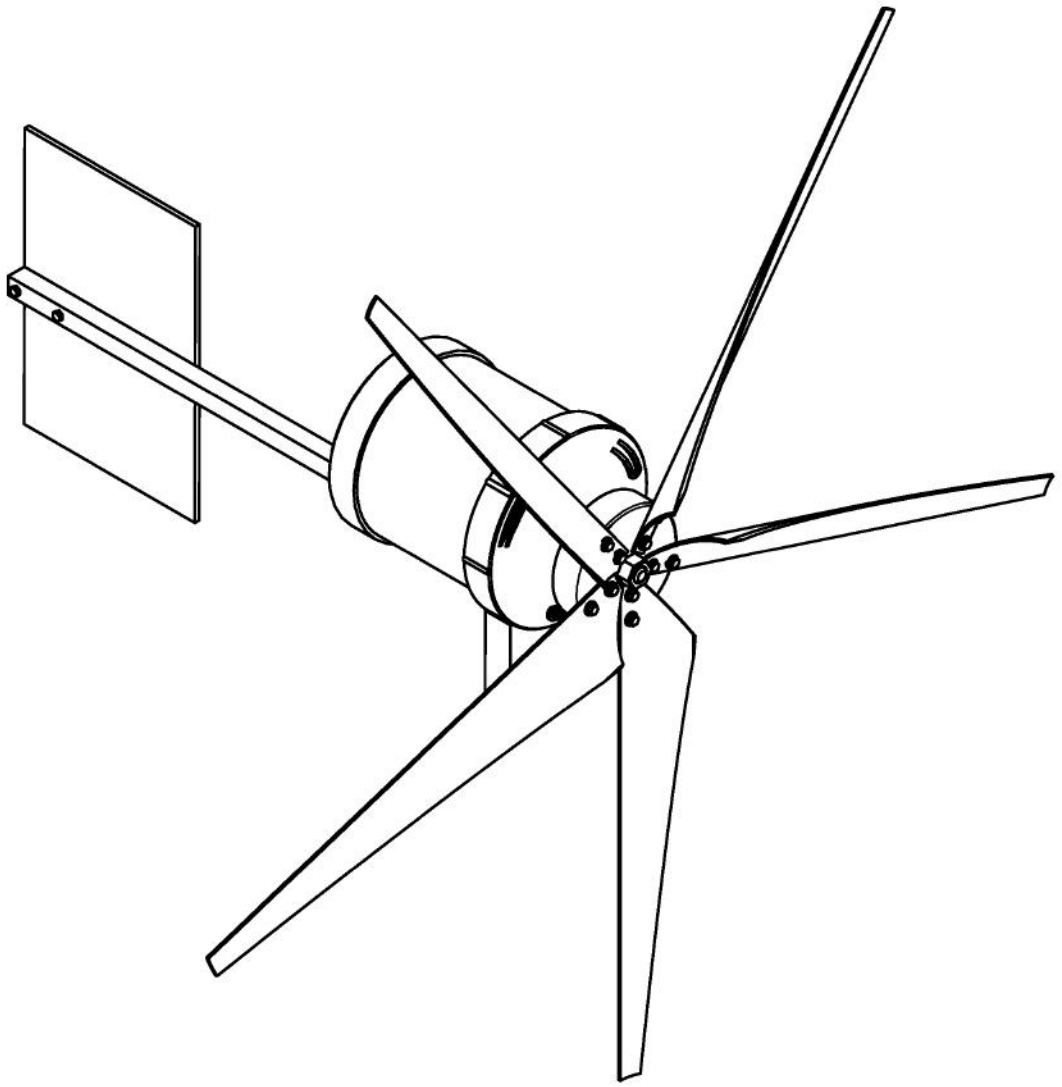
Local Electricity Project:
DIY Wind Turbine



SAFETY NOTE: Wind turbines can be extremely dangerous and should never be installed near highly populated areas. Always double check your work and make sure all fasteners use locking nuts or threadlocker.

Introduction

This is a guide to making your own low cost wind turbine using readily available parts, tools and labour. Please read the instructions all the way through before attempting to make your own turbine.

Most of the materials used were sourced from my local hardware store (Bunnings, Australia), with the exception of the treadmill motor, which was bought off eBay for $40AUD.

I tested the motor by turning it in a drill press and measured the voltage output at different speeds with a dummy load and datalogger, achieving 20W at 400RPM.

This wind turbine was built and tested with a maximum output of 20W, although more detailed analysis is required to determine the power curve.

Tools and materials required are listed below, but it should be noted that the instructions can be altered to suit your own circumstances.

We have split tools into those that are required, and those that are recommended for better precision, which is particularly important with the blades.

Contact Us

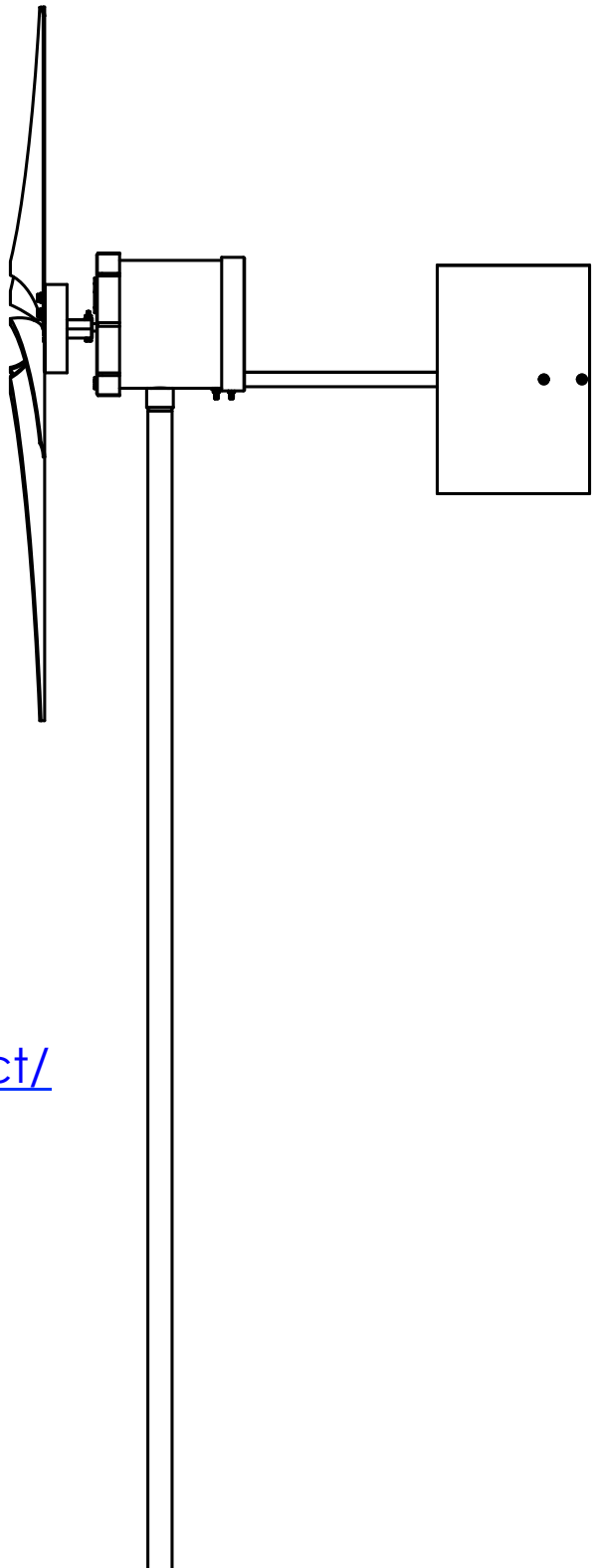
Our aim is to create a set of instructions that anyone can follow and in order to do this we need feedback.

Built this turbine? Send us a picture.

Have any suggestions to improve the design or the instructions? We'd love to hear from you.

You can contact us at:

http://localelectricity.org/contact/



Tools Required

Tools marked with * are optional

Hand saw

Ruler

Bench vice*

Hand drill

Tape measure

Power saw*

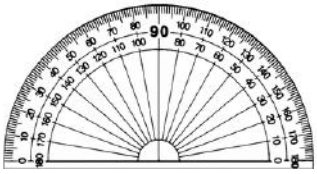
Spanners
(various sizes)

Thread-lock

Drill press*

File

Pliers



Protractor

Callipers*

Materials

90mm x 1m PVC pipe	x1	
12x12x1.4mm Angle Iron (0.5m long)	x1	
M16 x 60mm hex coupler	x1	
100mm PVC end cap	x1	
150mm PVC threaded access coupling	x1	

Materials

150mm PVC threaded end cap	x1	
150mm PVC end cap	x1	
20mm to 15mm PVC reducer	x1	
15mm PVC male thread adapter	x1	
Treadmill motor	x1	

Materials

300x300x5mm plywood	x1	
19mm aluminium box section (500mm long)	x1	
15mm x 200mm pipe	x1	
15mm pipe flange	x1	
31.8x1.2mm steel tubing (3m long)	x1	

Fasteners

Bolts:

M16x100mm	x1
M7x20mm	x4
M5x25mm	X10
M5x35mm	X4
0.5”x1.5”	x4

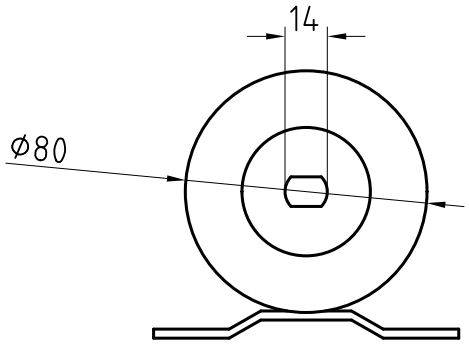
Nuts:

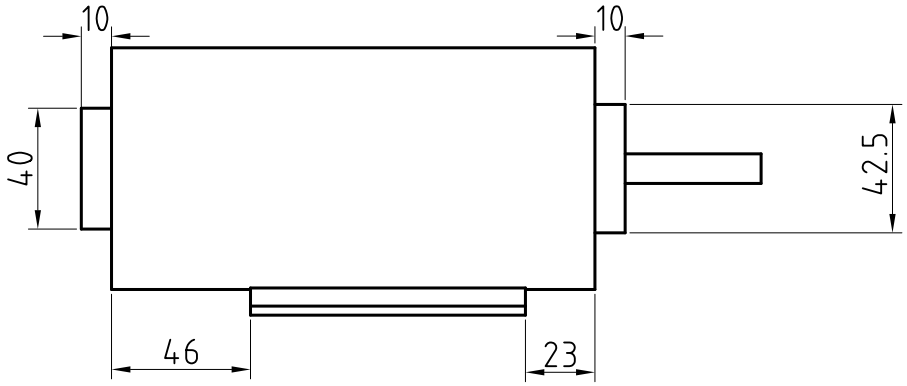
M16	x1
M7	x4
M5	X14
0.5”	x4

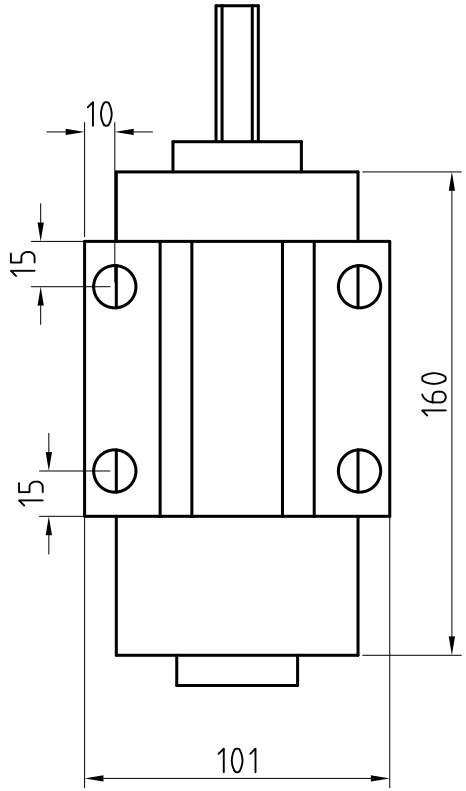
Washers:

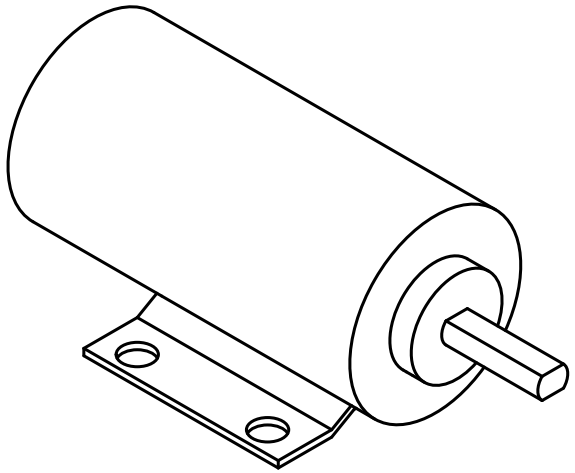
M7	x4
M5	X14
0.5”	x4

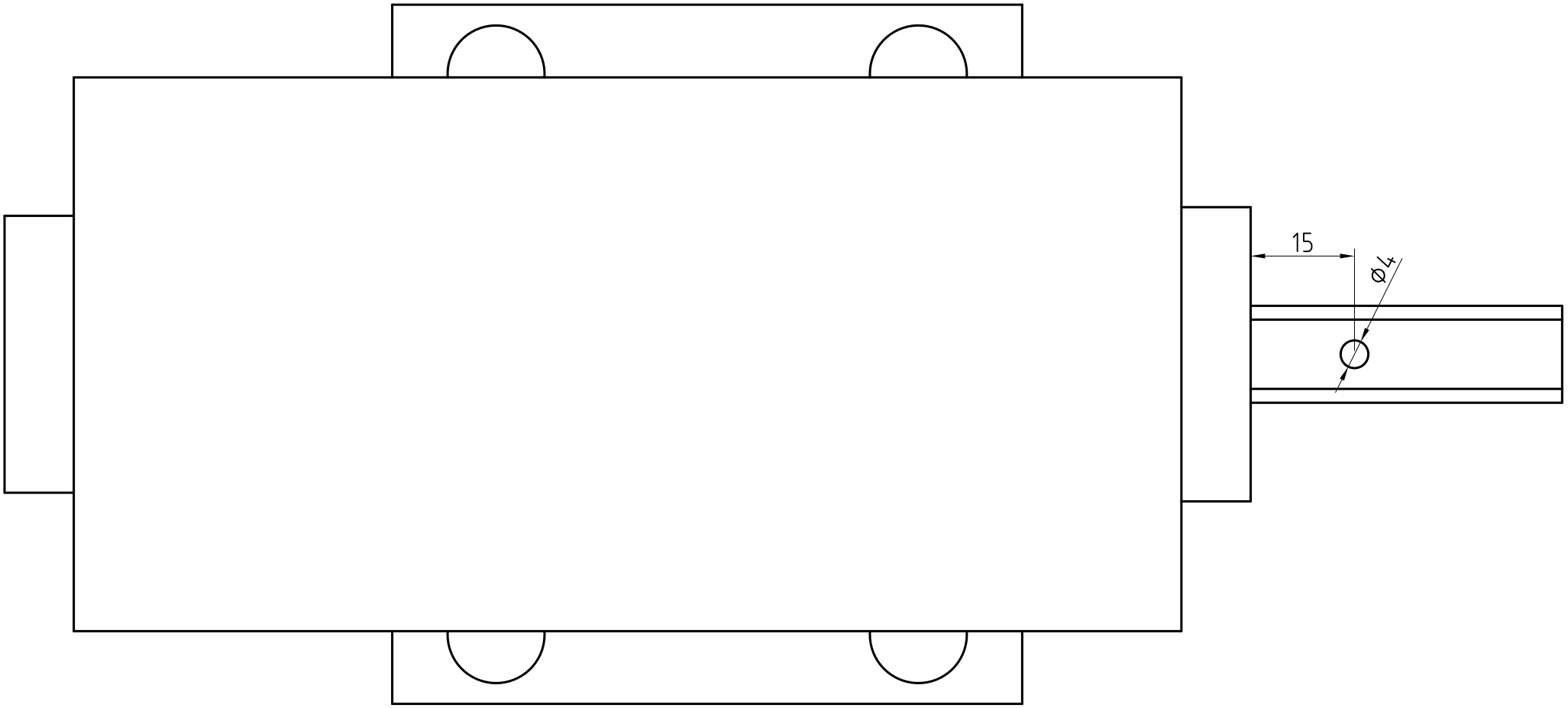
To build this wind turbine, we used an old treadmill motor that looks like this. Although the rest of these directions assume that you are using the same motor, it is possible to adapt them to suit your own motor.



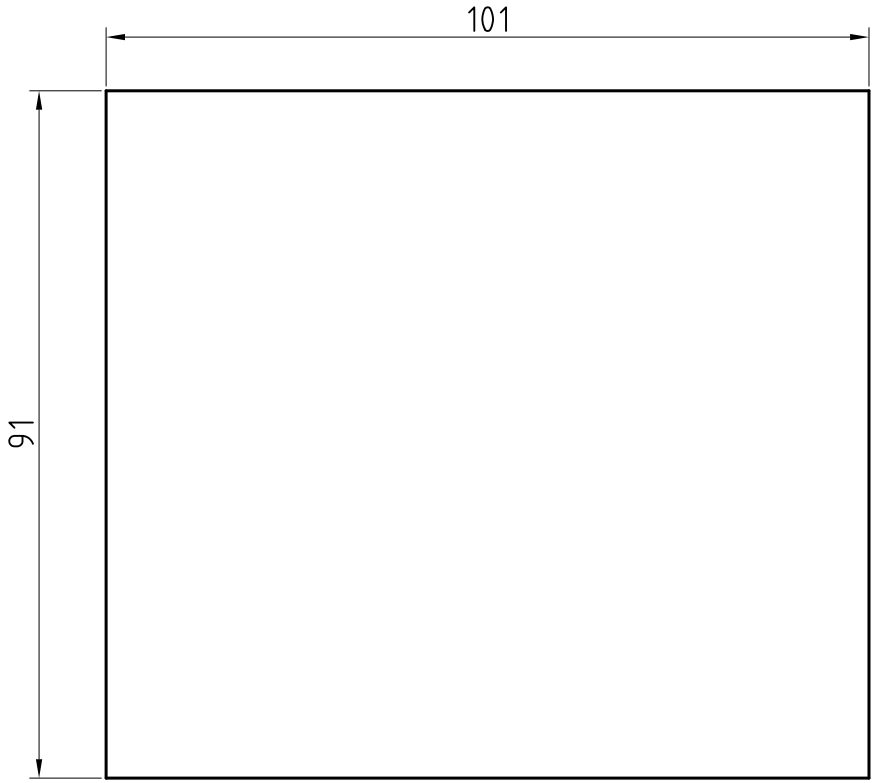




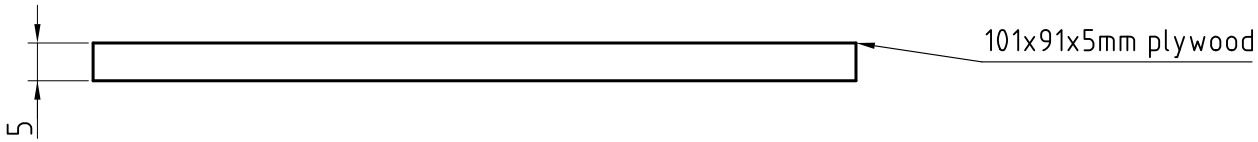




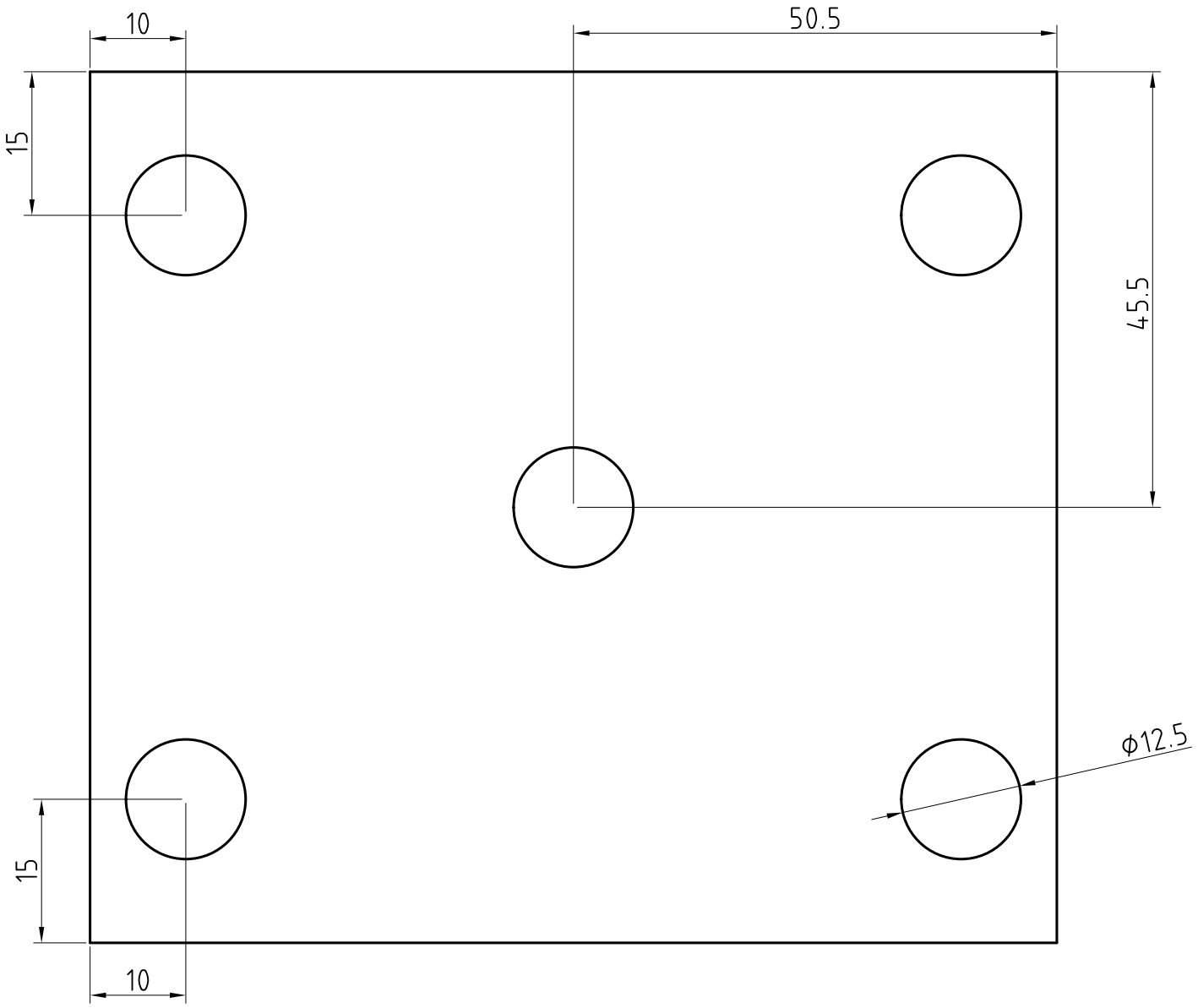
Drill a 4mm hole in the flat side of the motor shaft, 15mm away from the motor body.

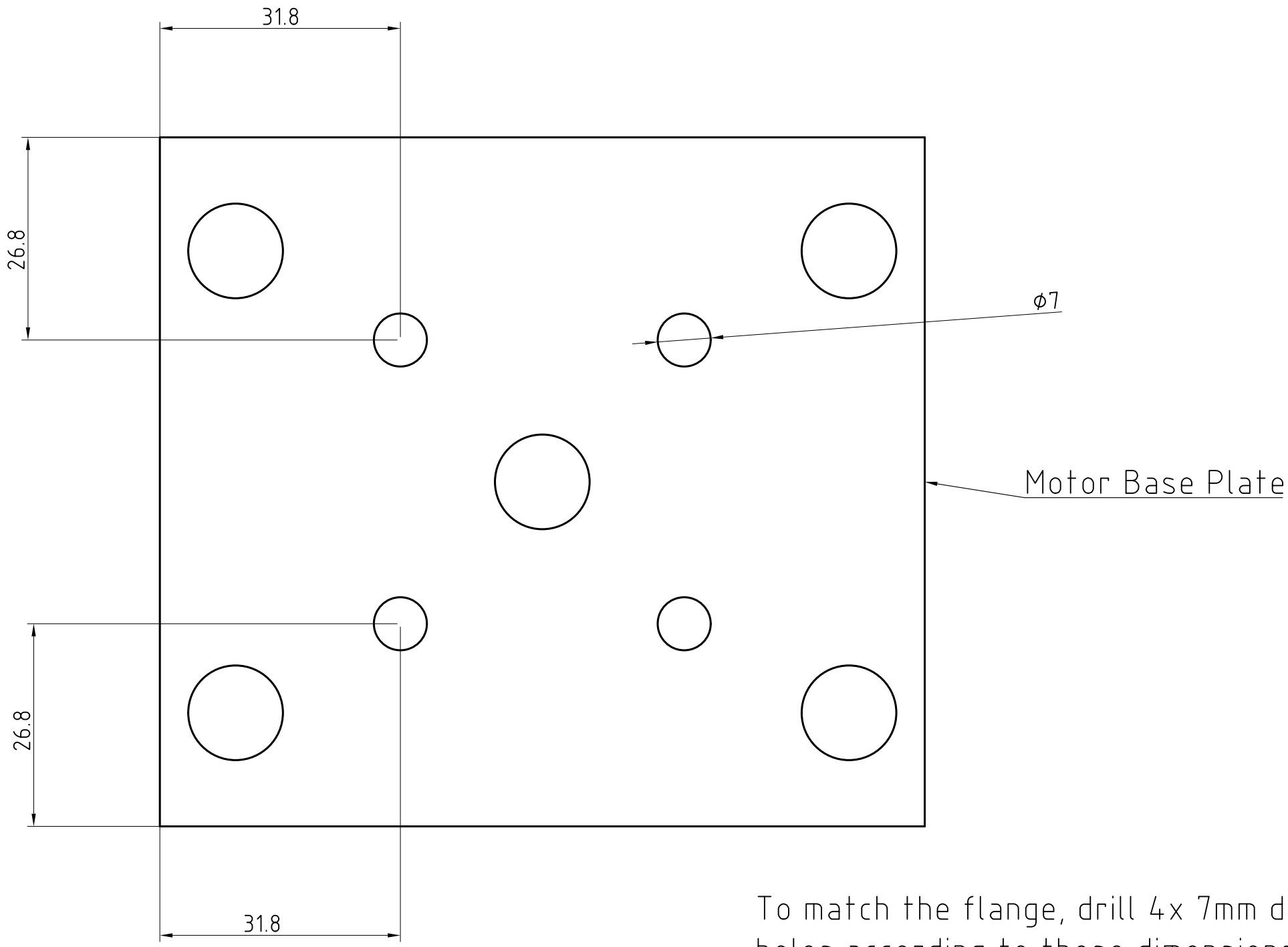


Next we need a way to fasten the motor down.
Cut a piece of 5mm plywood to this size.

