as shown.

I just suspend the RX in position by taping the servo and battery wire to the hull side and deck.





Sharpen the rig pivot with sandpaper in a drill
We want the boom joiner fitting to be 1 mm
Clear of the mast base fitting when finished



Assemble the spars, its very important that the gap between the 2 3D printed Fittings is 15mm. Glue everything together accurately ensuring the mast will be vertical. I check everything on a flat board from both sides of the rig.



Next up is the sheet adjustment fittings.

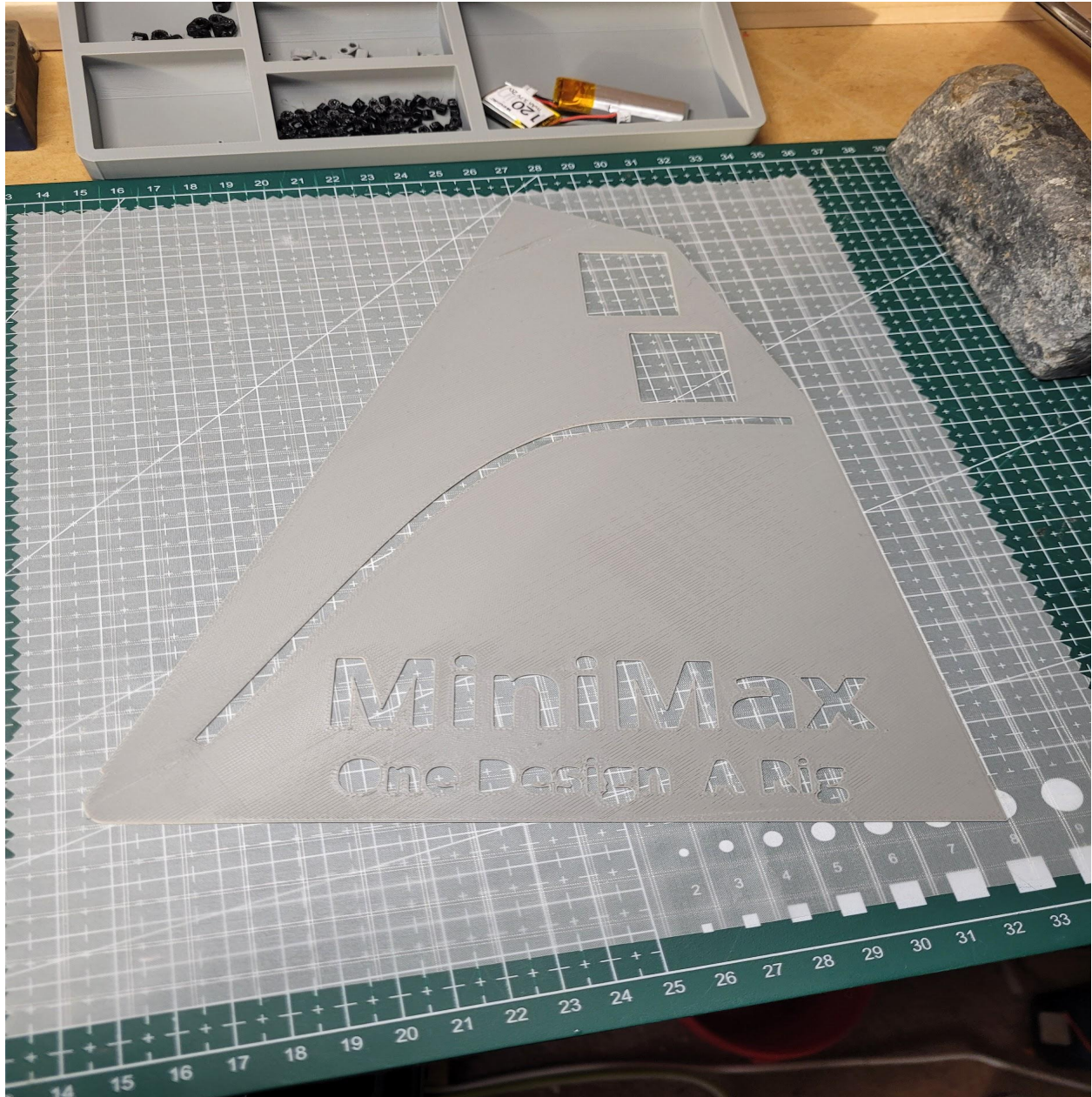
Make up the arrangement as shown.

Tie the string to the toggle, pass it through one of the TPU boom bands and then tie it off
To the 2nd one. It can be any length actually.

Slide it all on to the boom after you slide on the sheet fairlead.

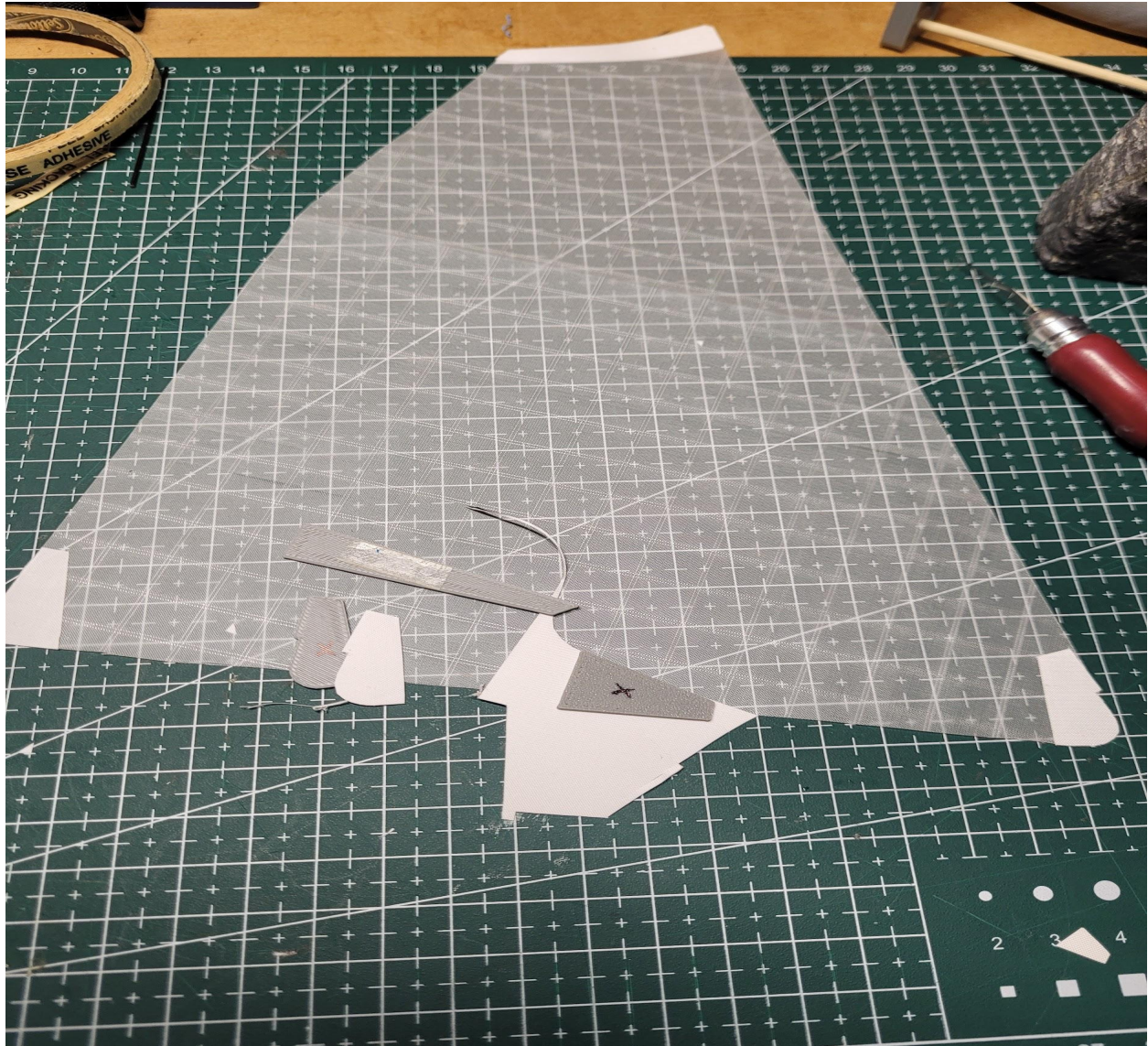


Tie a loop in the sheet. It passes through the fairlead and hooks over the toggle. You can fine tune the sheet length by moving the TPU boom bands and change rigs easily by unhooking it.