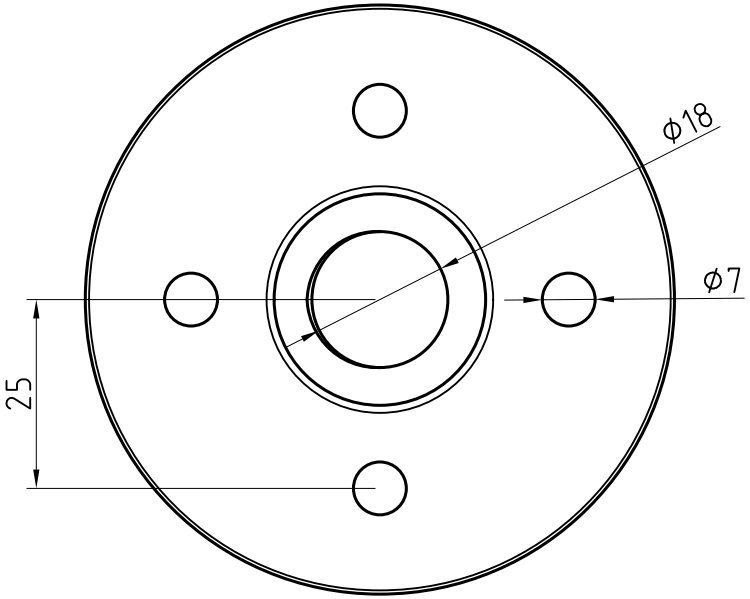


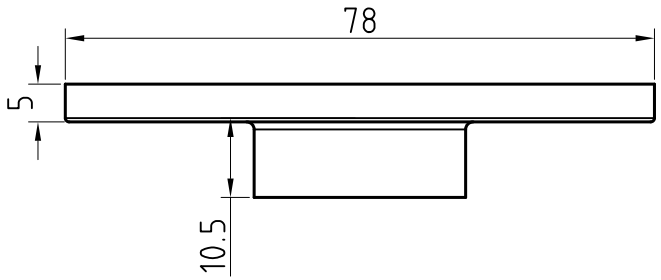
The holes to mount our motor are ½ inch diameter (approx 12.5mm), so we need to drill 4 holes to match. The hole in the middle is just so that the wires can pass through.



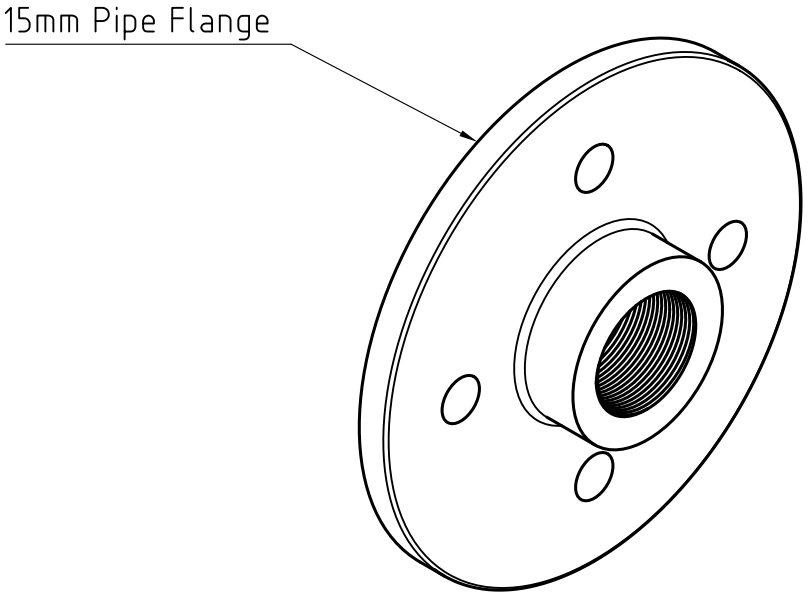


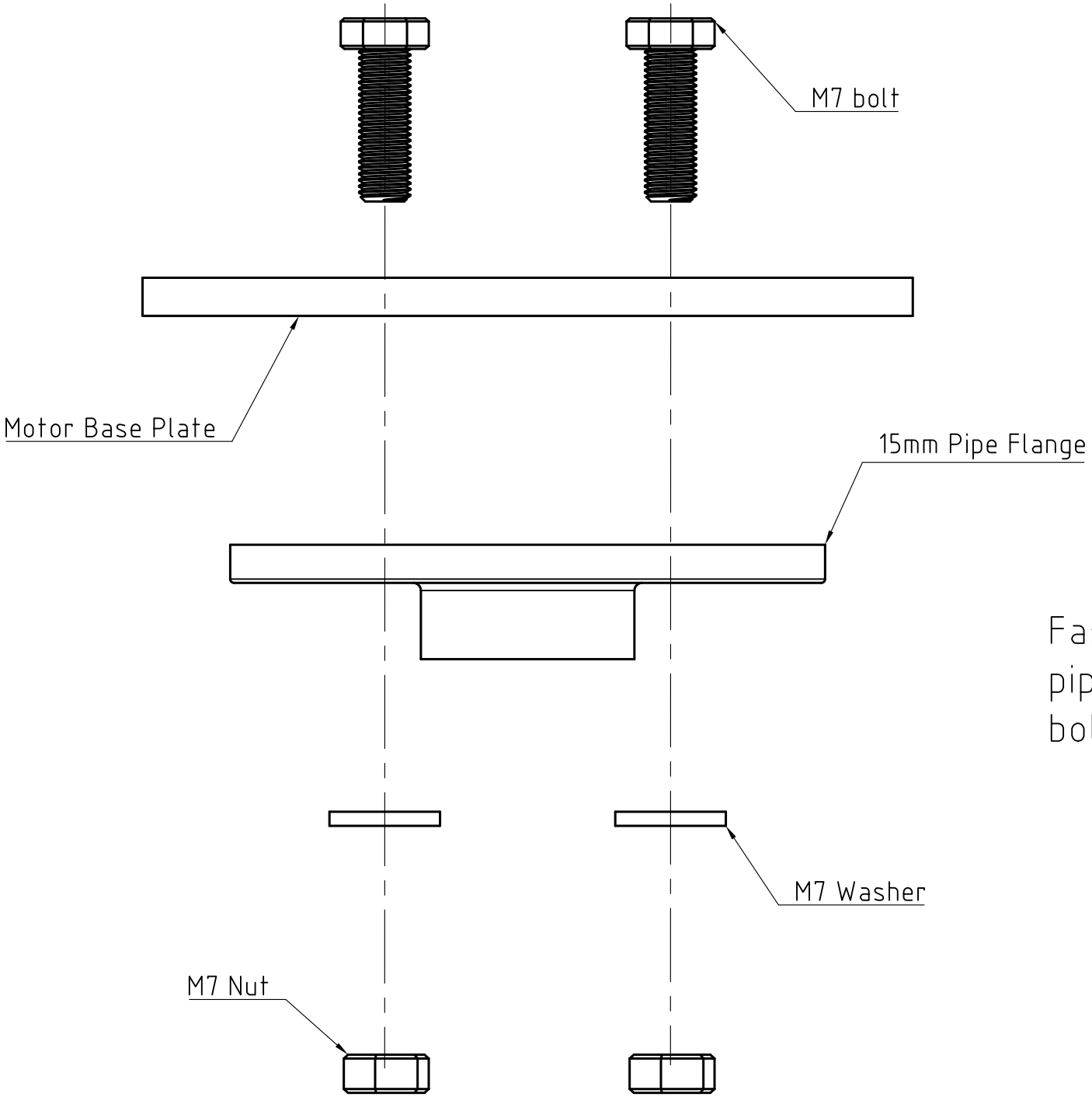
To match the flange, drill 4x 7mm diameter holes according to these dimensions.



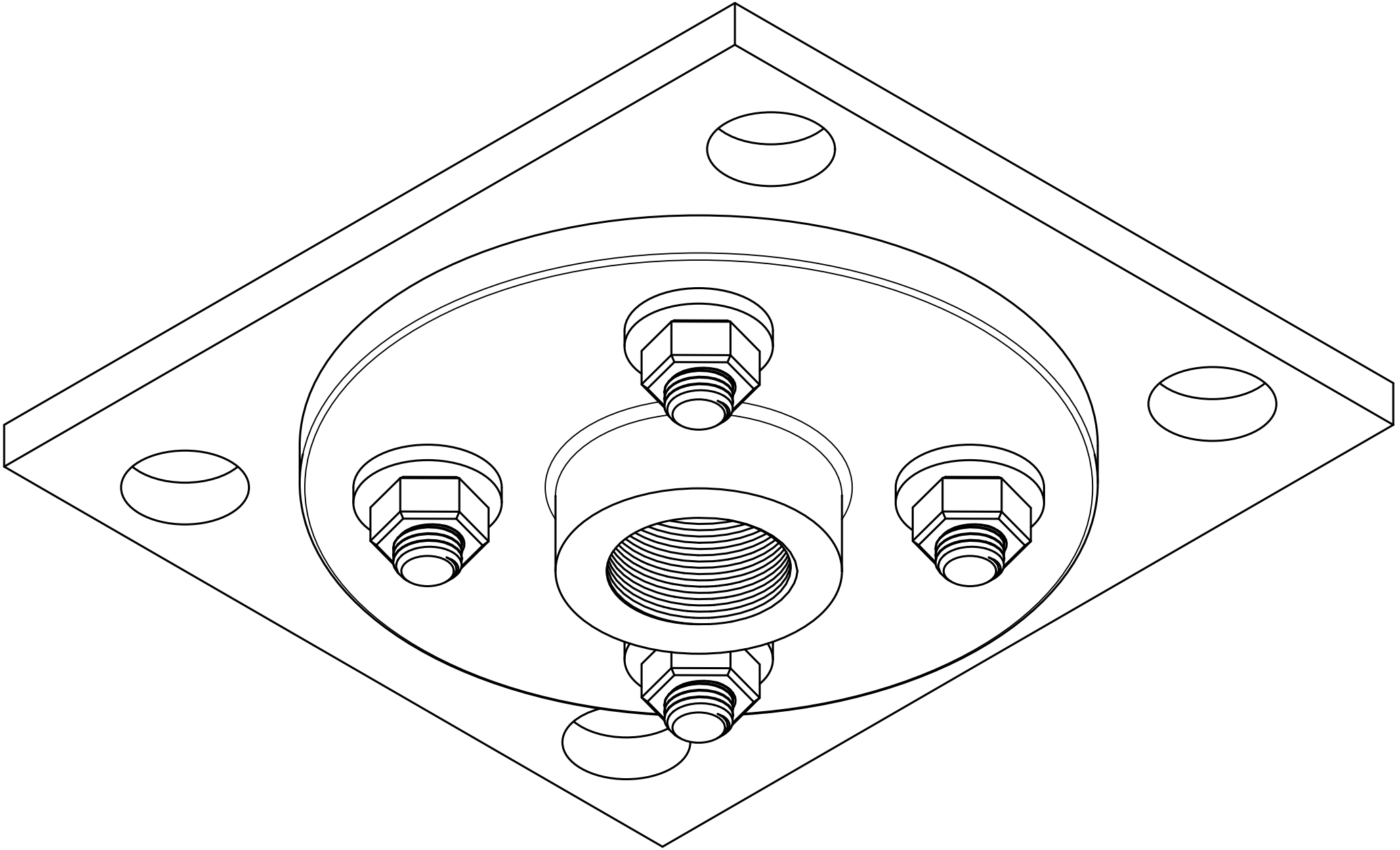


We also need to drill the base plate to attach an off-the-shelf 15mm pipe flange.

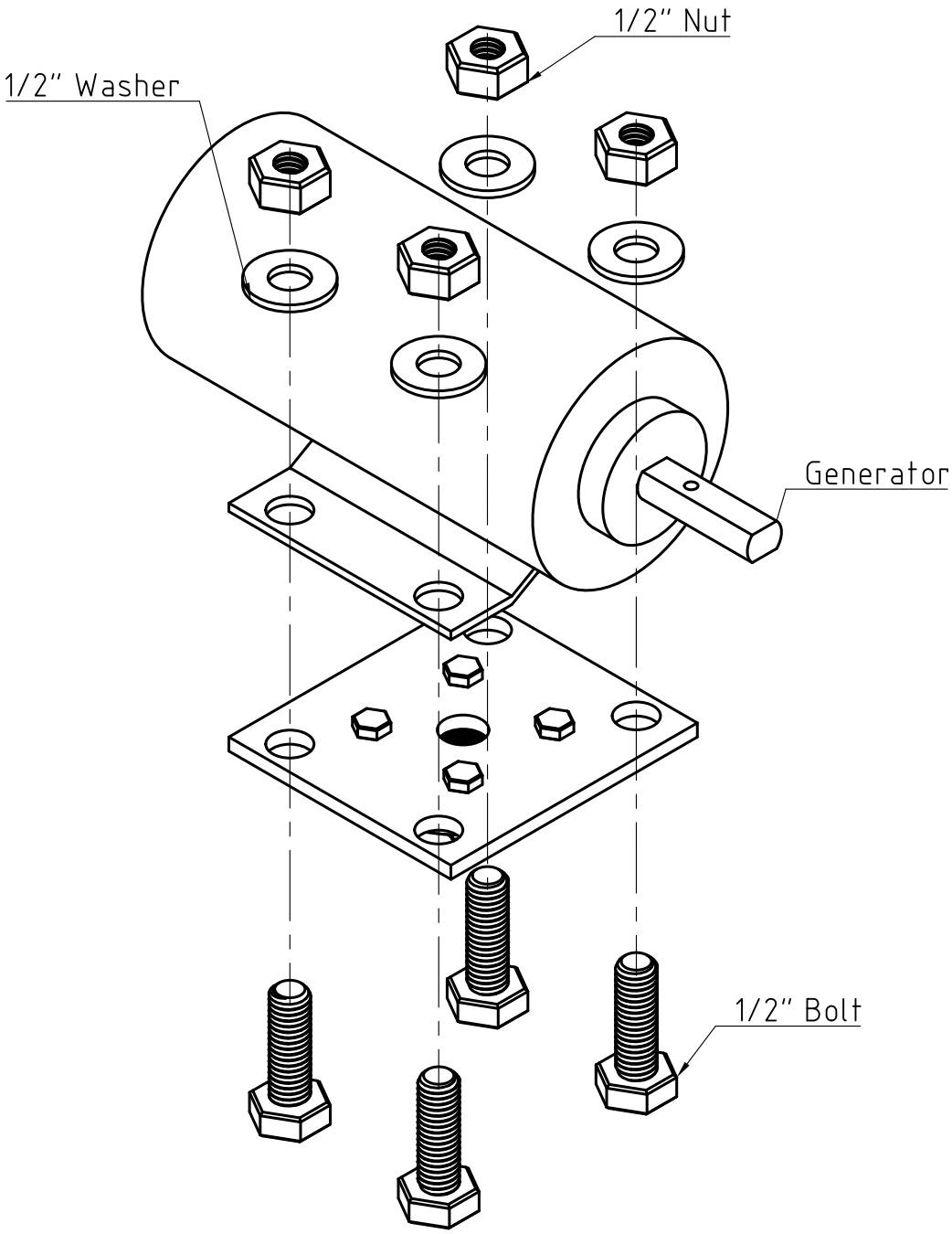


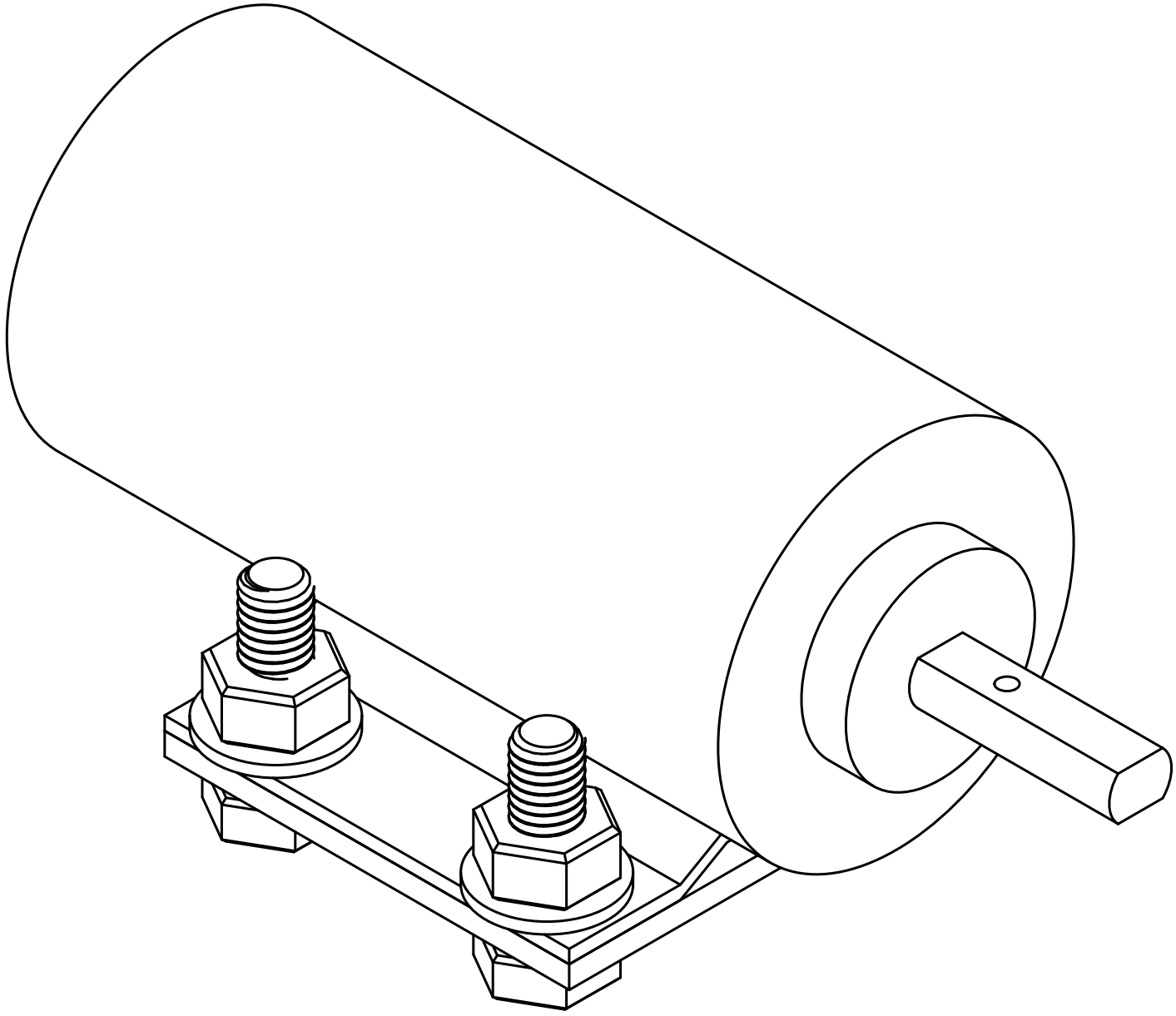


Fasten the base plate to the pipe flange using M7x20mm bolts, nuts and washers.

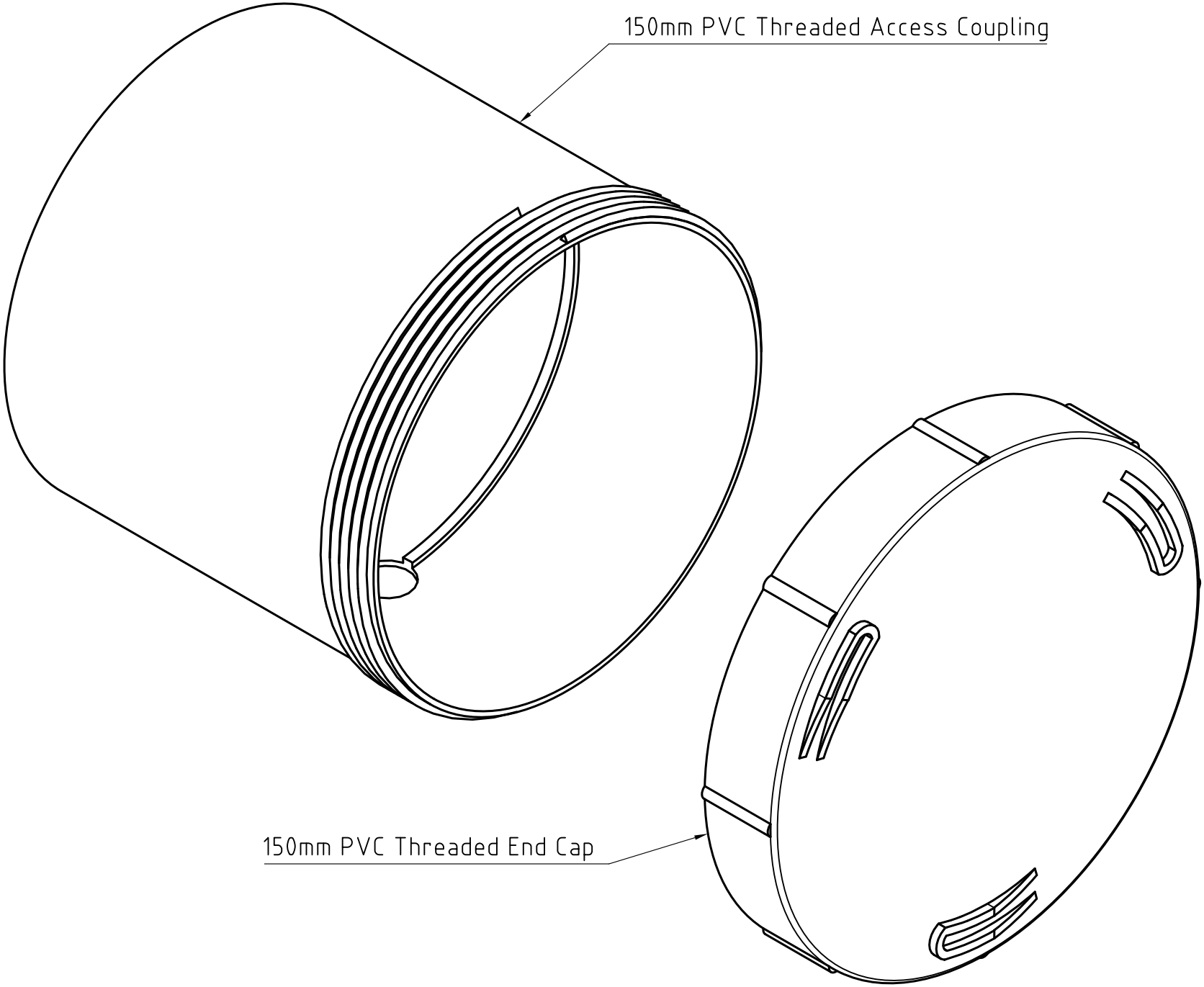


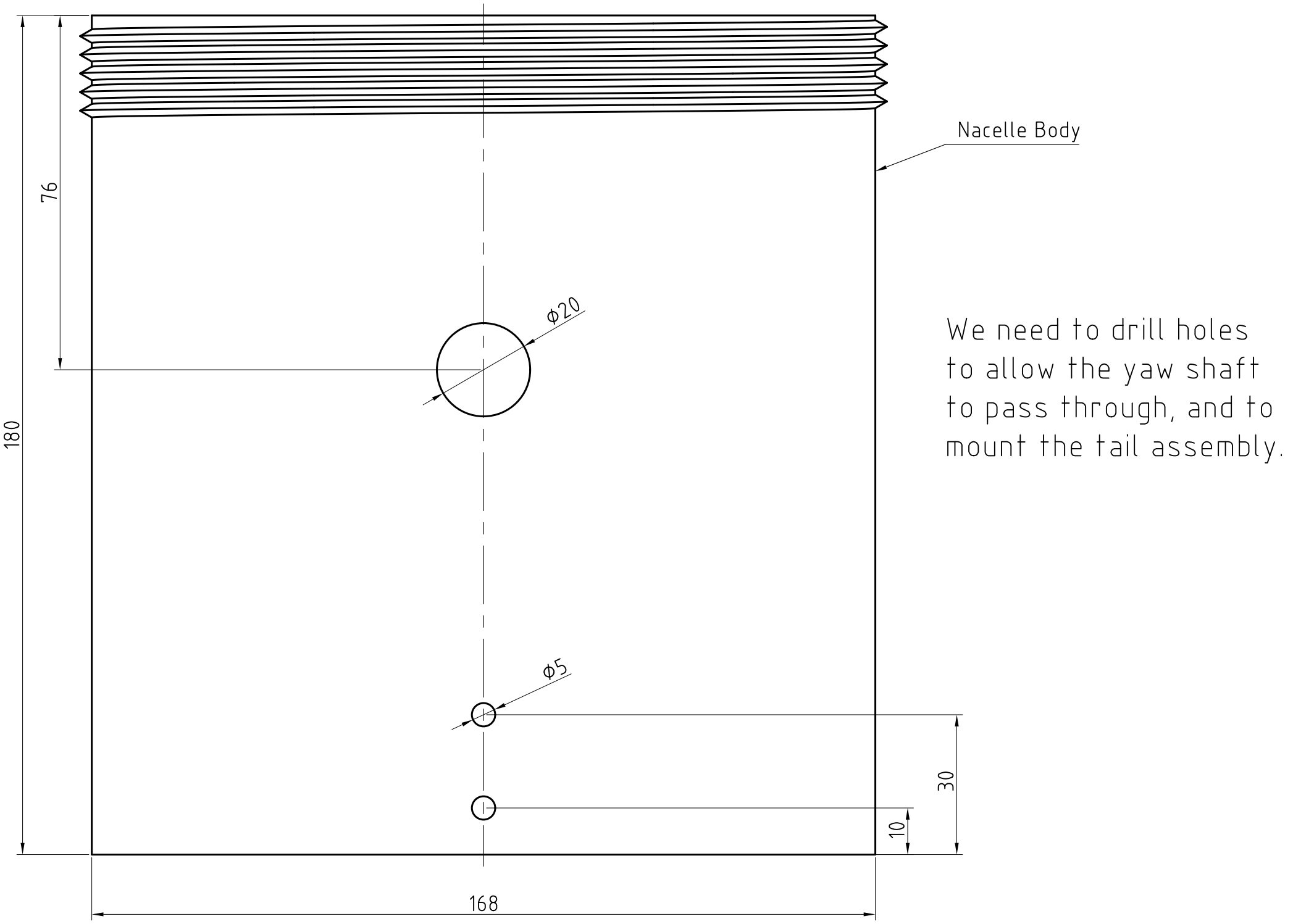
Fasten the generator to the base plate assembly using ½"x1.5" bolts, nuts and washers.