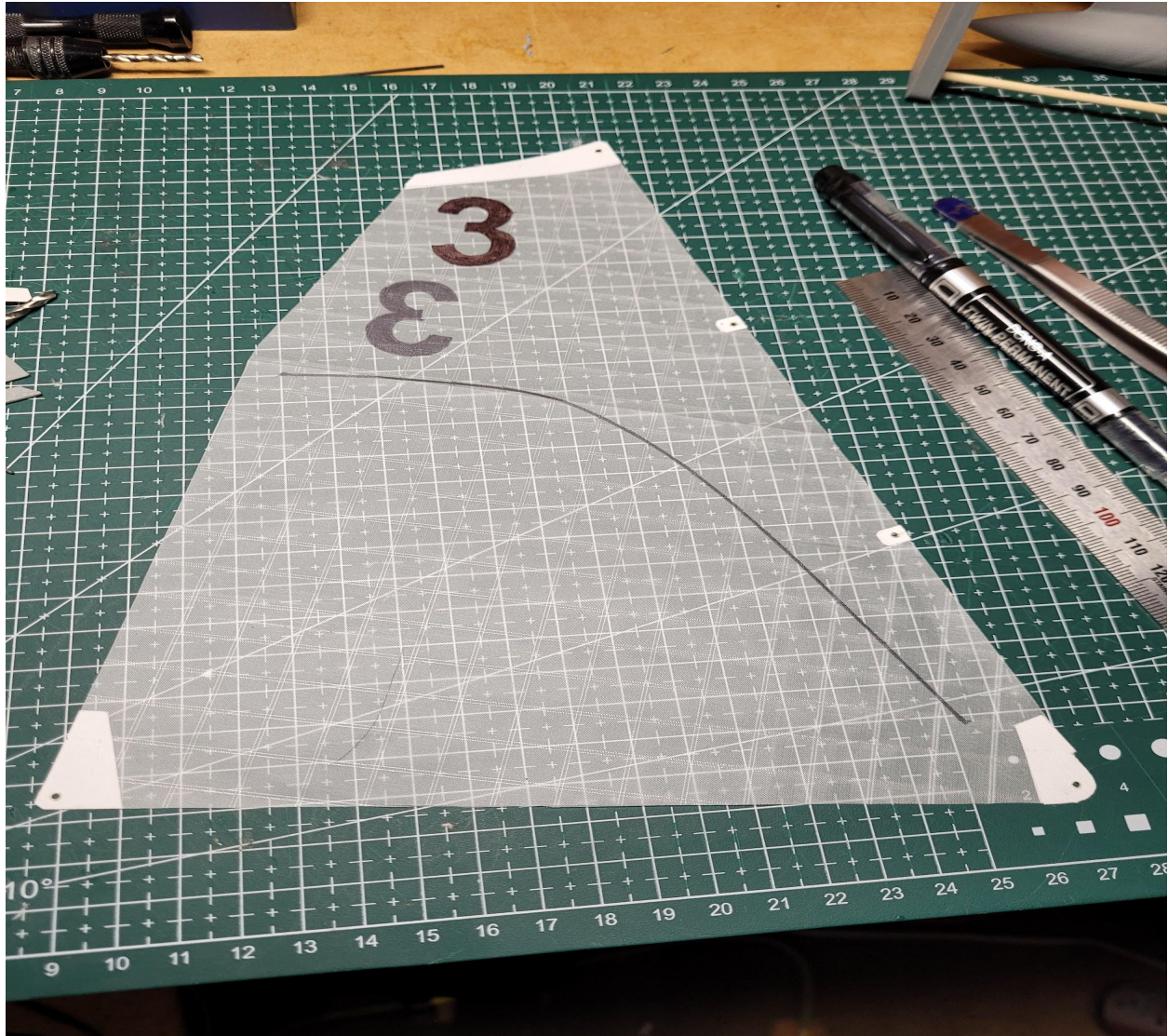


Lay the 3D printed template on your sailcloth
Cut around it carefully.