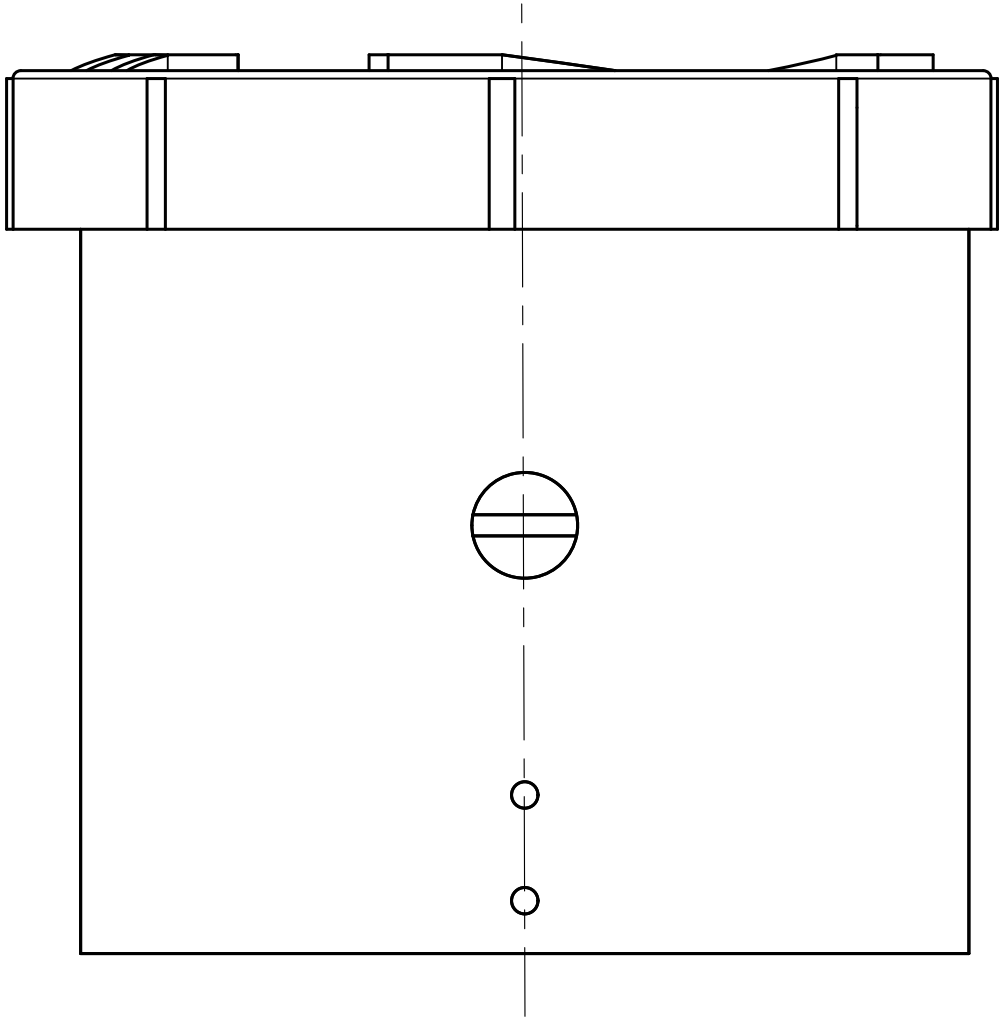


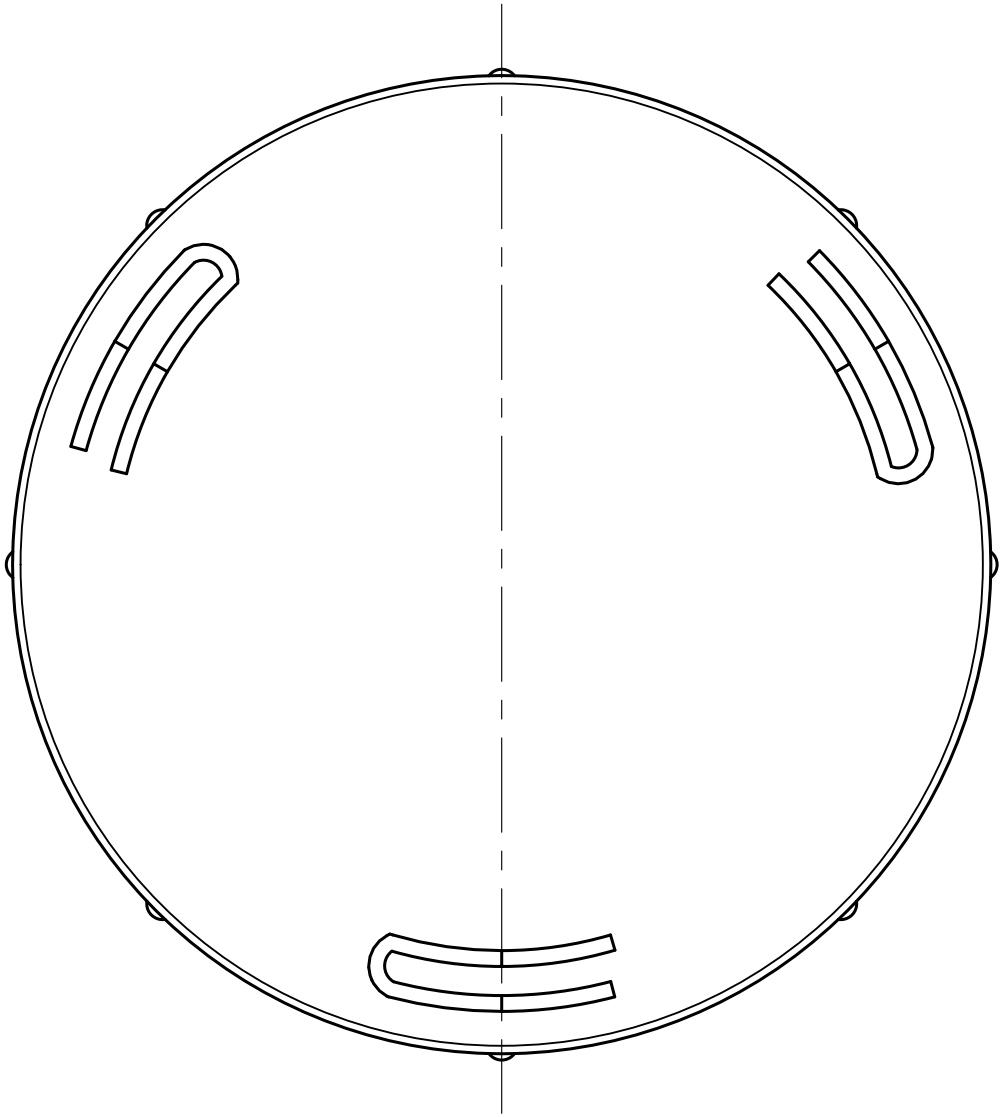
To keep the motor protected from rain, we use a threaded section of 150mm PVC and end cap.



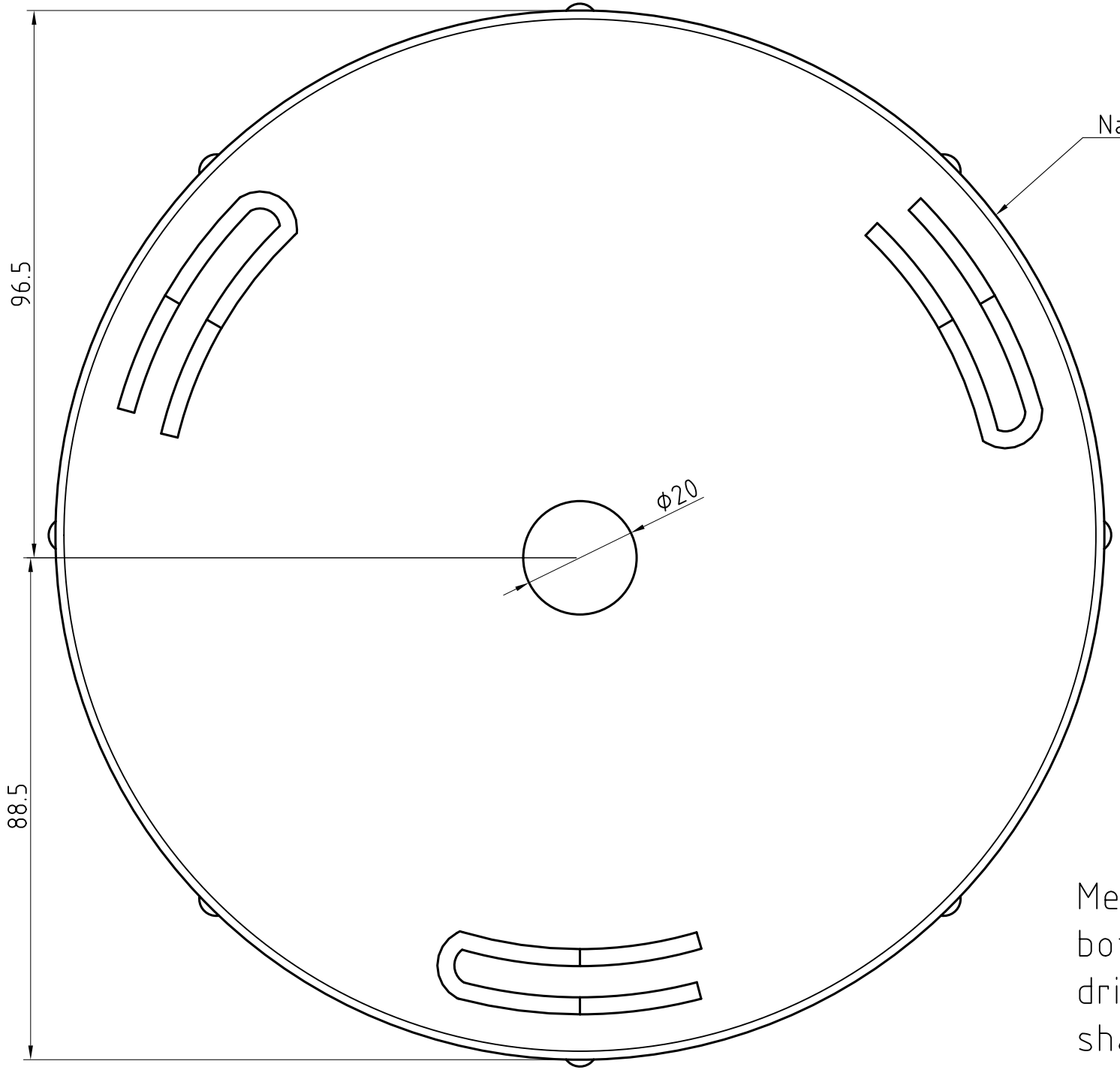


We need to drill holes to allow the yaw shaft to pass through, and to mount the tail assembly.



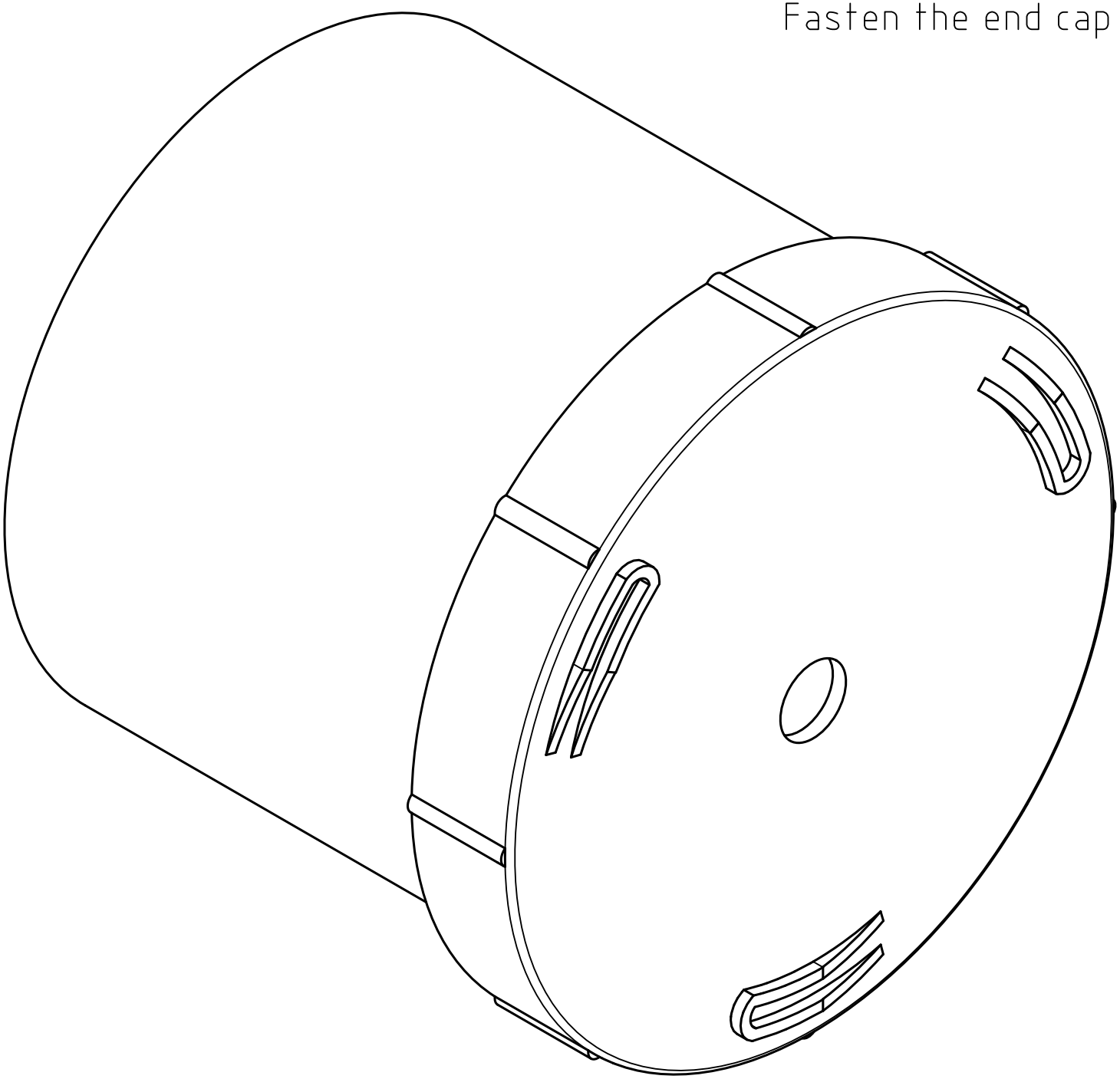


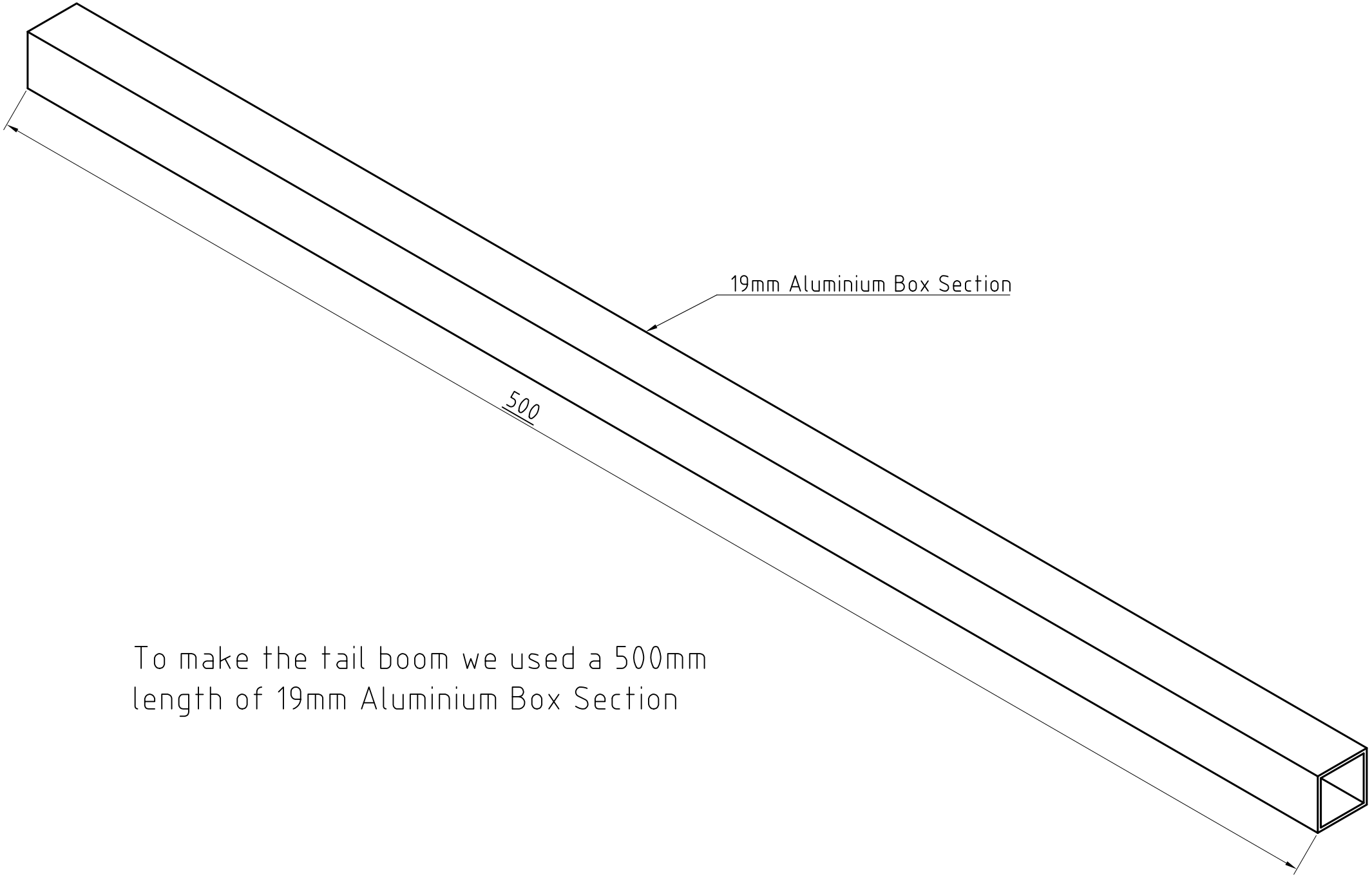
The hole in the end cap is slightly off-centre due to the dimensions of the motor. To ensure it is drilled in the correct place, first fasten the end cap to the coupling and take note which direction the end cap sits when fully secure. Mark out a vertical line to make it clear.



Measure 88.5mm from the bottom of this vertical line and drill 20mm hole for the motor shaft to pass through.

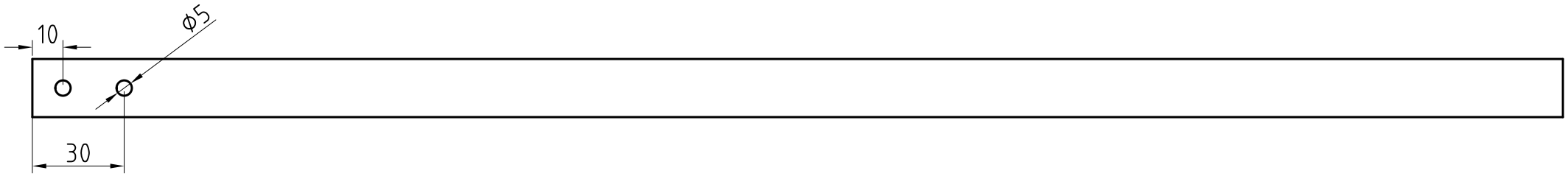
Fasten the end cap and the coupling together.



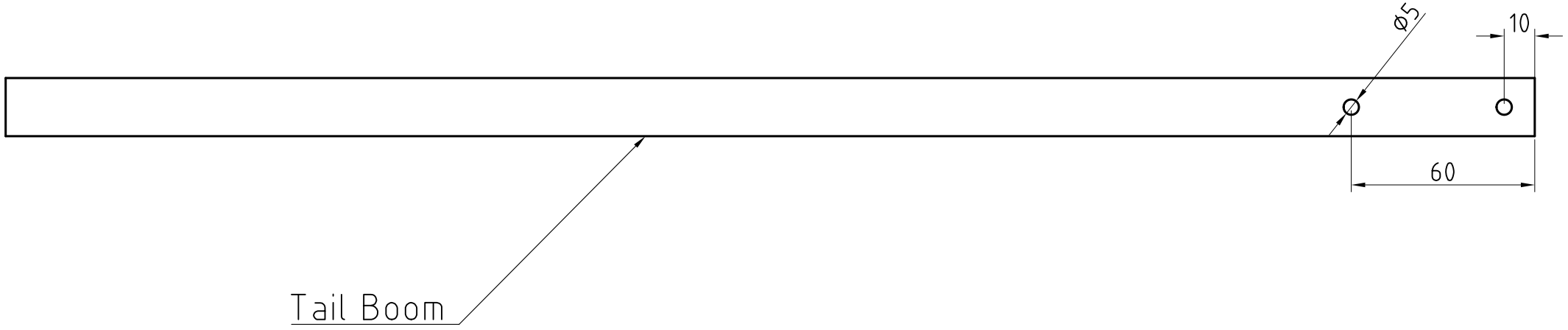


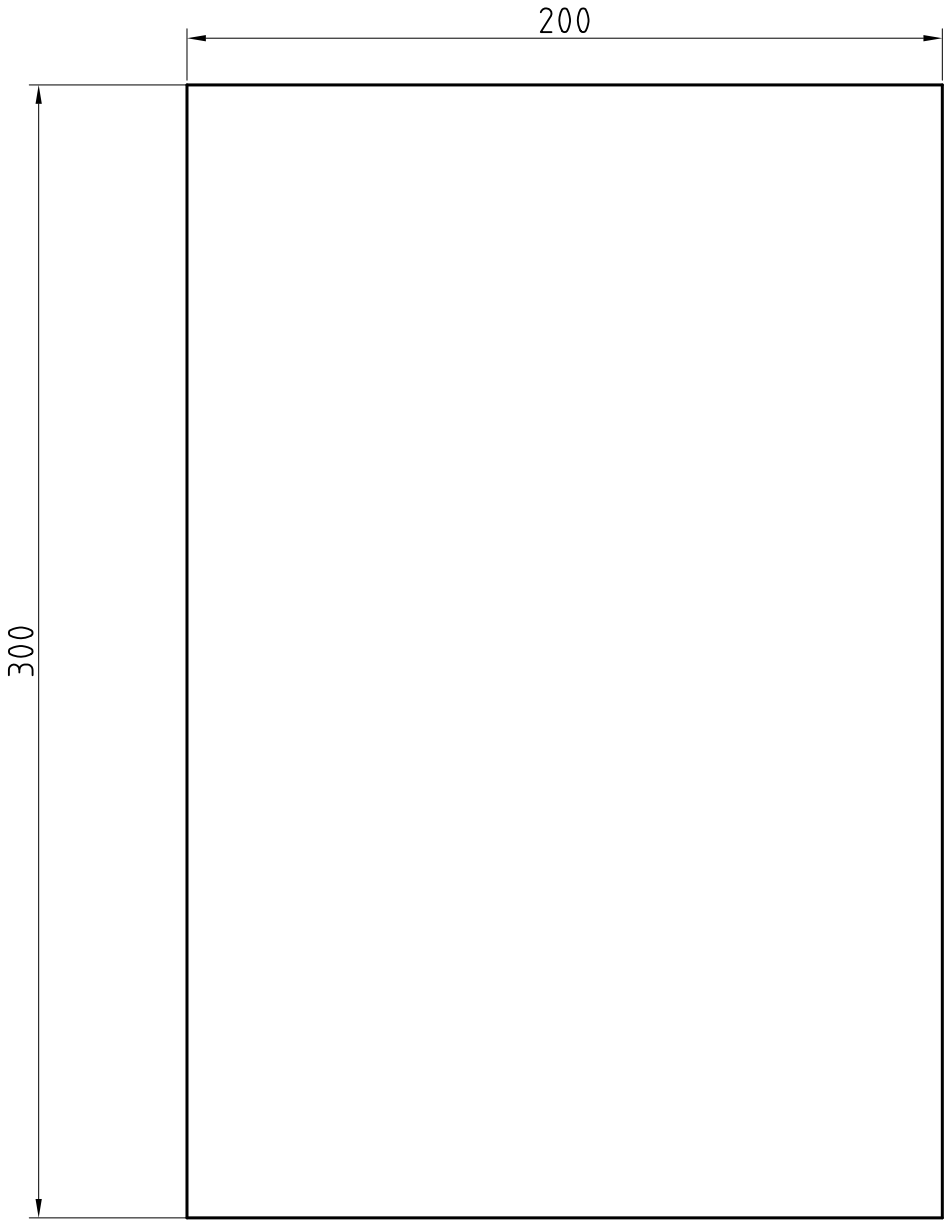
To make the tail boom we used a 500mm length of 19mm Aluminium Box Section

Drill 2x 5mm holes all the way through:

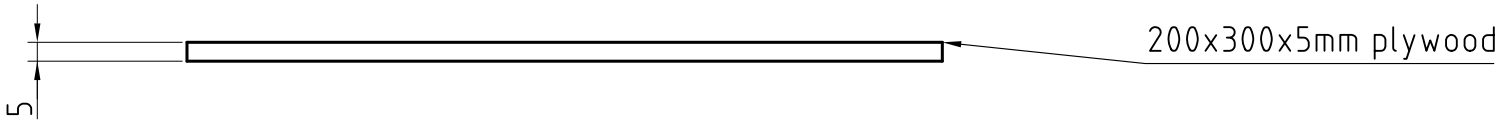


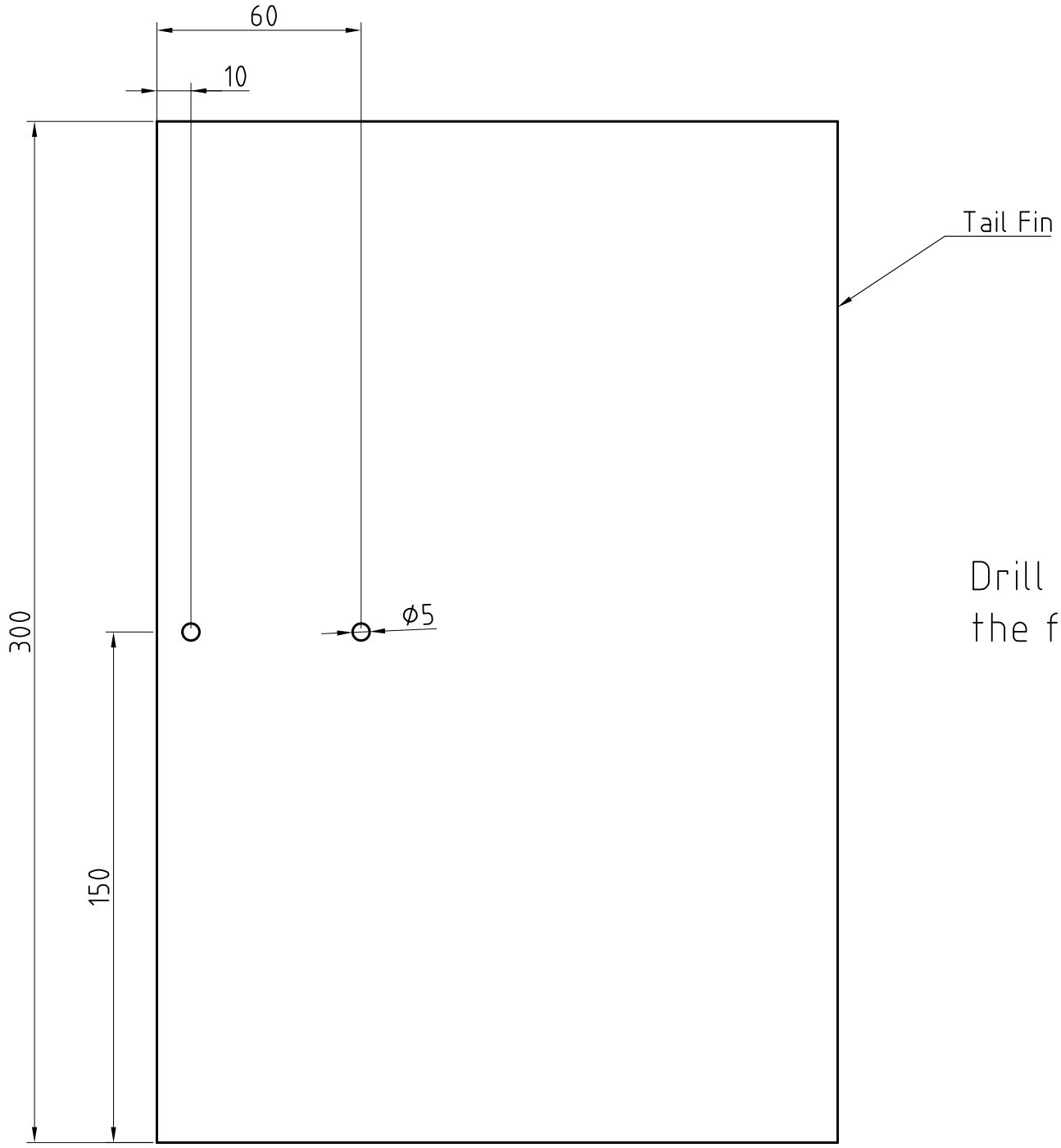
Rotate the piece by 90 degrees and drill two more holes at the other end.





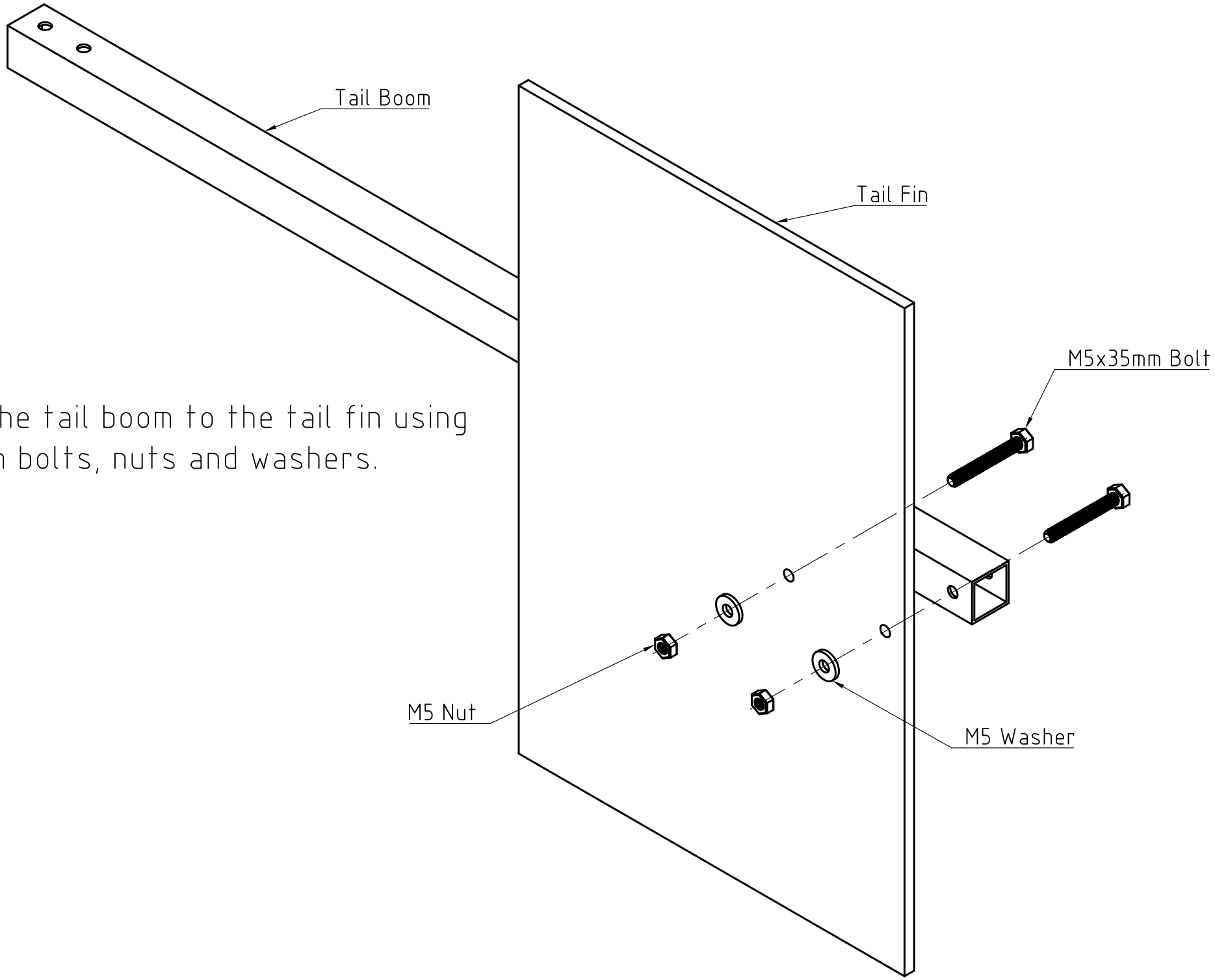
For the tail fin we need to cut another piece of 5mm plywood measuring 200x300 mm.

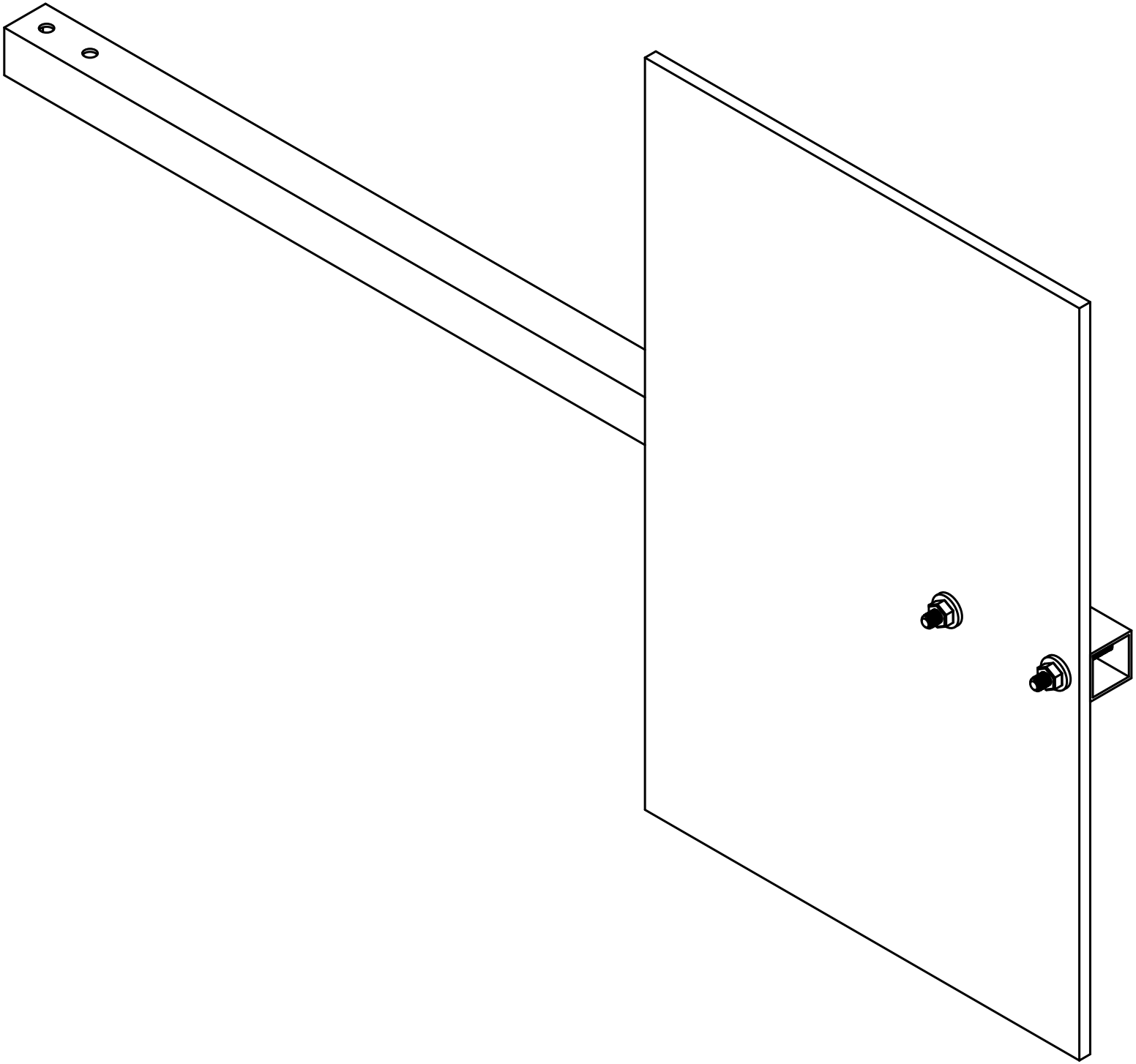


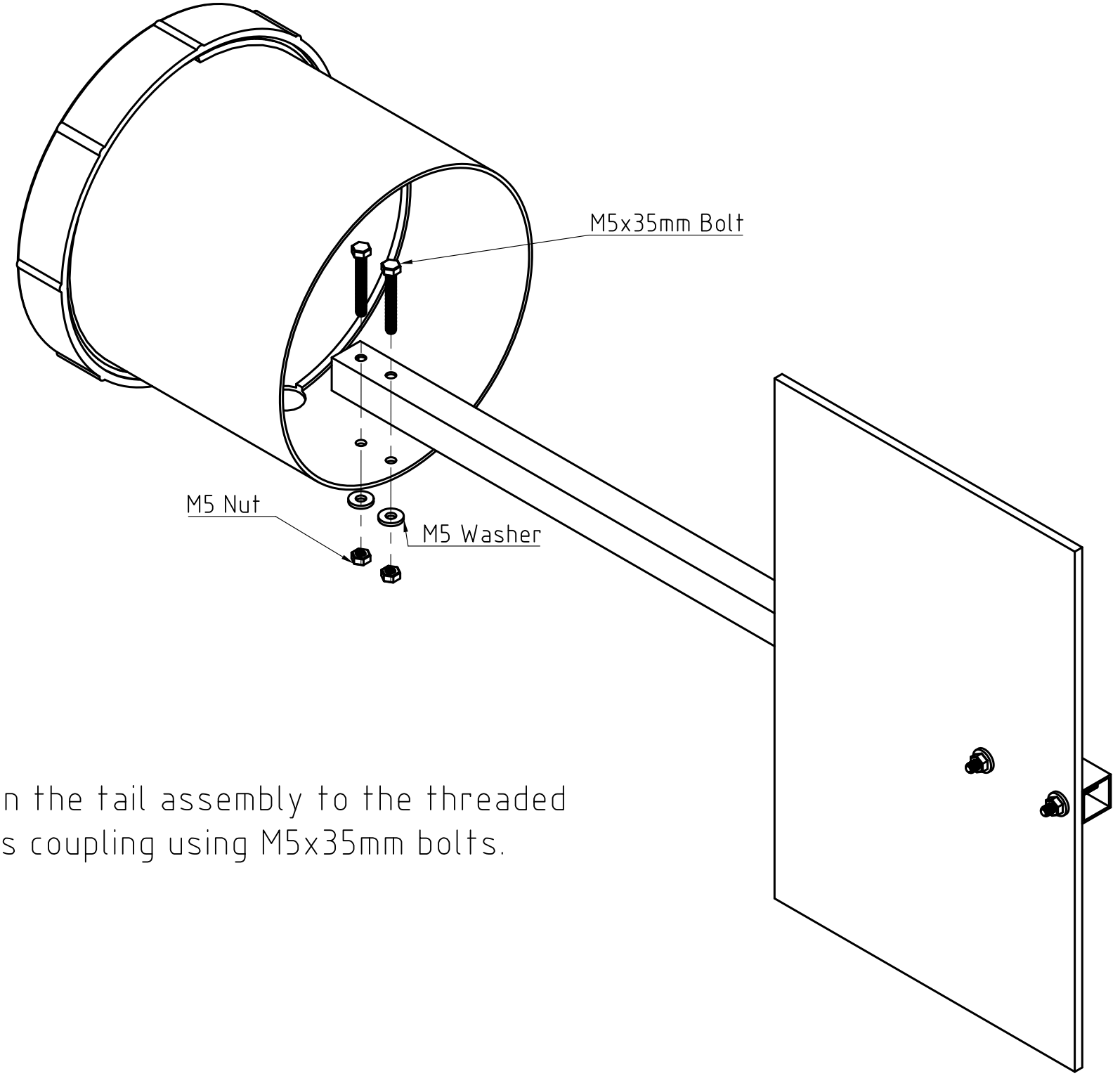


Drill 2x 5mm holes according to the following dimensions

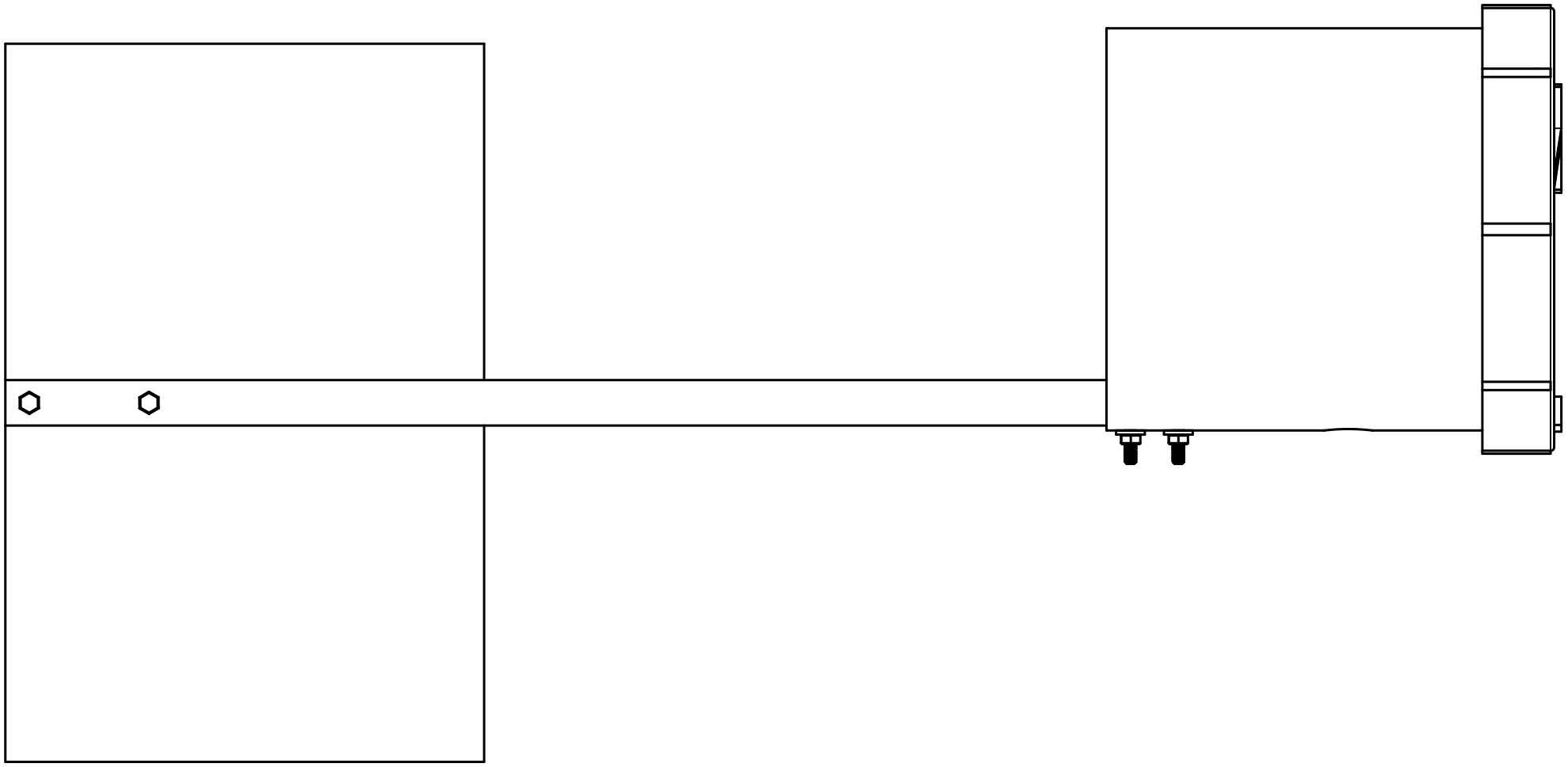
Fasten the tail boom to the tail fin using M5x35mm bolts, nuts and washers.

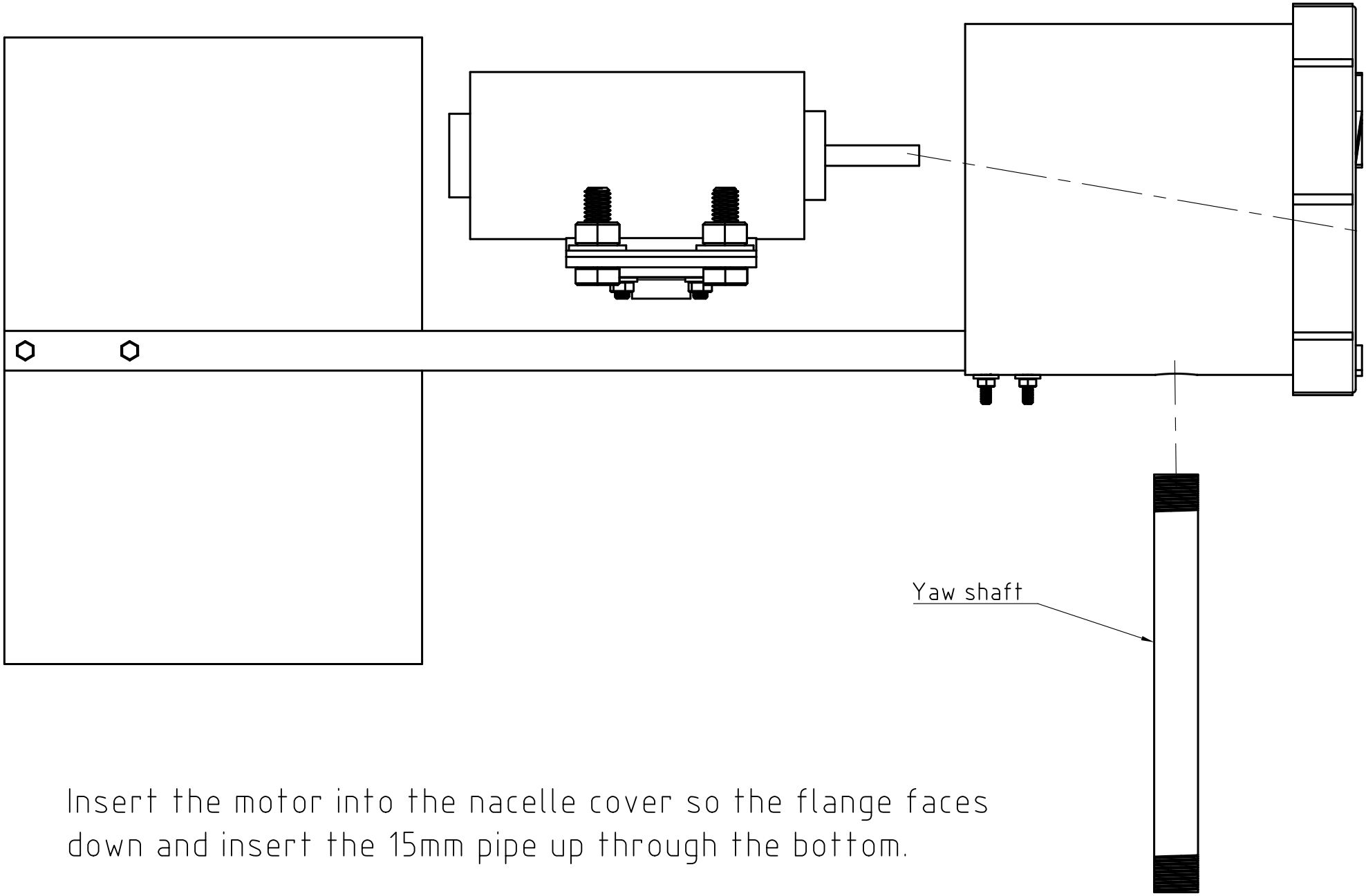




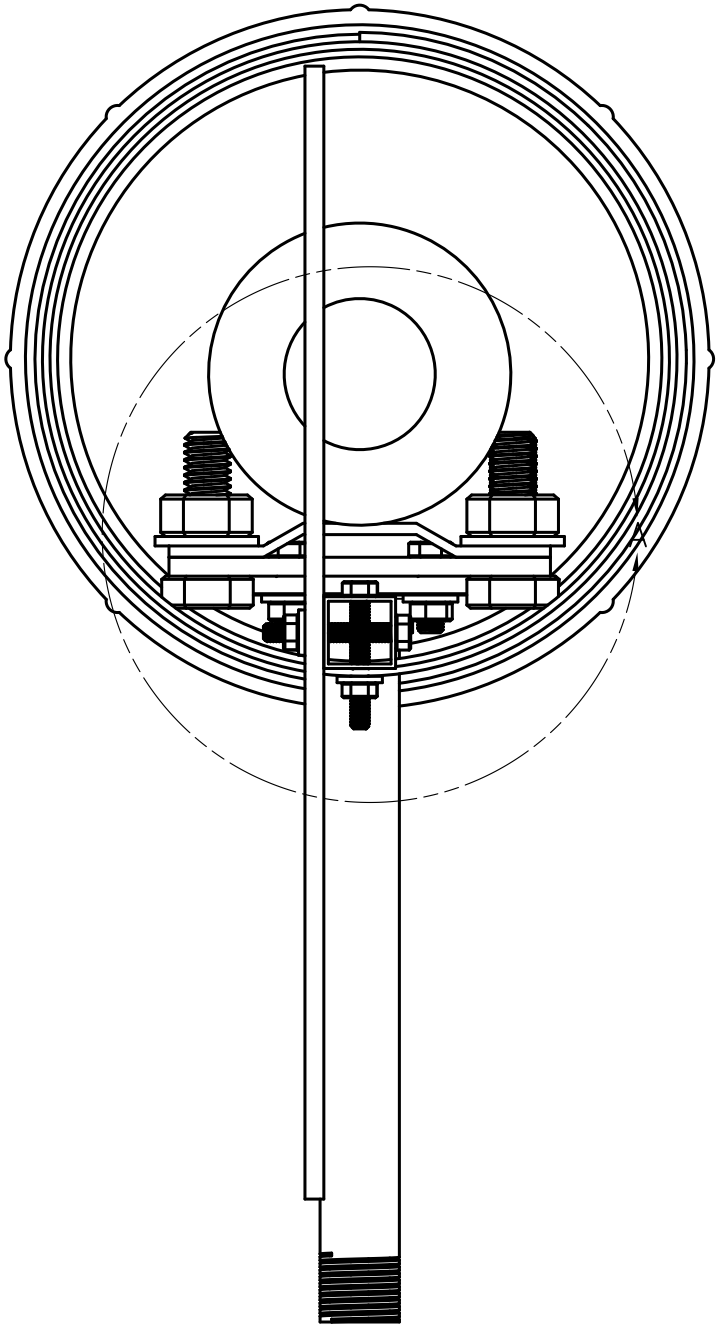


Fasten the tail assembly to the threaded access coupling using M5x35mm bolts.