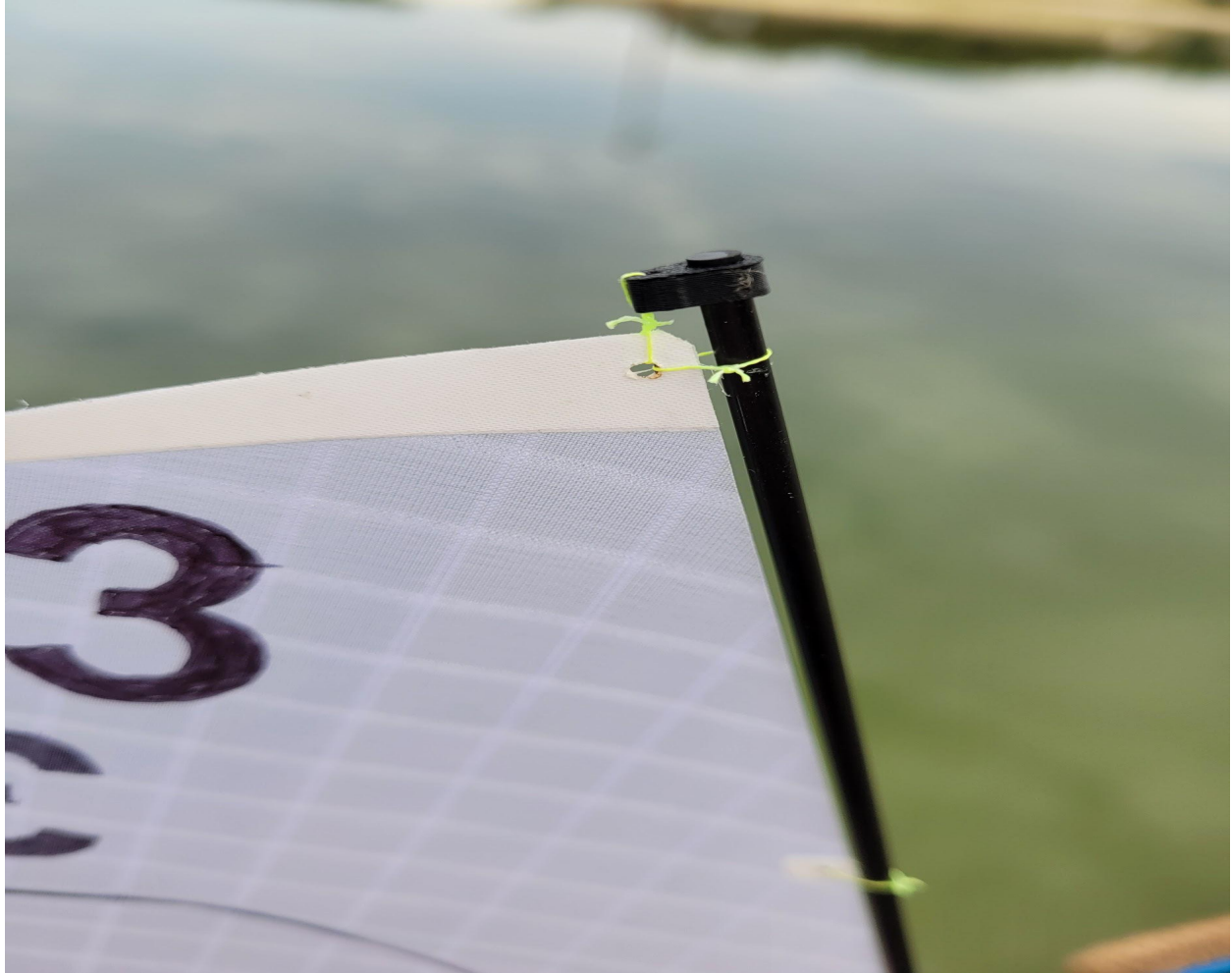
I use 35 micron Icarex. You can use Mylar film or any other suitable product
Even a plastic rubbish bag can work in a pinch.