Insert the motor into the nacelle cover so the flange faces down and insert the 15mm pipe up through the bottom.



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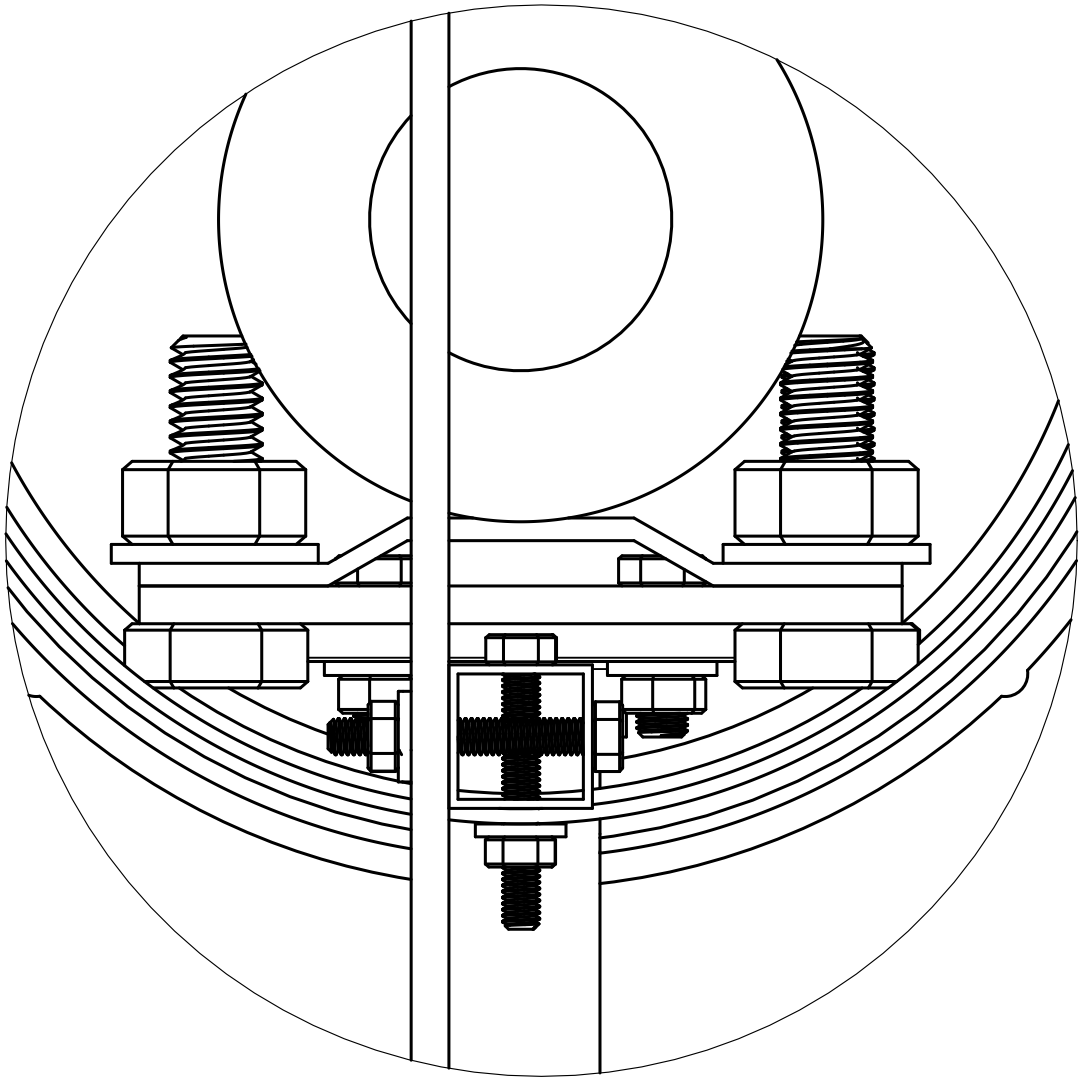

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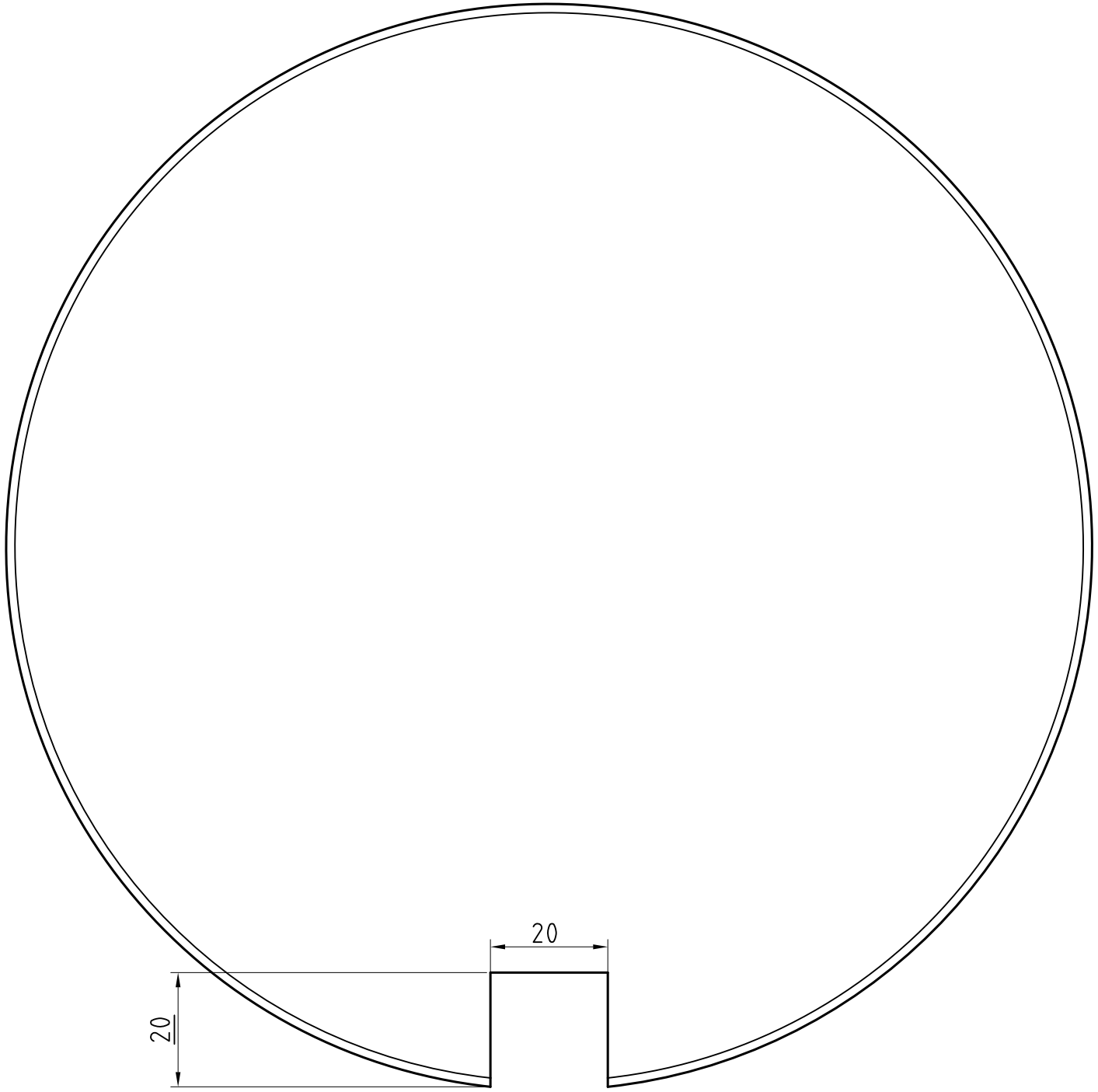
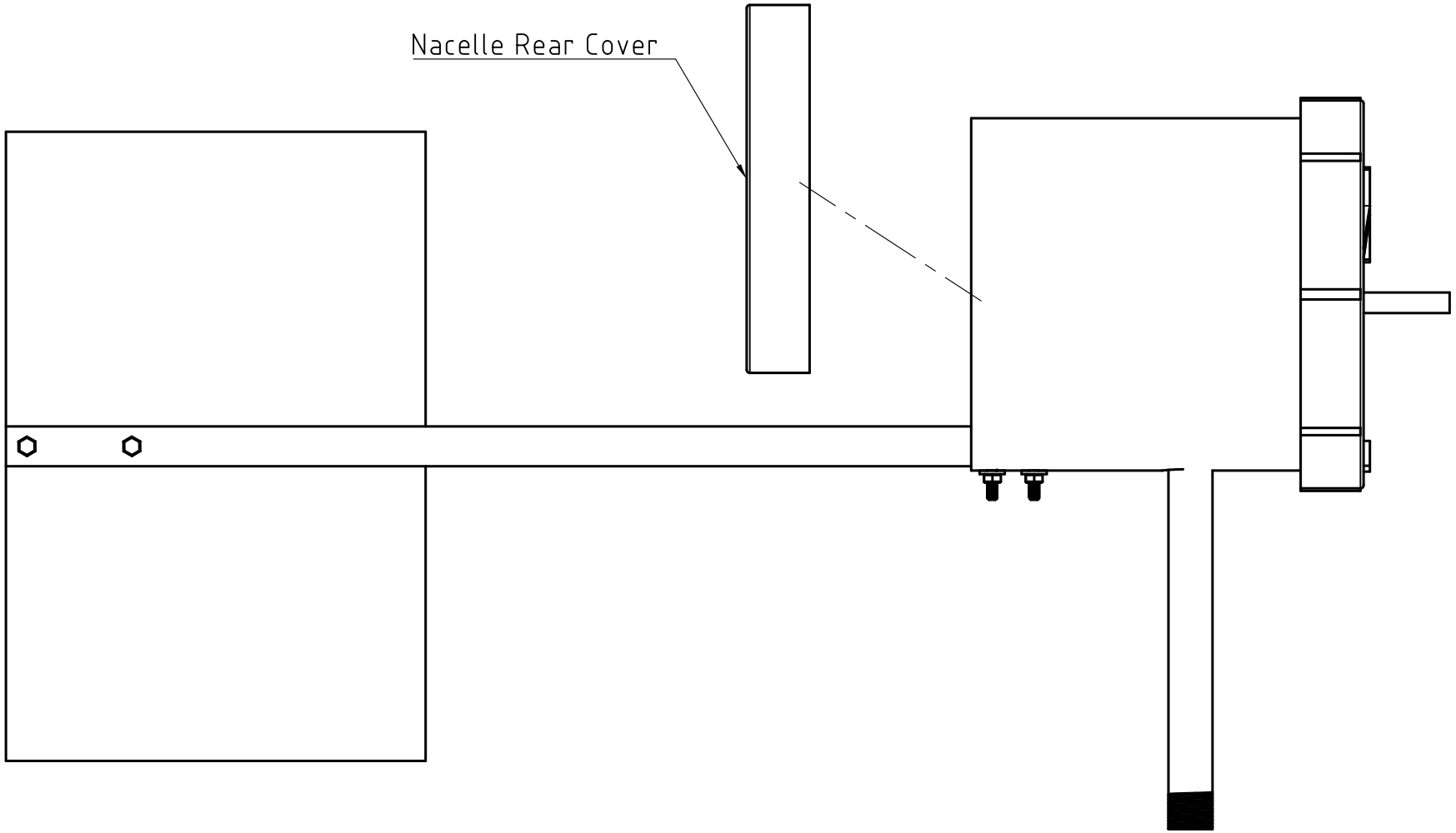
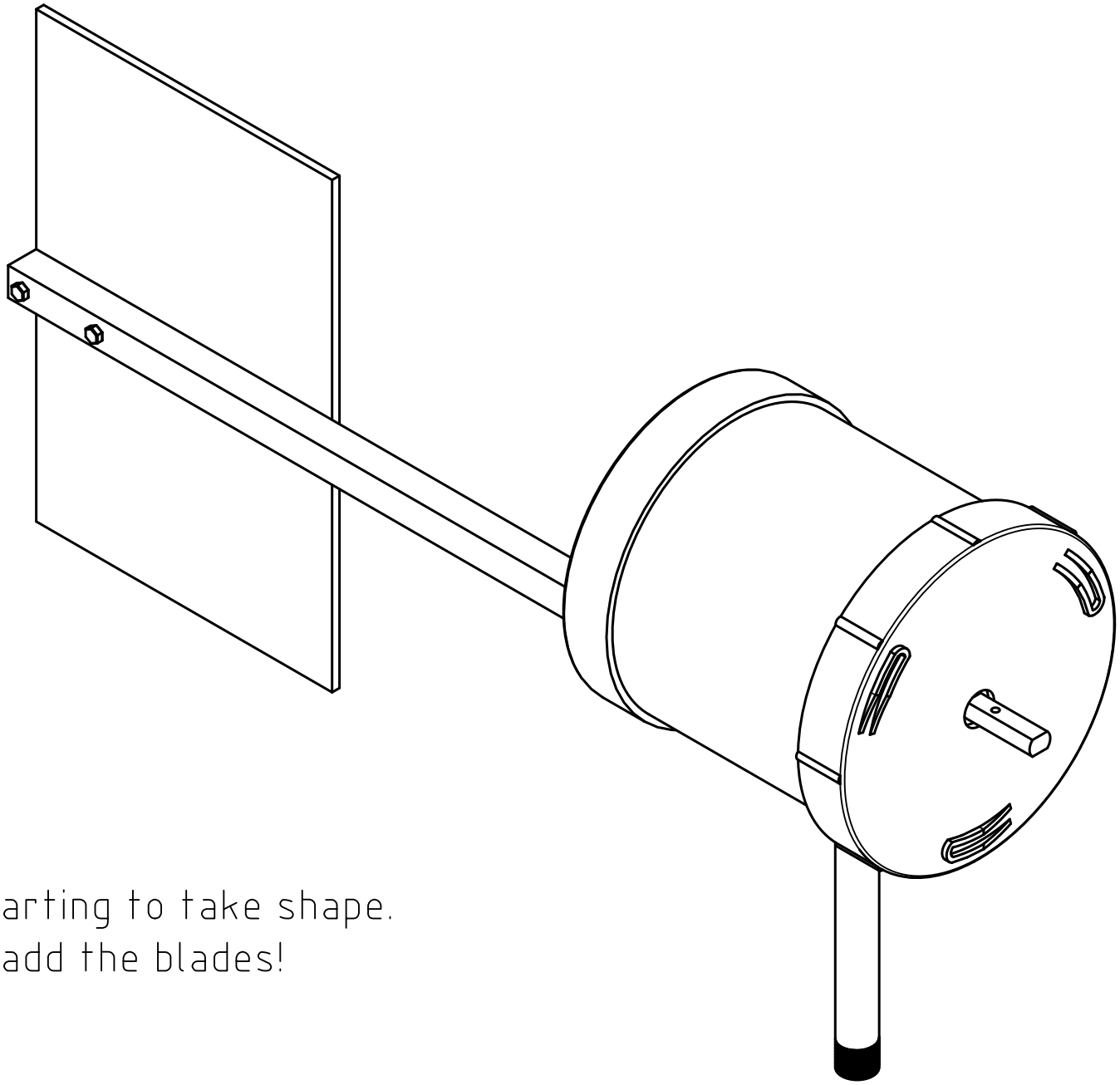
Screw the 15mm pipe into the flange as tight as possible. Note that the bolts will prevent the flange from sitting on the PVC, but this isn't a problem!

Cut out a 20mm square section from the edge of the non-threaded PVC end cap.

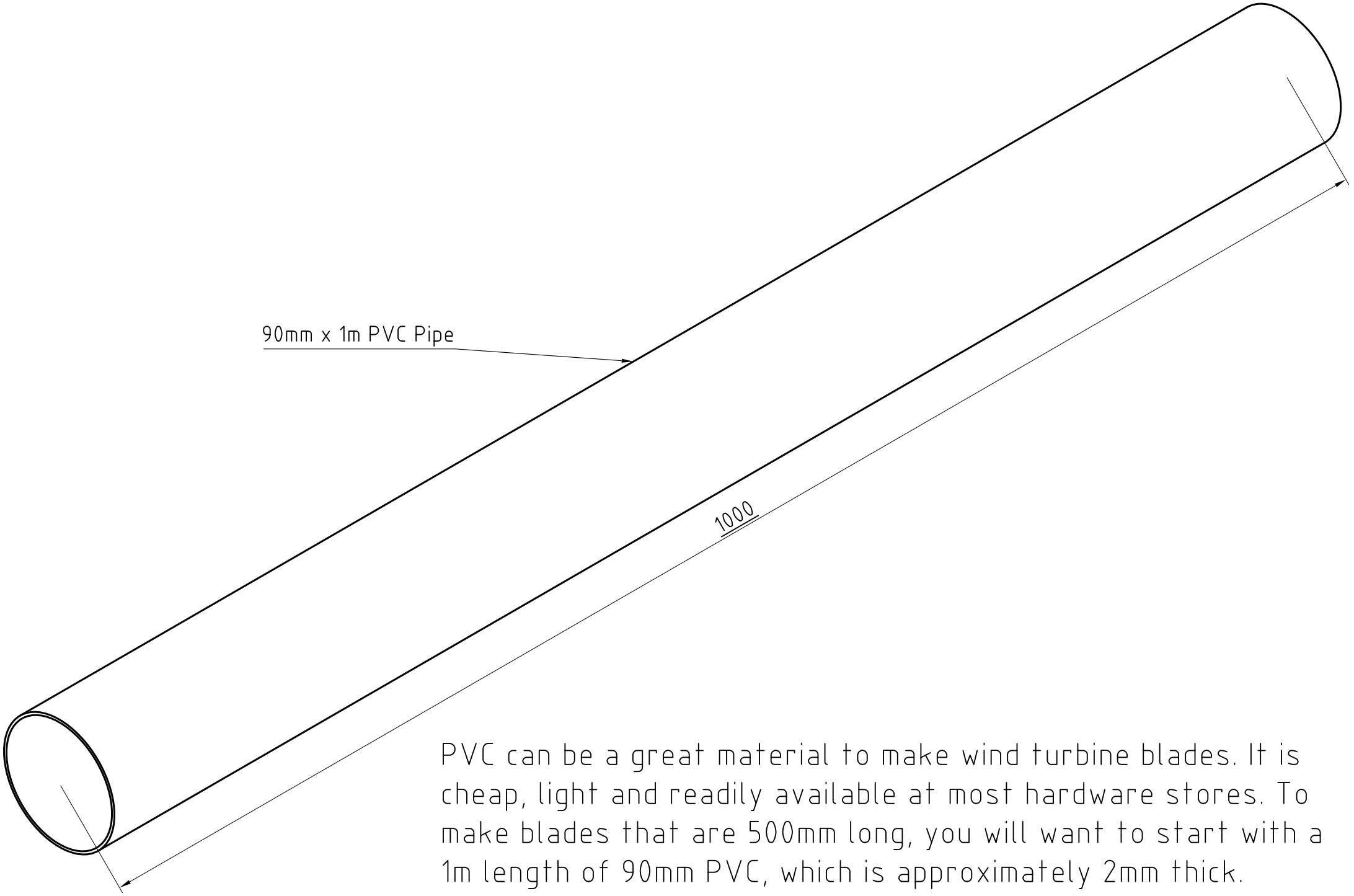




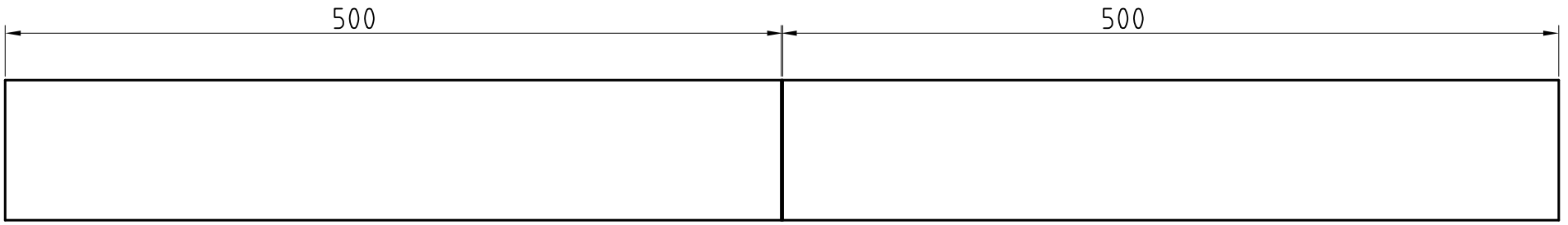
Push the PVC end cap onto the back of the coupling. You should have a tight fit and so don't need to use any fasteners.

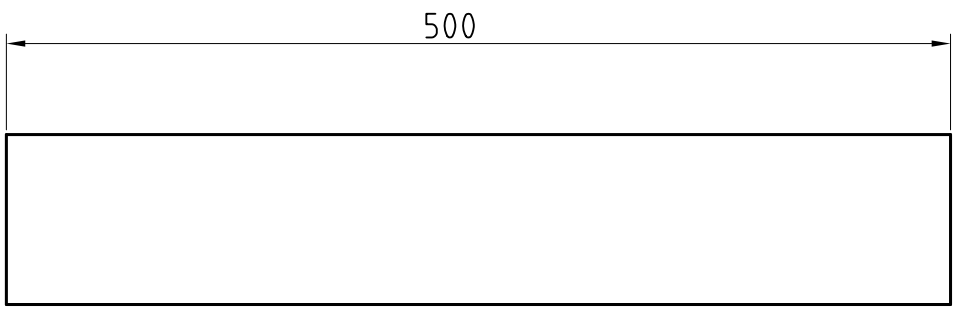


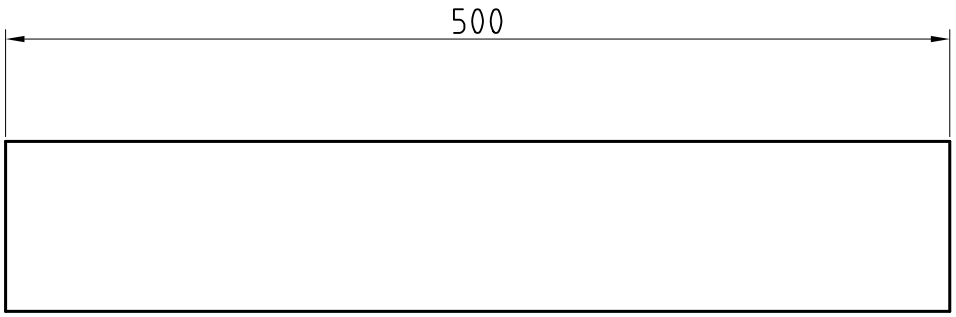
The turbine is starting to take shape.
We just have to add the blades!



PVC can be a great material to make wind turbine blades. It is cheap, light and readily available at most hardware stores. To make blades that are 500mm long, you will want to start with a 1m length of 90mm PVC, which is approximately 2mm thick.

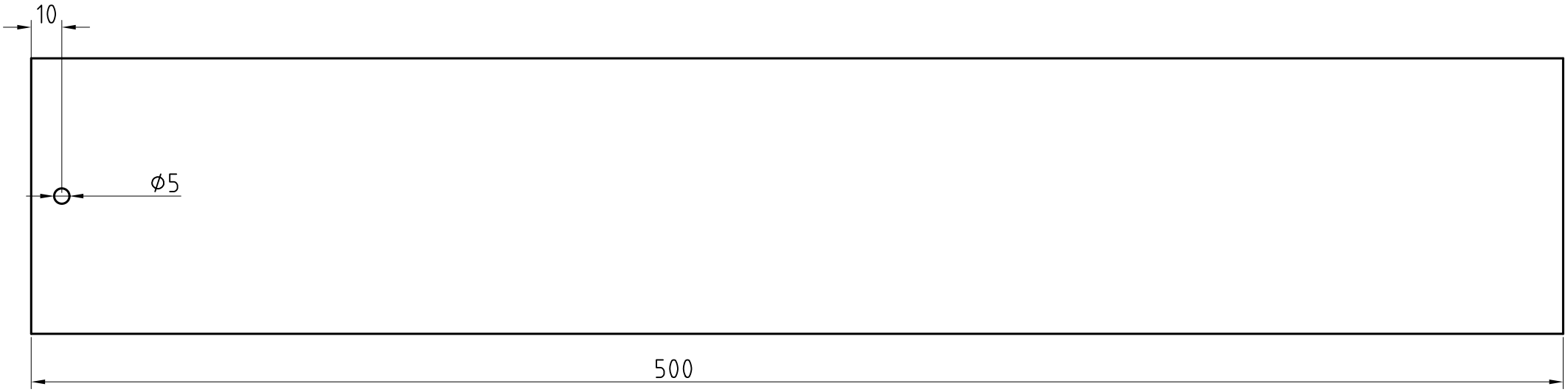


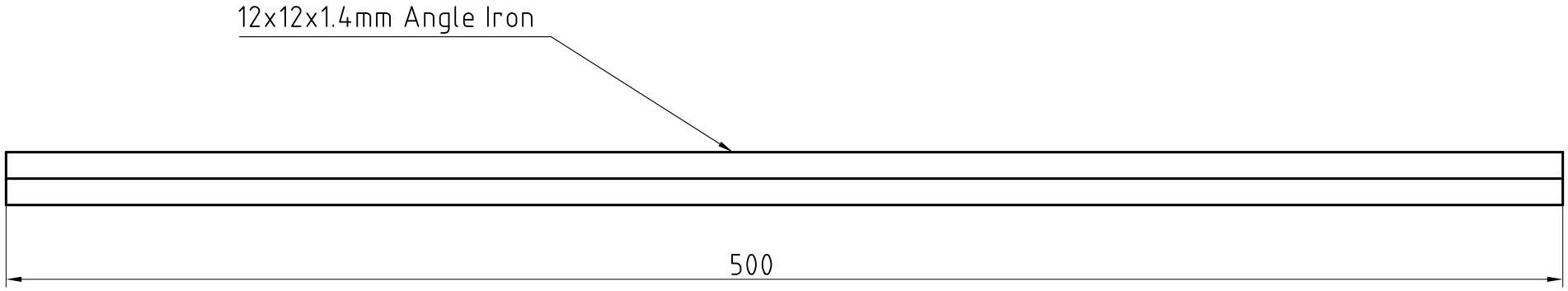




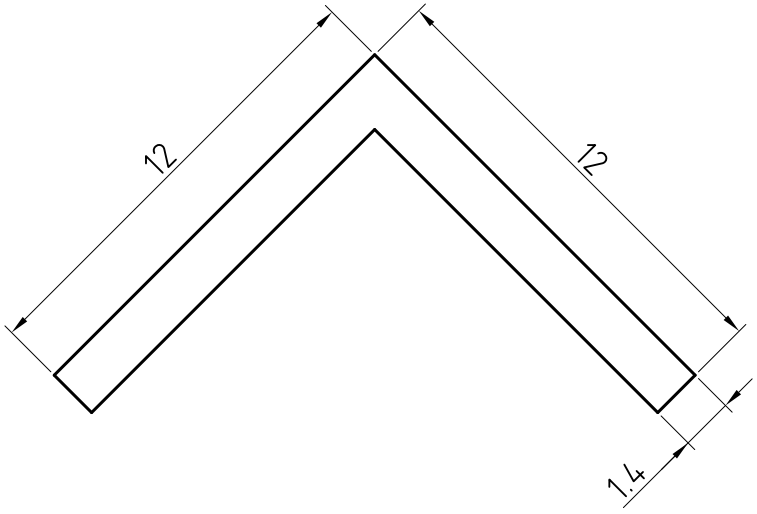
Measure and mark off 500mm from the end of the pipe.
Then carefully cut through to make two equal lengths.

Drill a 5mm hole, 10mm from one end of the pipe. Rotate the pipe 90 degrees and repeat three more times to give a total of four holes.

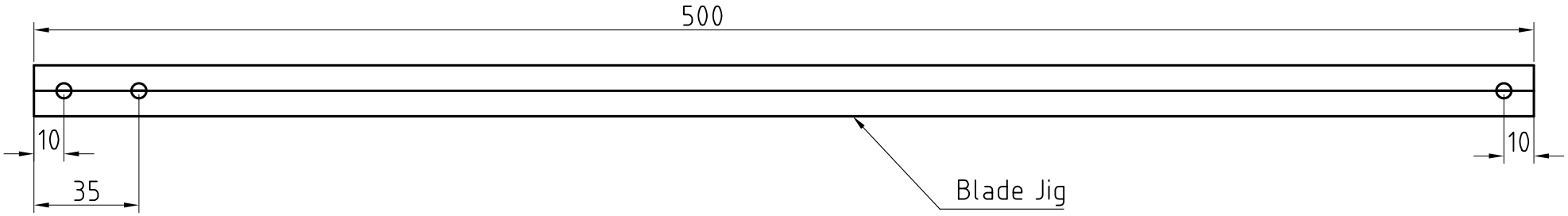


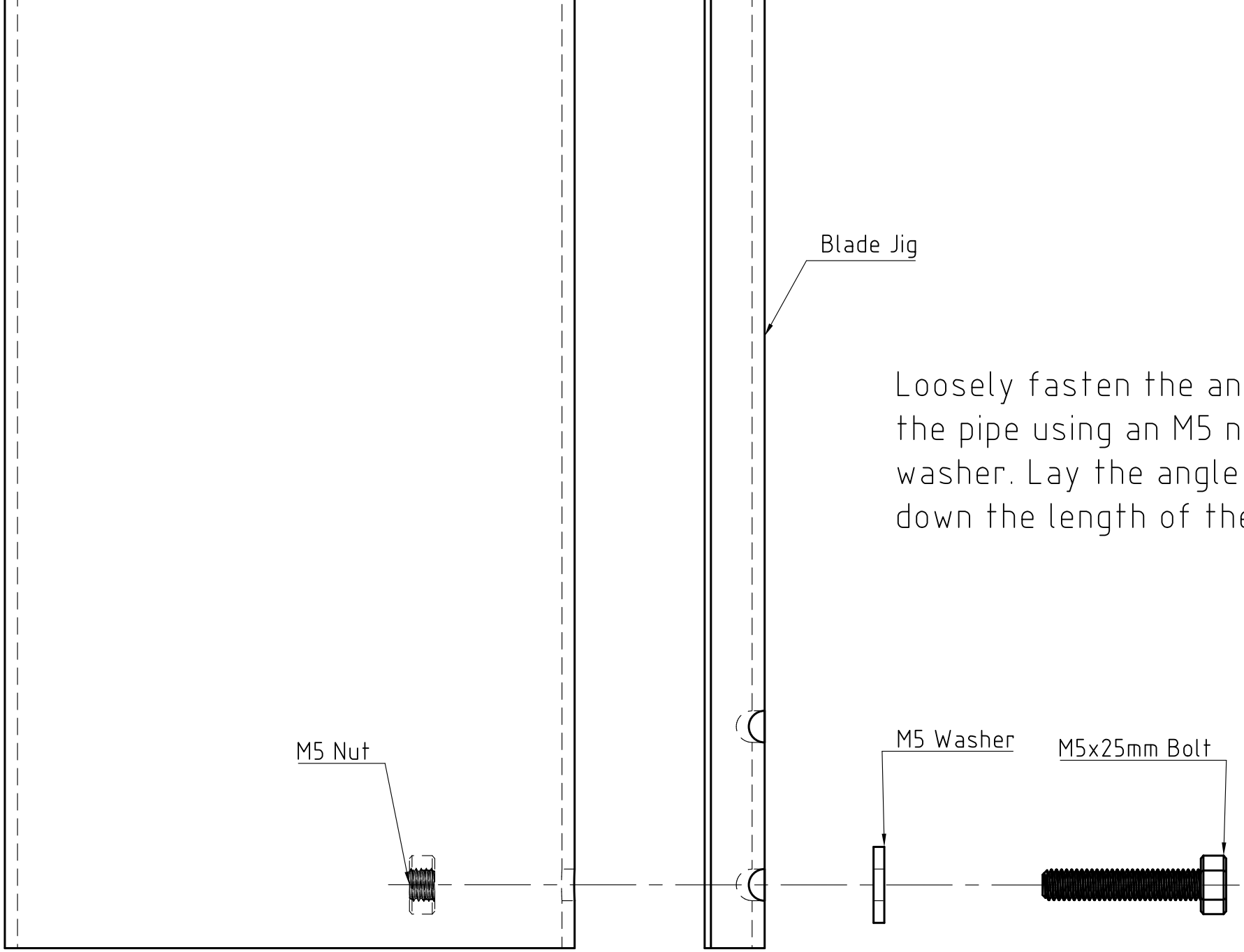


To make sure we cut and drill the blades accurately, we made a jig out of 12x12x1.4mm angle iron.

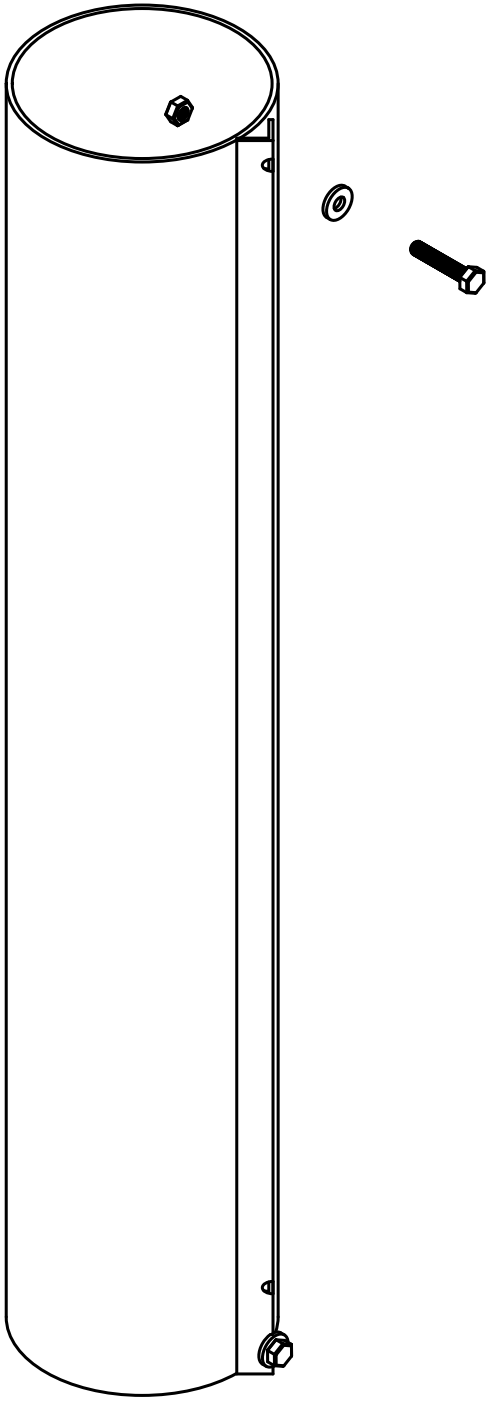


Drill three holes in the centre of the angle iron as shown here:



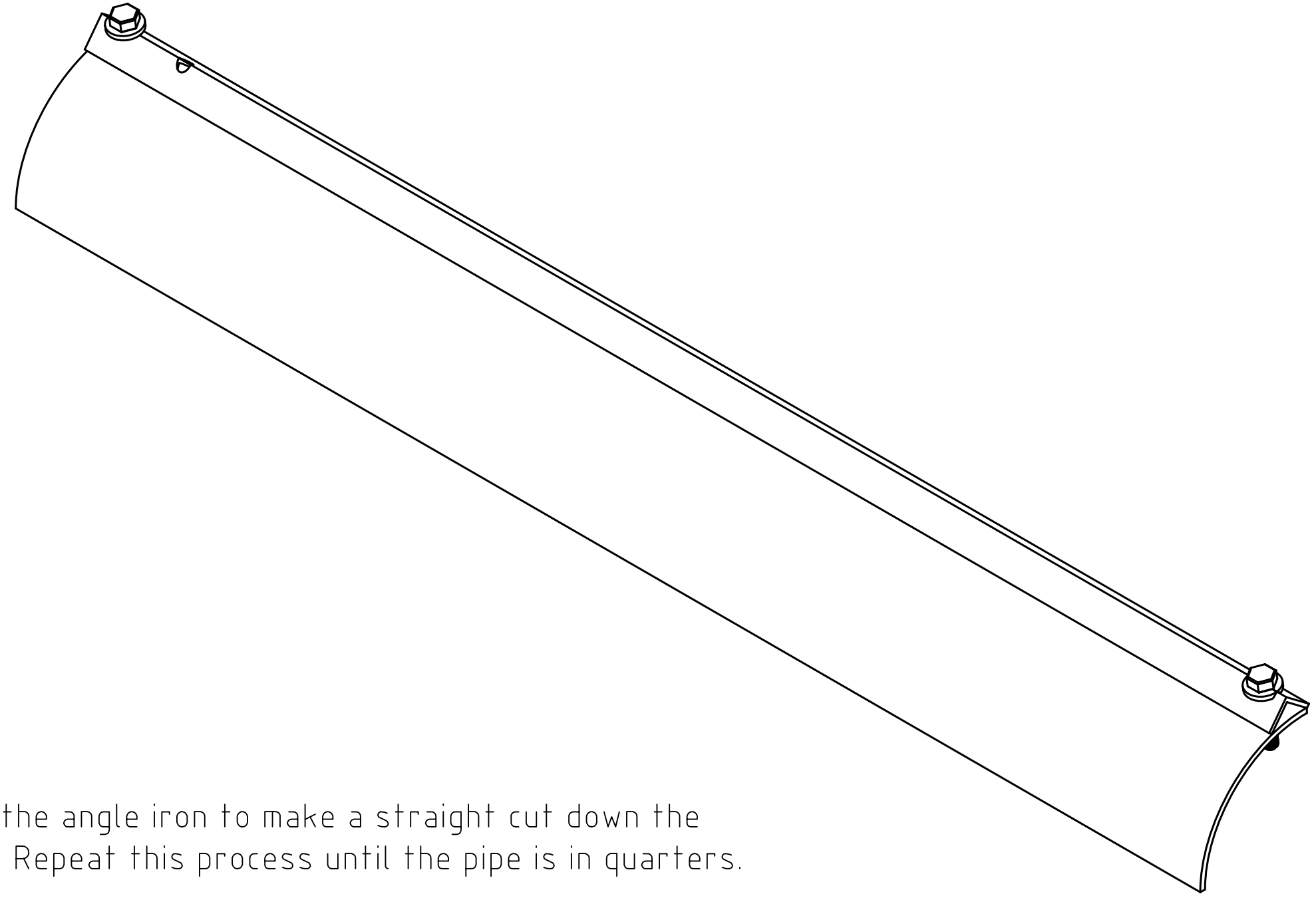


Loosely fasten the angle iron to the pipe using an M5 nut, bolt and washer. Lay the angle iron straight down the length of the pipe.



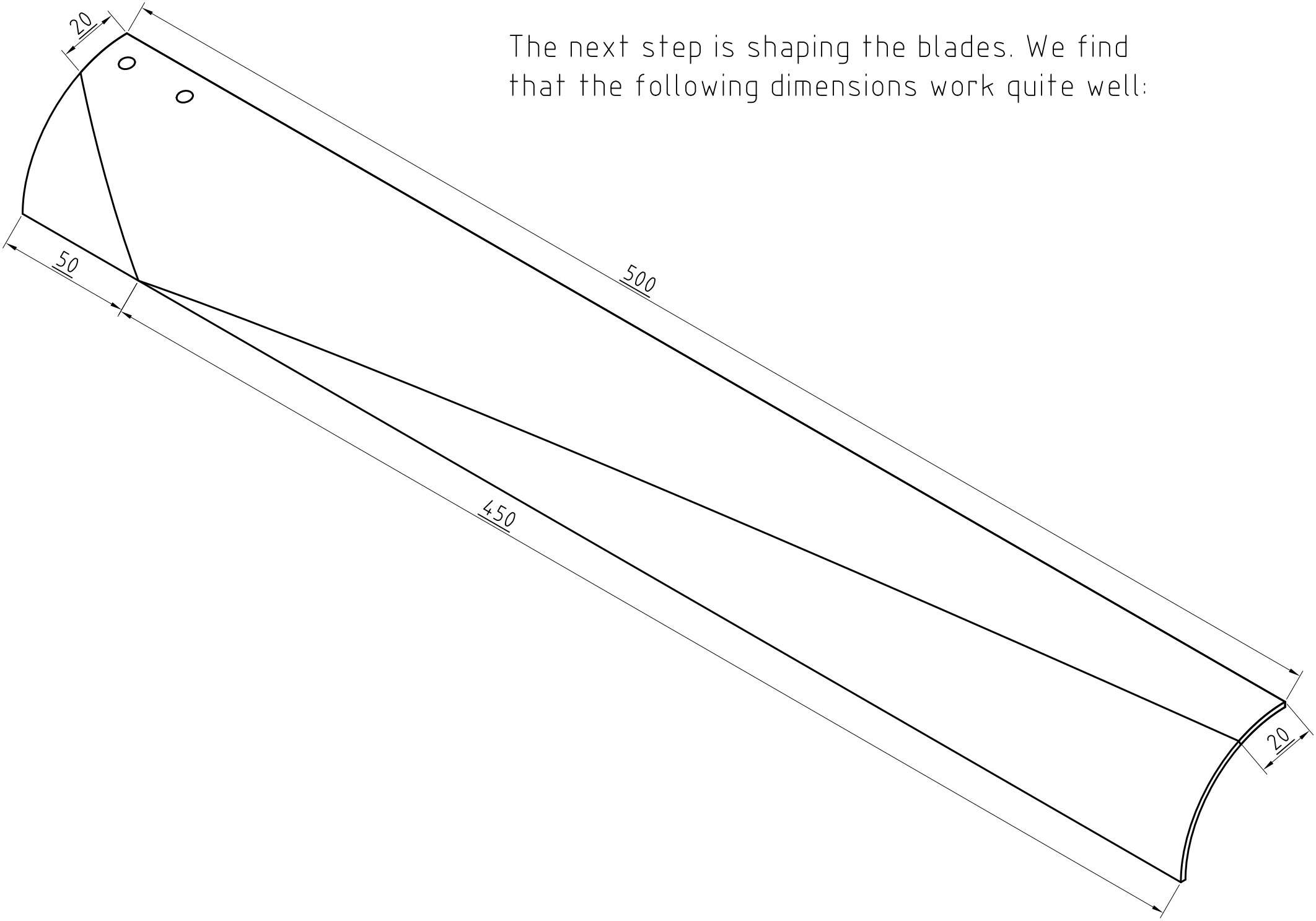
Line up the angle iron straight down the pipe and use the holes in the angle iron to drill two more holes in the PVC pipe.

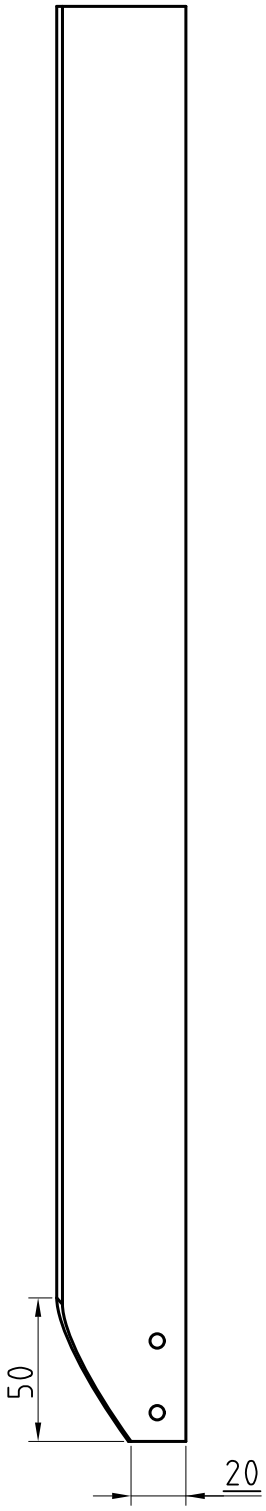
Fasten down the other end of the angle iron with another M5 nut, bolt and washer. Make sure the angle iron is straight and the bolts are tight.



Use the angle iron to make a straight cut down the pipe. Repeat this process until the pipe is in quarters.

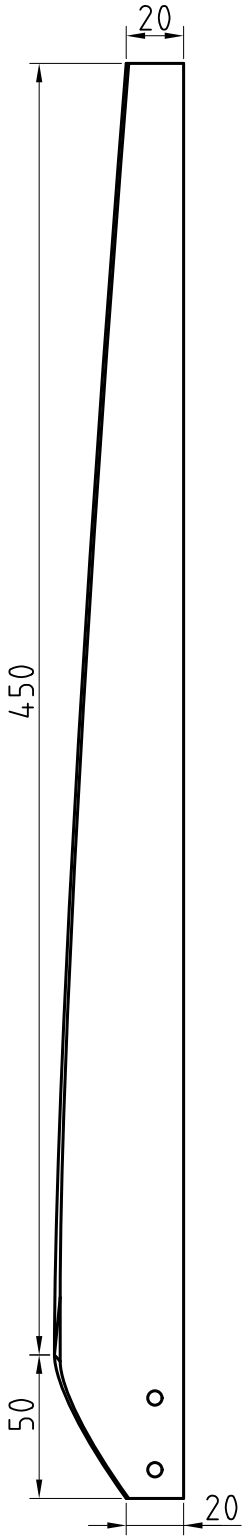
The next step is shaping the blades. We find that the following dimensions work quite well:



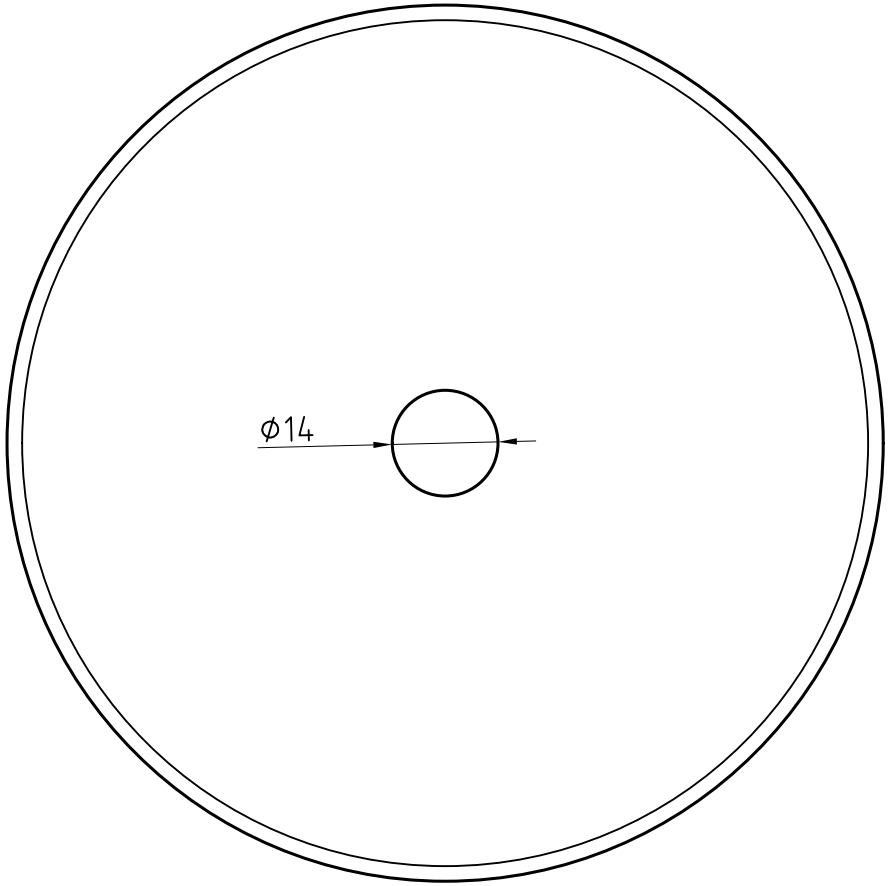


First we cut the 'root' of the blade. This is the end where the blade will be attached to the generator.

Measure the root to be 20mm wide and then mark off a point 50mm from the end. Using sticky tape, join these two parts with a straight line and make a cut to shape the blade.

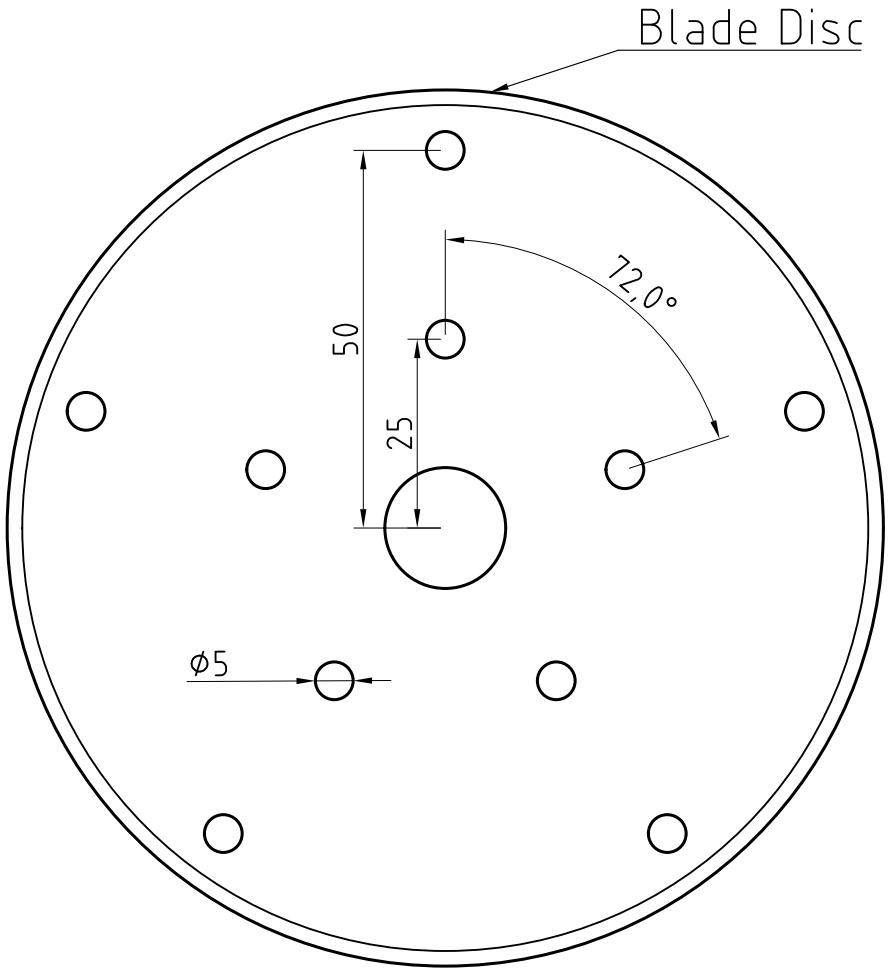


Repeat this process for the blade 'tip' using the dimensions shown. Note that it is difficult to cut accurately due to the shape of the blades, and so it is recommended to cut less than you think and then use a file and sandpaper to finish.



Find and mark off the centre of the 100mm PVC end cap. Use this mark to drill out a 14mm hole.