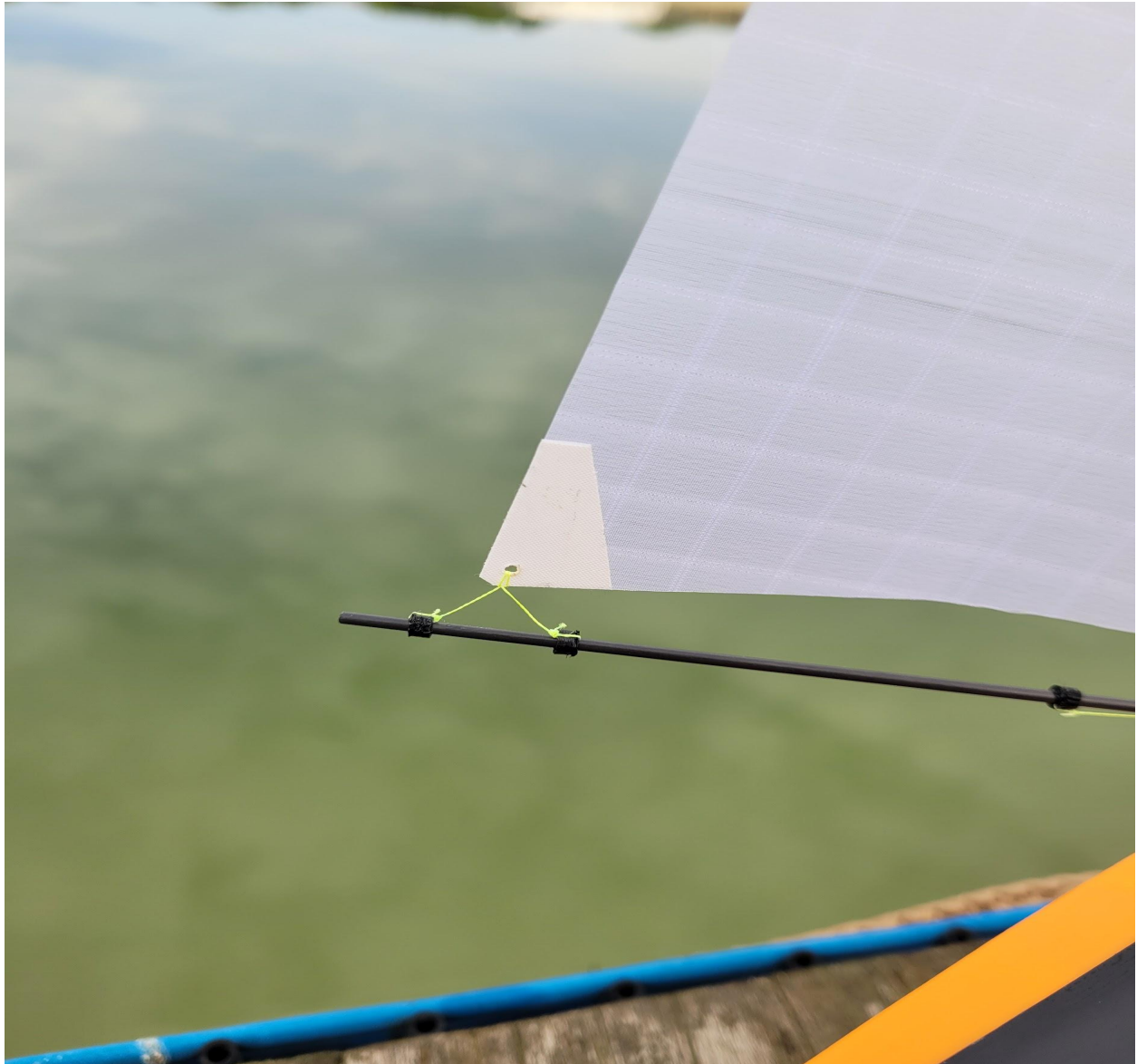
The 3D printed sail corners can be used as cutting templates
To make your sail reinforcements.
I use sticky back dacron but any type of tape compatible with
Your sail material can work.
Apply both sides carefully and neatly.



Add the 2 smaller reinforcements up the luff, they are approx 80mm apart.
 Make a hole through all of the patches to take your lines.
 I use the tip of a wood burning tool on mine.
 Draw the curved line using the template
 This is the class "Logo" I would love it if you
 Use it! Also add the numbers. They are placed in the cutouts on the template.
 Numbers are a single digit 1-9. Use whatever single digit you would like
 I also want to make this part of the class identity.
 The Numbers are 30mm high and the one on the Starboard side goes at the top!
 That's the sail complete!



Head detail.
The TPU slider can be adjusted to vary luff tension



Outhaul

You can adjust the sail depth and twist with this arrangement



Tie the tack line accurately
All the little details matter, it may take several tries to get the knots
Exactly where needed.
Glue all your knots with CA glue.



Mini Max is finished!

The completed yacht ready to sail should not weigh less than 120 grams or exceed 130 grams
If it is light, put a small weight in the bilge to bring the weight up.

Seal the hatch opening with any suitable 50mm wide tape or dacron sticky back

I have included STL files for the stand

I make it up with 3 x 3mm bamboo skewers cut to 95mm.

Carbon rods could also be used.

Have fun building and sailing your MiniMax,I can't wait to see what you create.

This is going to be an ongoing project,for sure we will make improvements as time goes on.

I will share some tuning measurements once we learn how MiniMax behaves best.

There is a B rig template for windy days,The rig construction is the same though the mast and boom can be shorter,a C and D rig will follow.