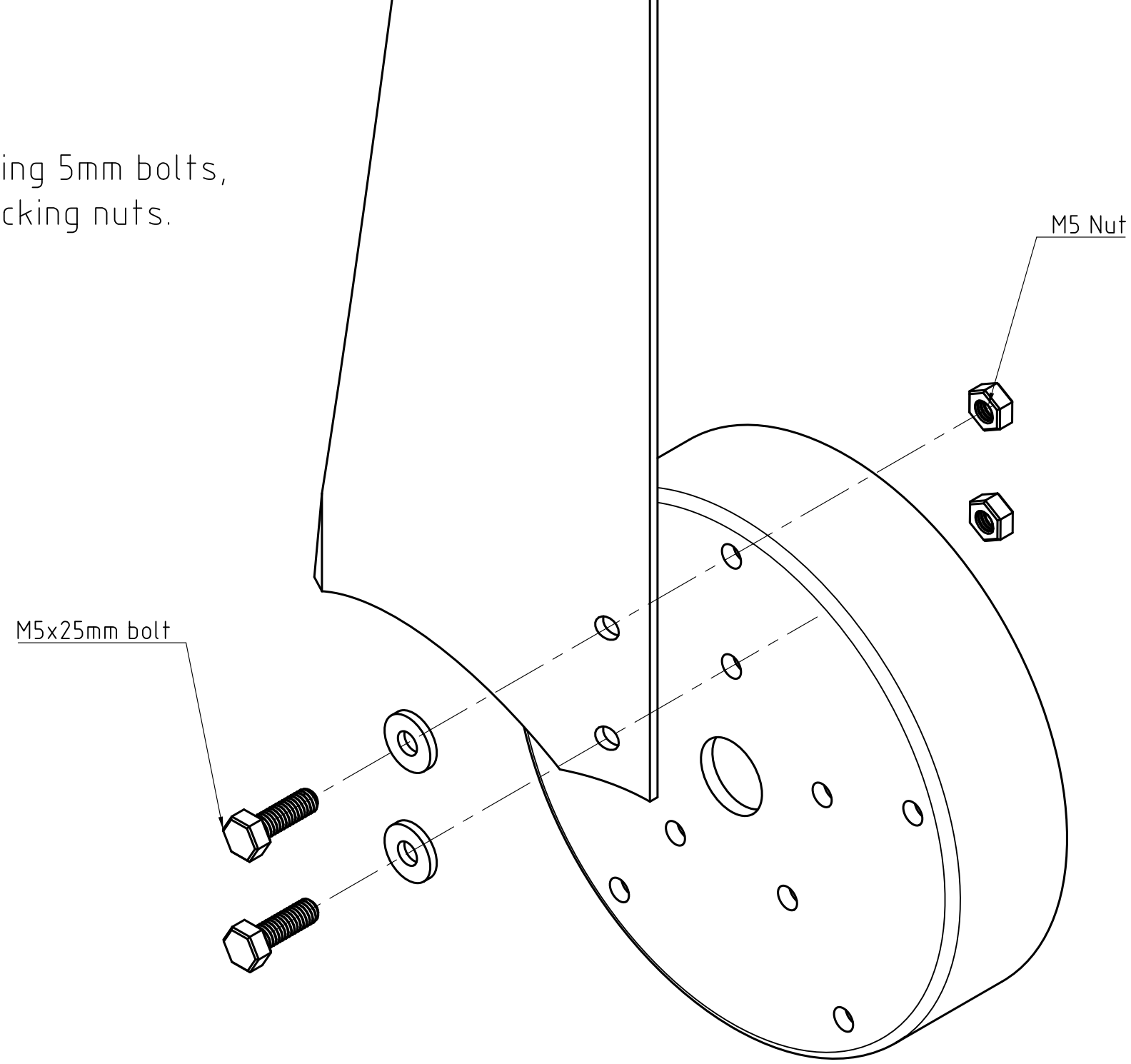
There may be a centre mark from manufacturing, but if this is difficult to find, see this guide for finding the centre of any circle:
http://www.instructables.com/id/How-to-find-the-center-of-a-circle/

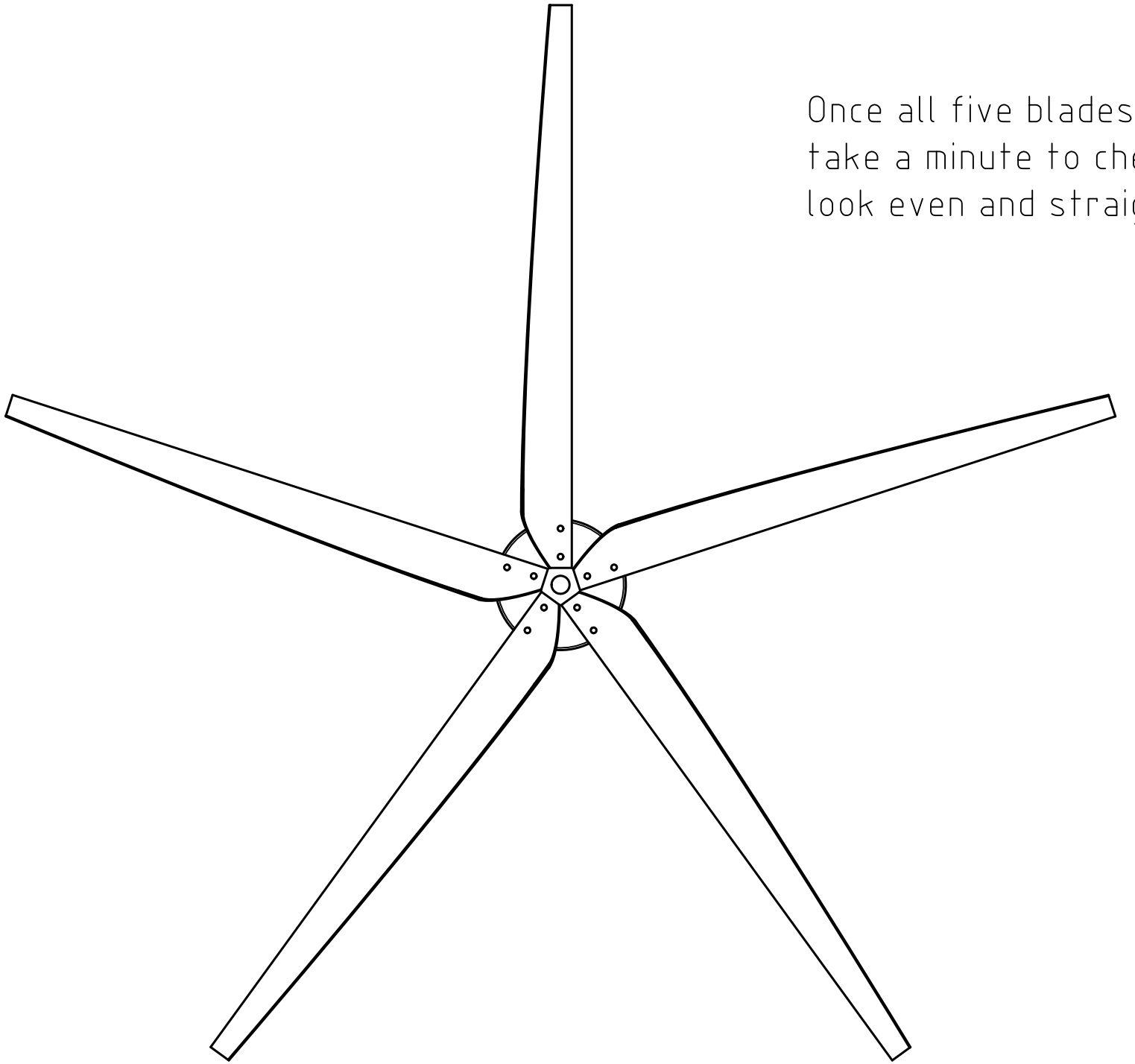


Using a protractor and ruler, mark out and then drill 5mm holes to attach the blades according to these dimensions.

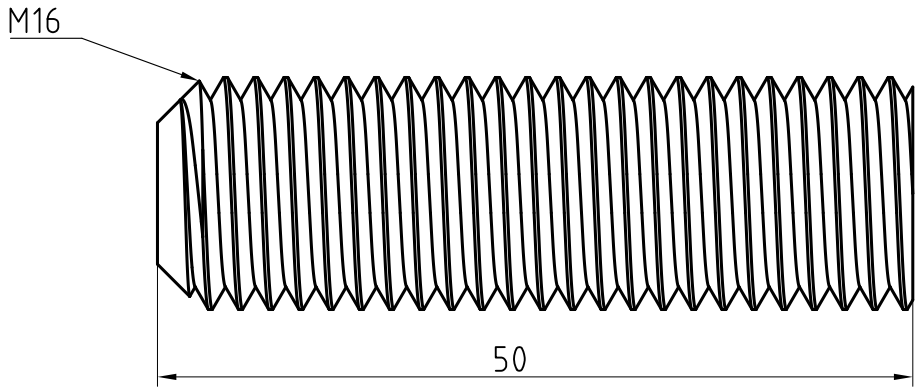
Alternatively, print this page to scale and use the drawing as a template.

Attach each blade using 5mm bolts, washers and nylon locking nuts.

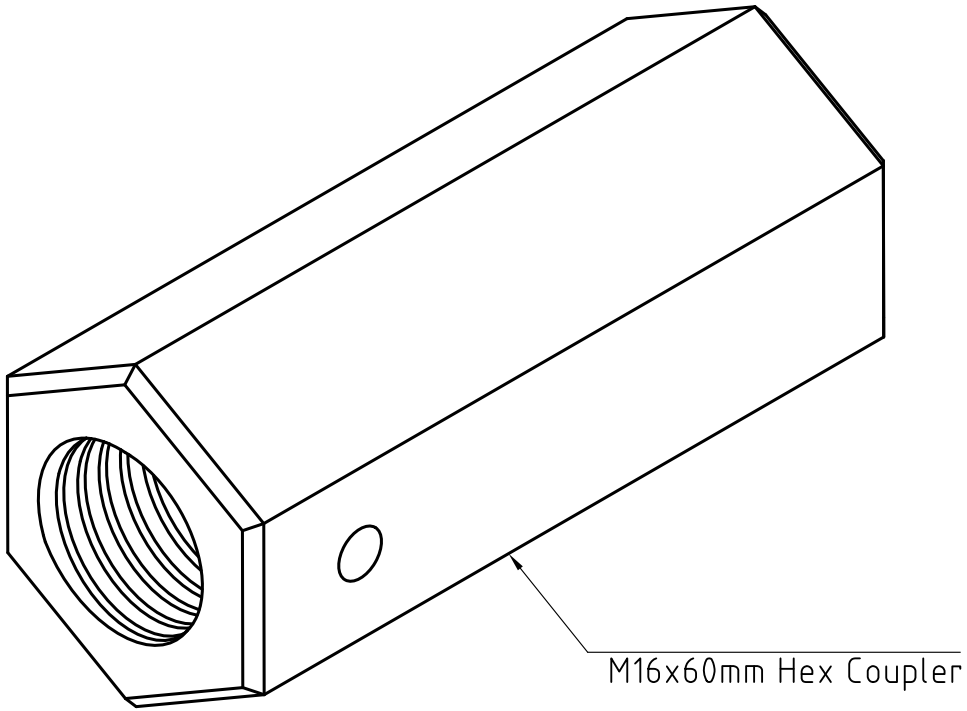


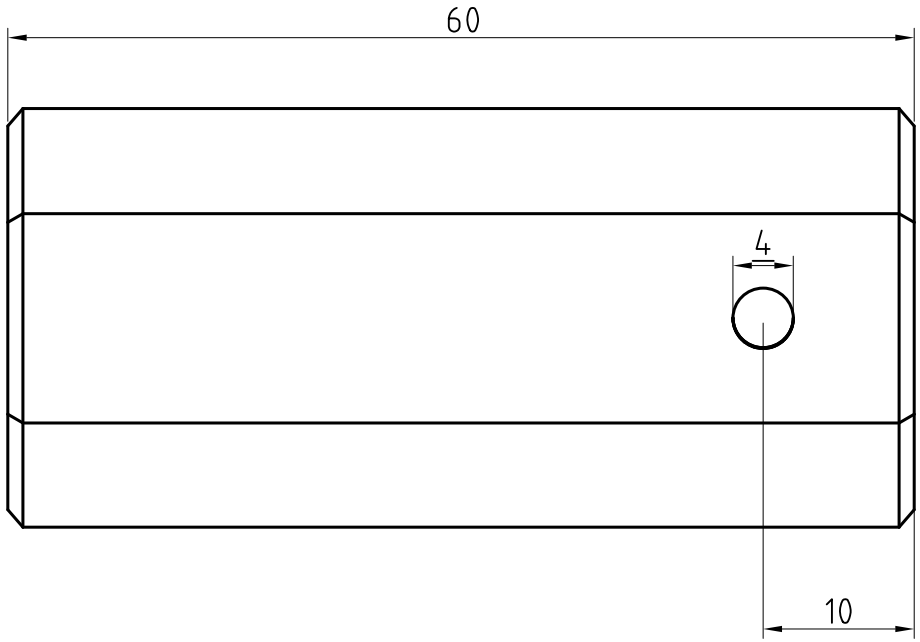


Once all five blades are attached, take a minute to check that they all look even and straight.

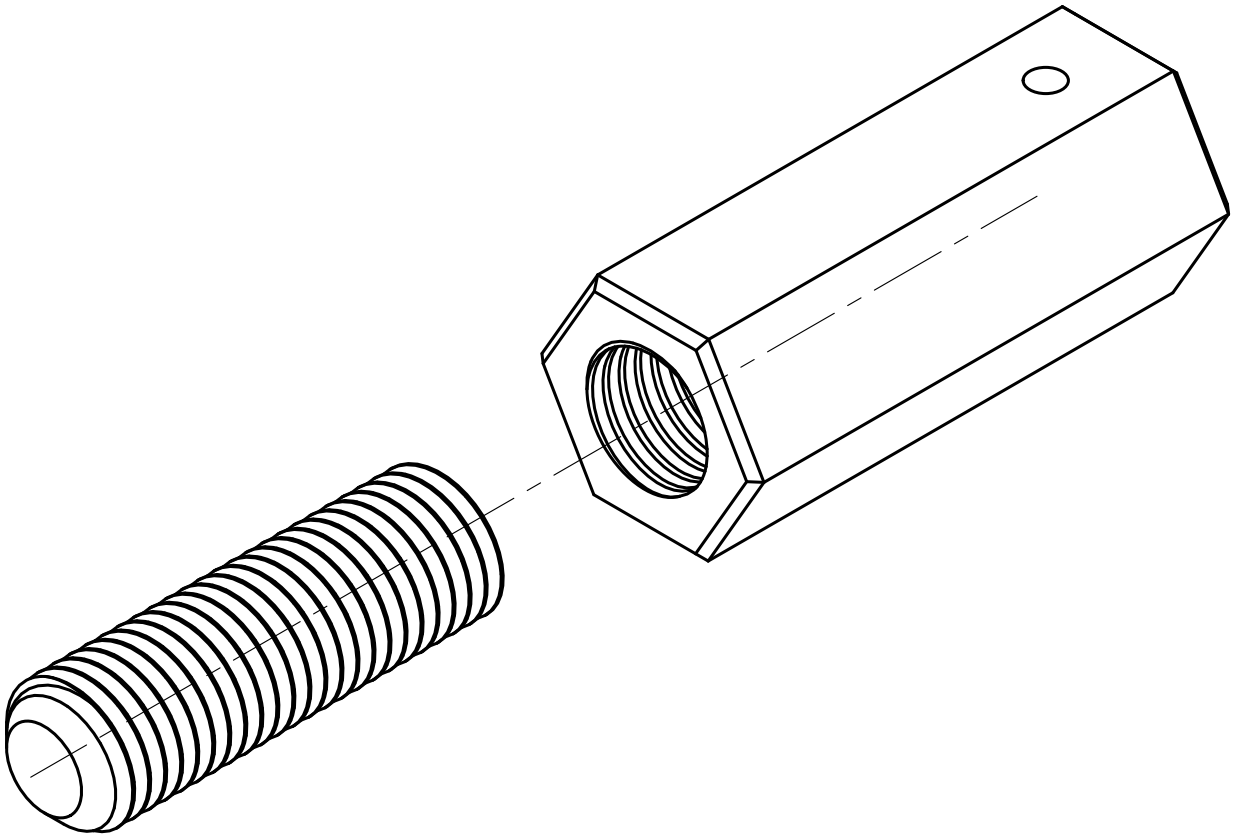


Cut off a 50mm length of an M16 threaded shaft.

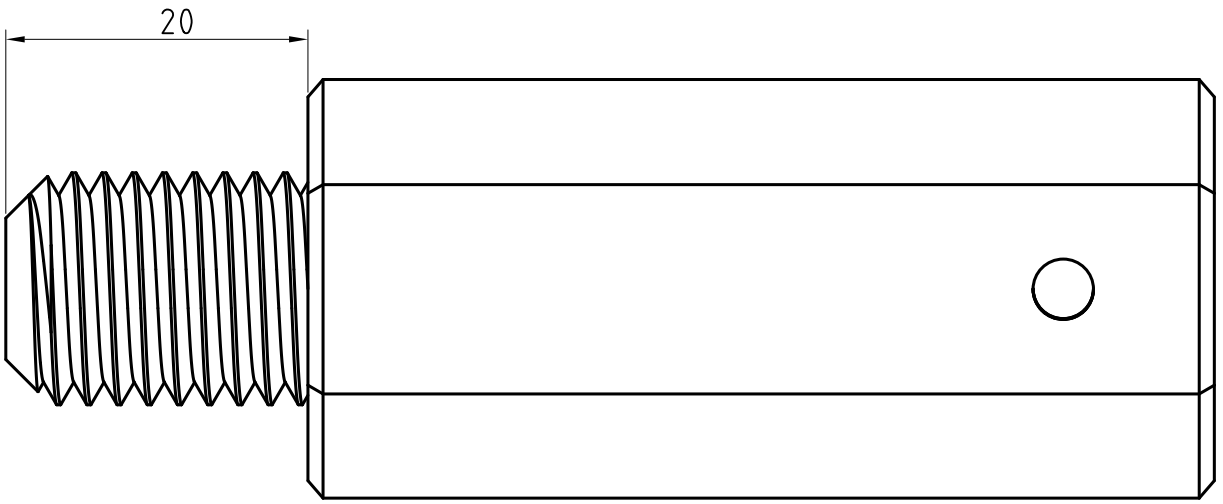




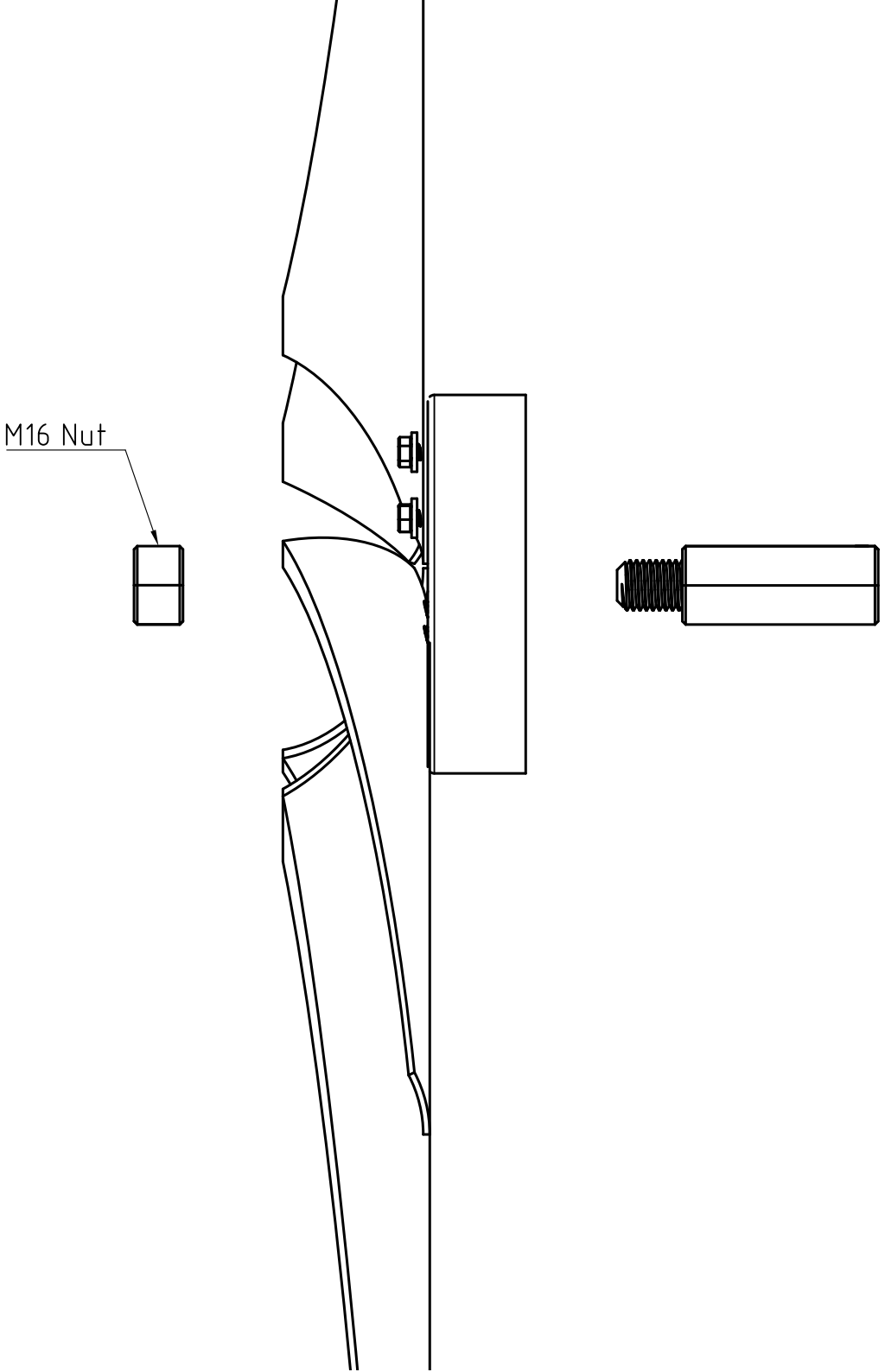
Drill a 4mm hole all the way through the M16 hex coupler, 10mm from one end.



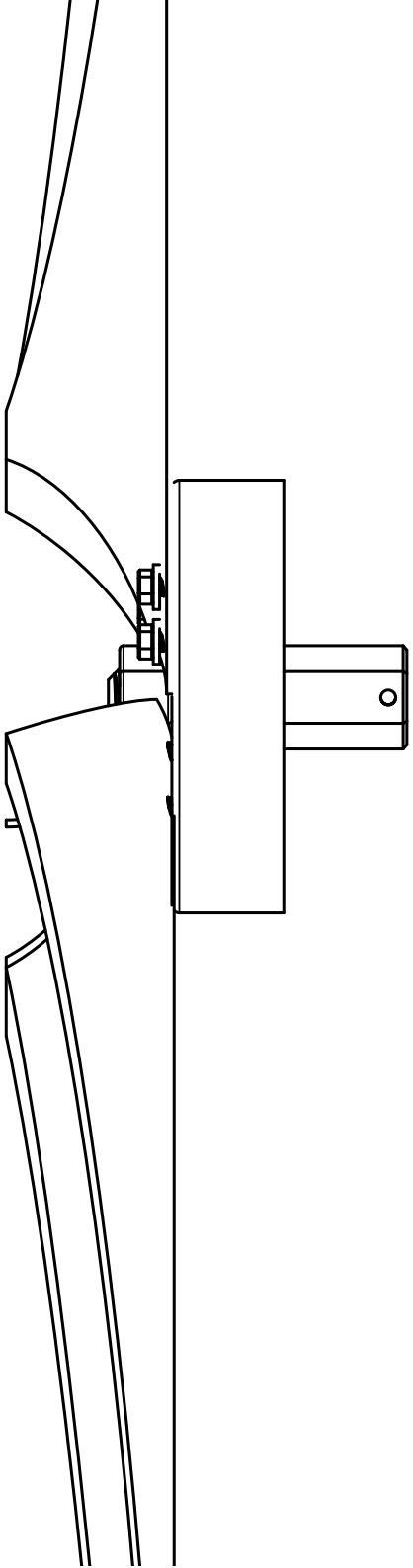
Apply threadlock/superglue and insert the M16 thread into the coupling



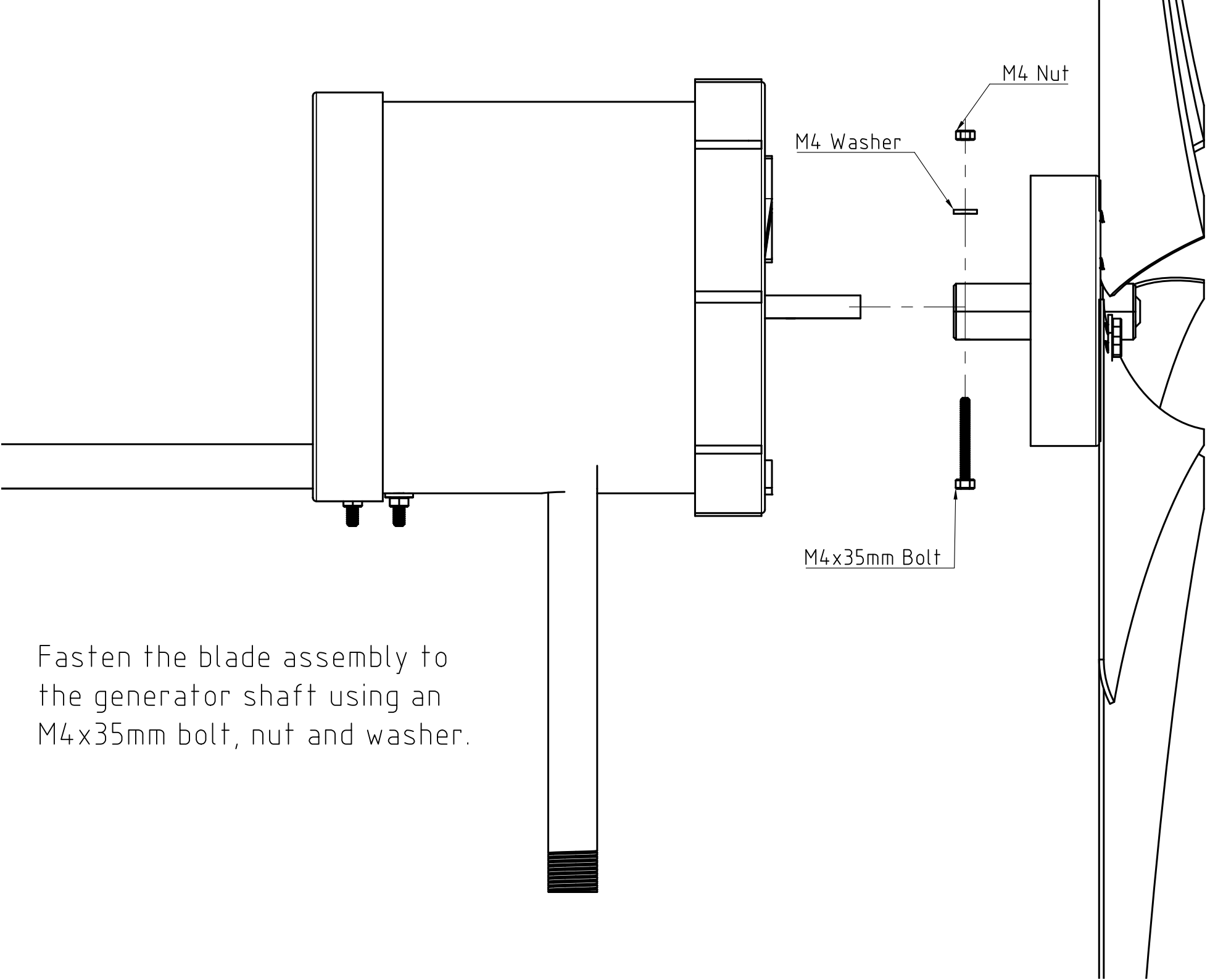
Leave 20mm of shaft exposed and allow to dry.



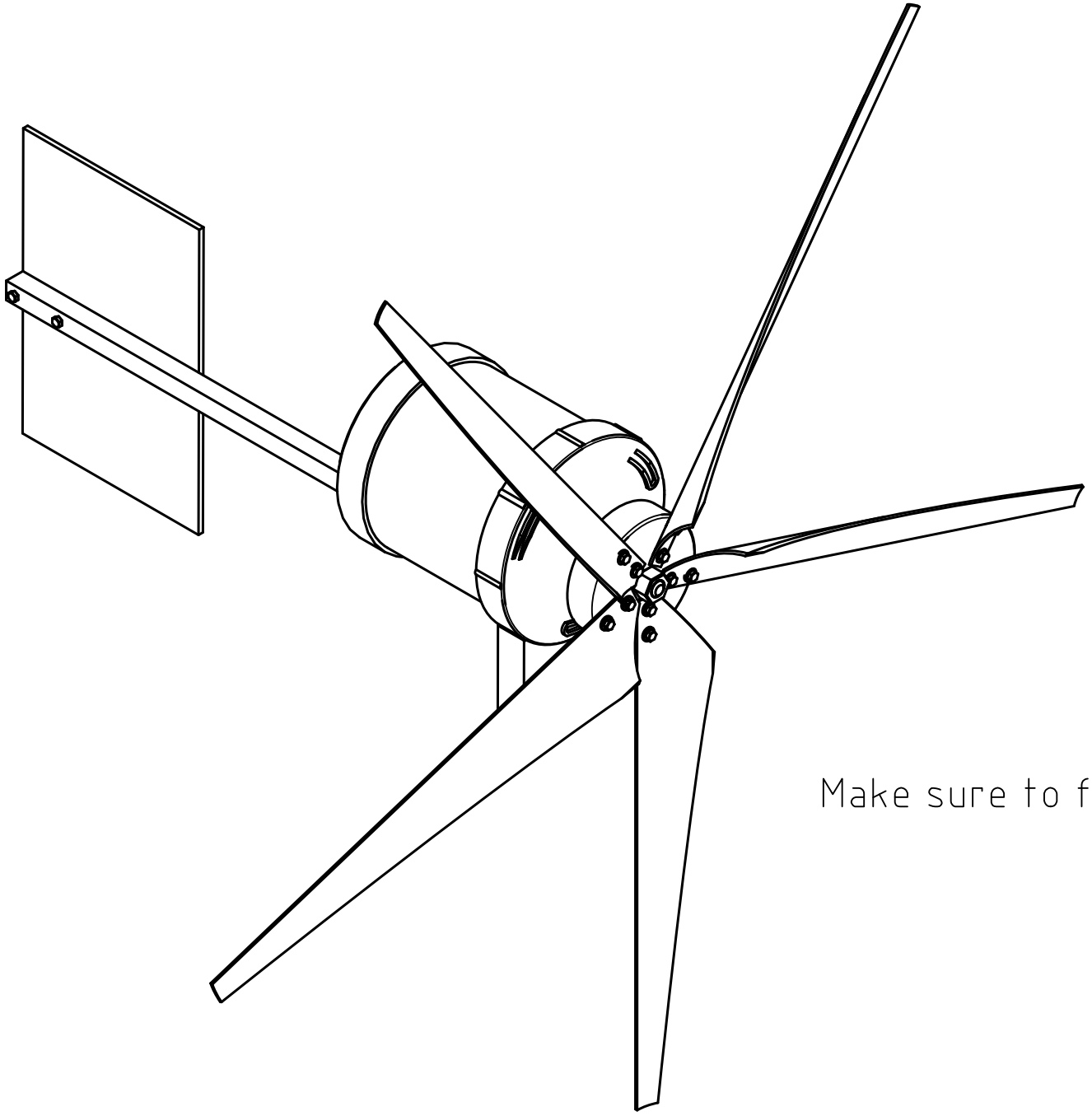
Fasten the whole blade assembly together, until really tight, using superglue or threadlock to hold the fasteners in place.



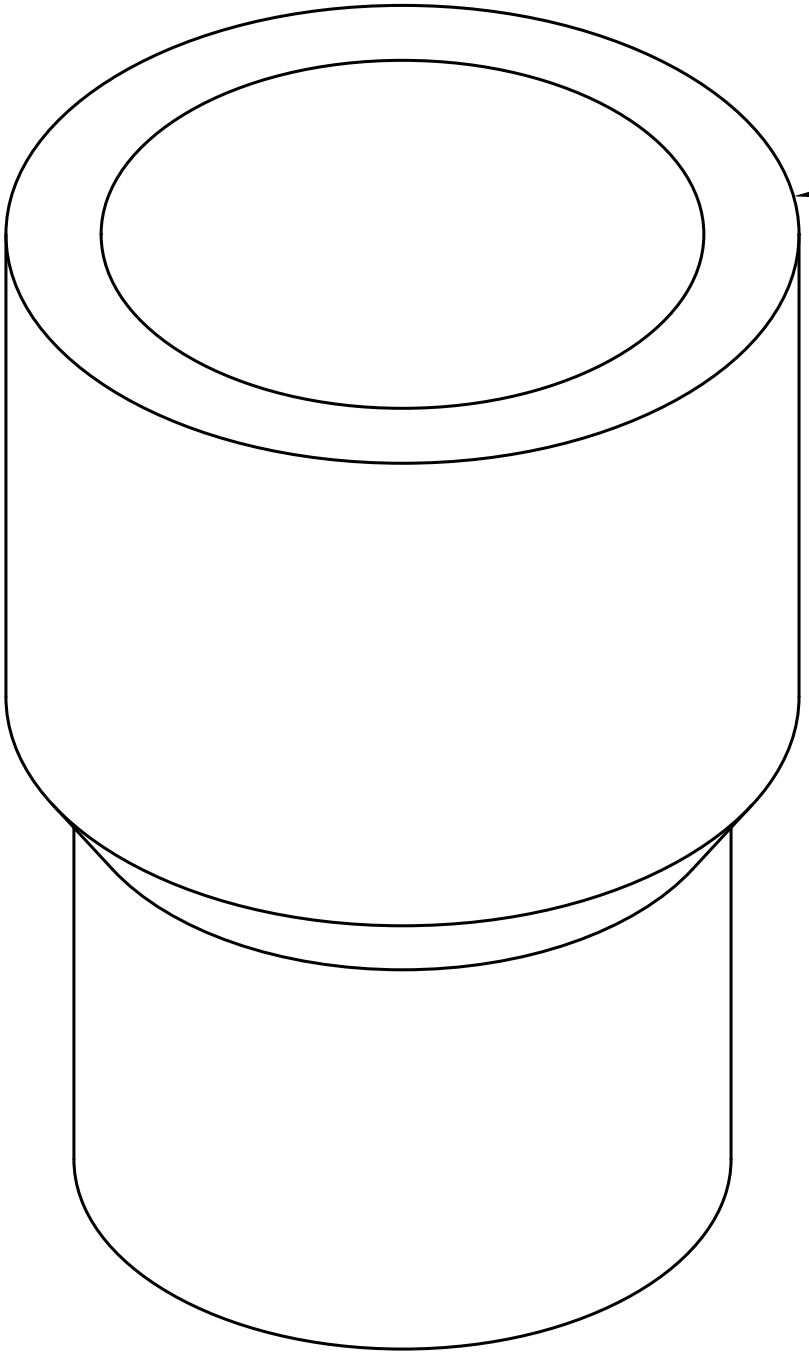
Marvel at your new blade assembly!



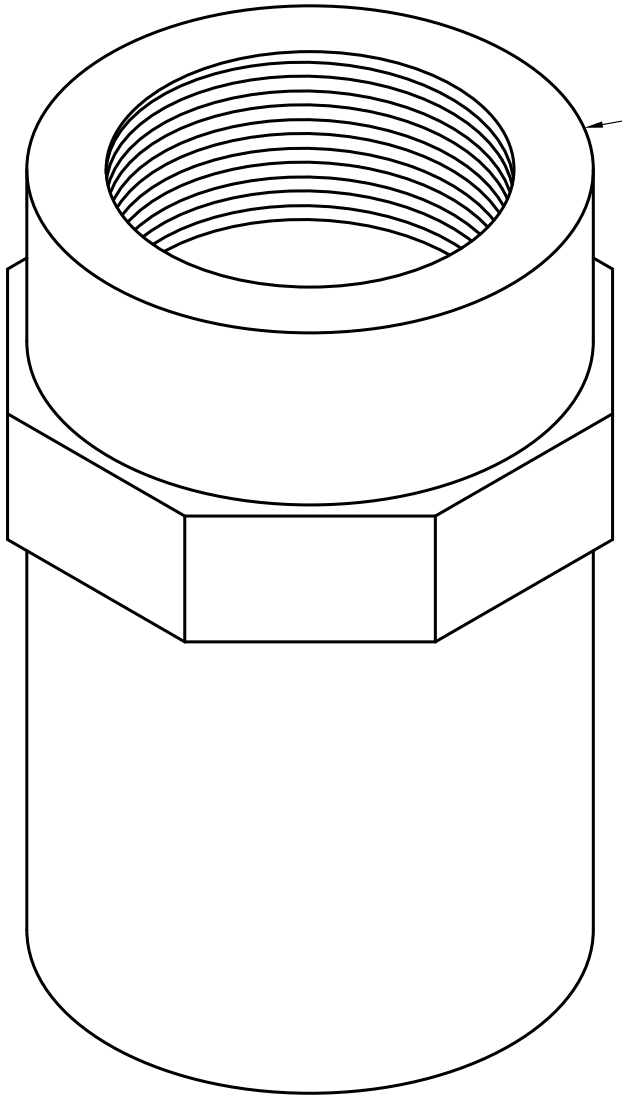
Fasten the blade assembly to the generator shaft using an M4x35mm bolt, nut and washer.



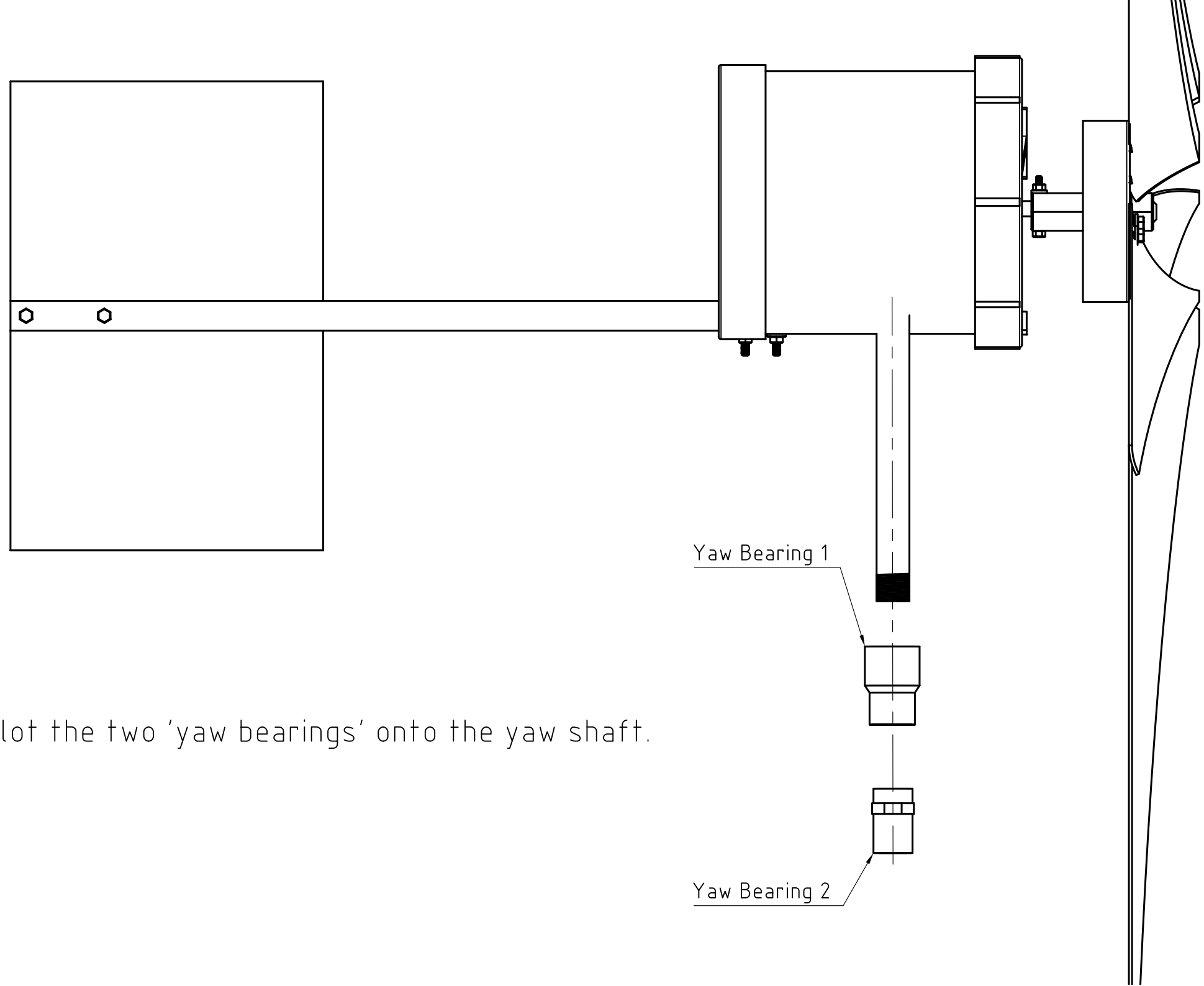
Make sure to fasten the blades down tightly.



In order to allow the turbine to rotate, we use a 20mm to 15mm PVC reducer as a 'yaw bearing' to reduce friction

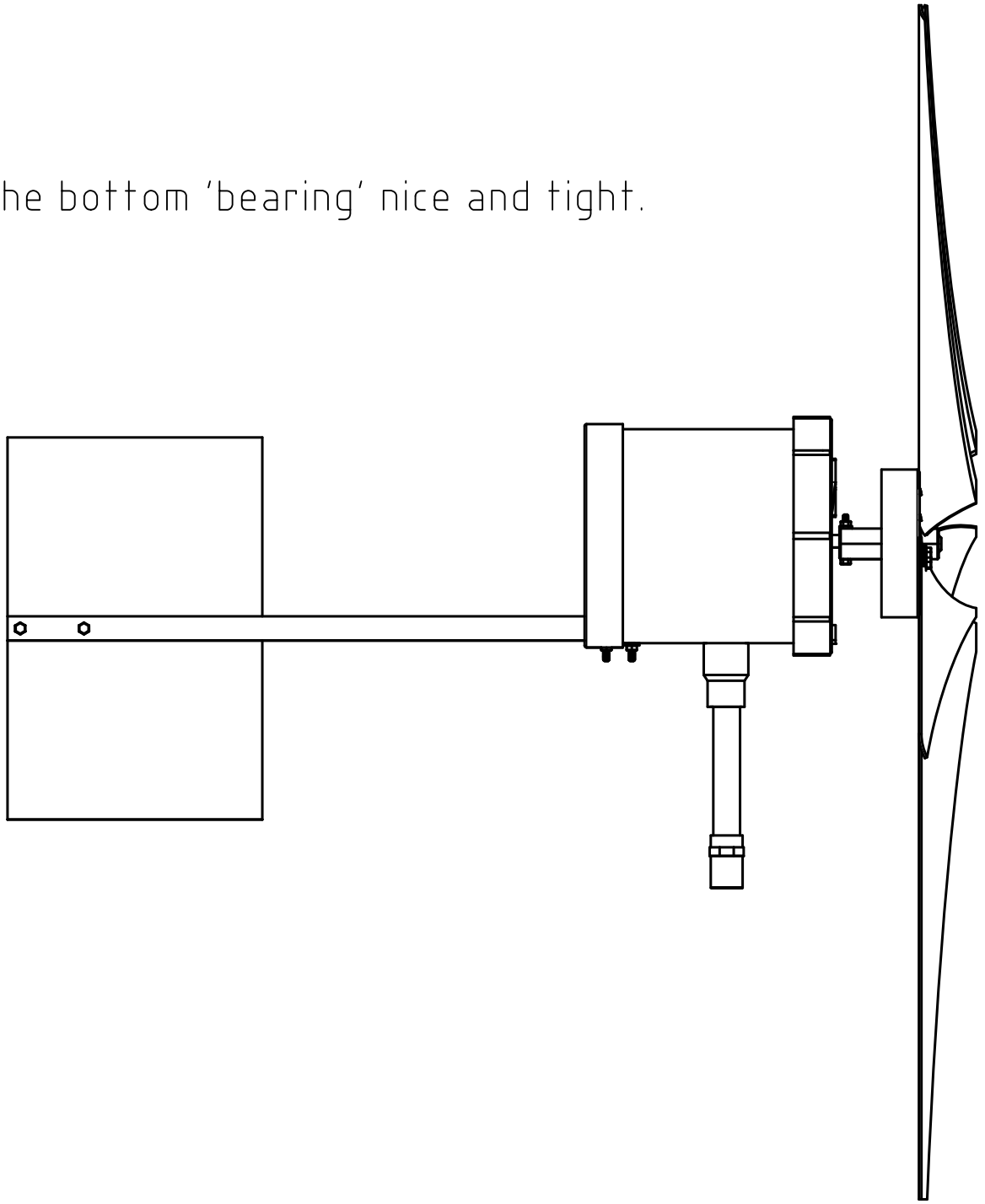


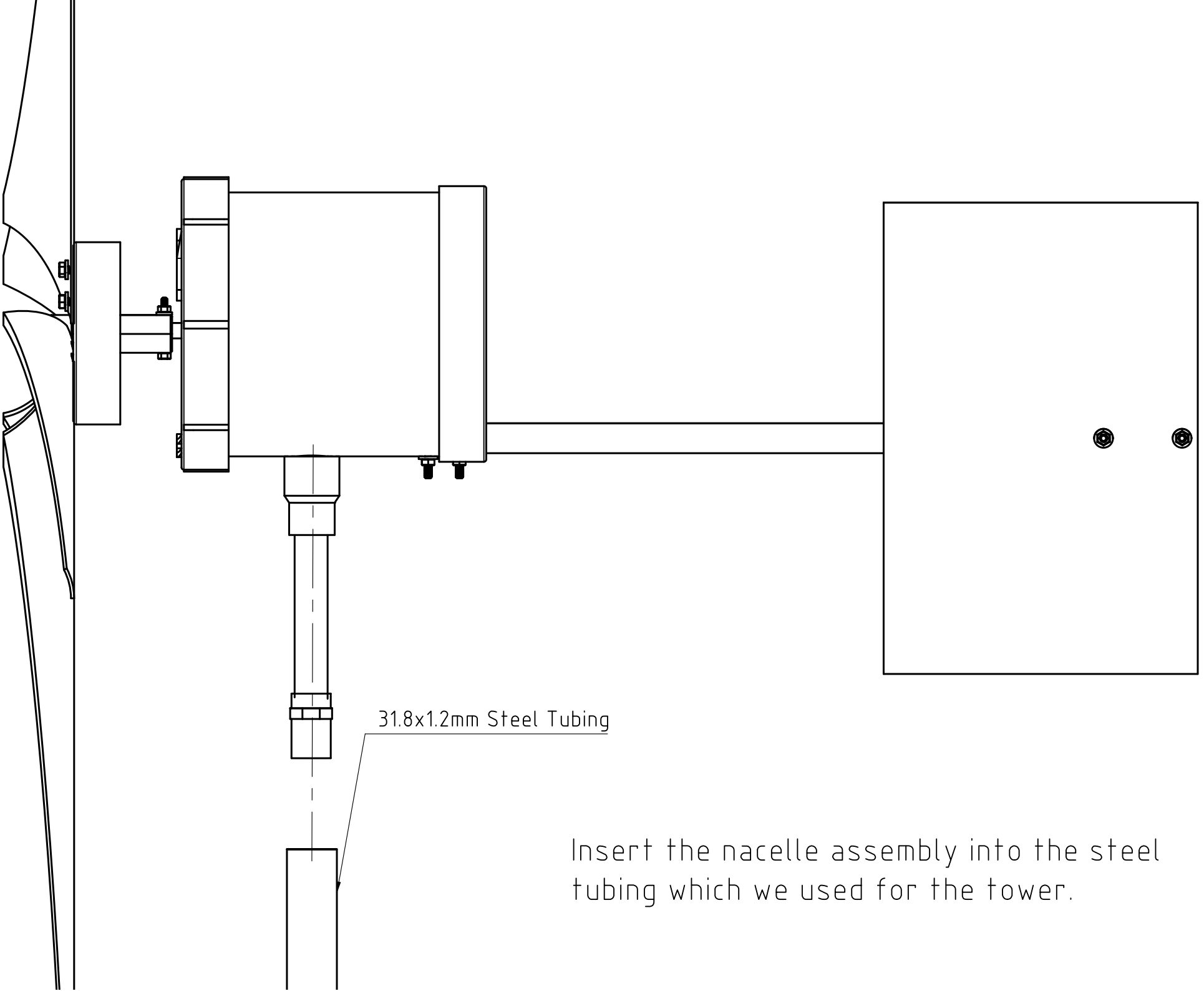
Another part of our 'yaw bearing' is made up of a PVC Male Thread Adapter



Slot the two 'yaw bearings' onto the yaw shaft.

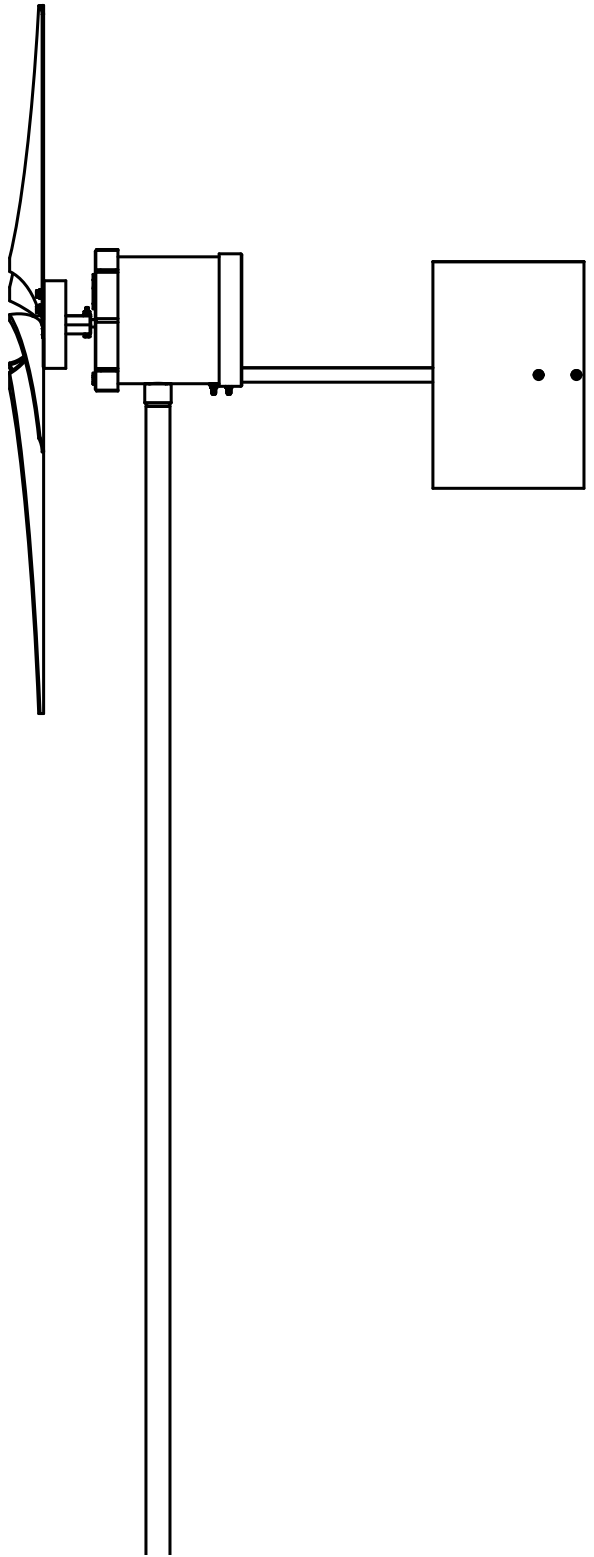
Make sure to screw in the bottom 'bearing' nice and tight.





Insert the nacelle assembly into the steel tubing which we used for the tower.

That's it! Your wind turbine is ready to be wired in and start producing electricity.



Next Steps

This is a first attempt at creating a wind turbine that fits our requirements and a set of instructions to go with it. While we are reasonably happy with the success we acknowledge that there is plenty of room for improvement!

- Tower/foundation – we have not yet addressed how to mount the tower, we will be creating some guidelines on this soon.
- Furling – a good wind turbine should have a system to stop it spinning too fast in high winds. We will be incorporating a passive furling system into the next instructions.
- Power curve – while we have done some basic testing in the wind, we will be logging the power output at various wind speeds using an anemometer to develop a detailed power curve which will allow us to incorporate improvements and test their effect.
- More power – ideally we want to achieve 50W in moderate wind conditions. This will require a new motor and we are on the lookout!
- PVC – we appreciate that PVC is not ideal for applications in direct sunlight. This can be rectified by painting with paint that protects from UV rays, but we are looking to minimise use of PVC with our next design.