## **Prop Engine Assembly & Operation Instructions**

Please read all the way through the assembly instructions to familiarise yourself with the process before you start and pay close attention to the alignment of all the parts in the diagrams.

Assembly time should be approximately 35-40 minutes.

Please take great care when opening the bag of small parts! It is recommended to remove the packing tray from the box and open the bag over the box to catch dropped parts.

The engine parts list starts on the next page.

Maintenance and operation instructions can be found at the end of this document.



### **SAFETY NOTICE:**

- All parts of the engine will be very hot while in operation and will take time to cool down after running.
- The flame produced by a steel wick can be almost invisible, ensure burner is extinguished after use.
- Make sure you have a suitable fire extinguisher to hand in case of emergencies.
- Never leave a running engine or naked flame unattended.
- Make sure children are fully supervised.

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### wn after running. shed after use.

### Prop Engine Parts 1 / 3



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### Prop Engine Parts 2 / 3





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## Prop Engine Parts 3 / 3



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Tweezers

Fit the strut into the pocket in the base and screw two M2x4 roundhead screws through the strut into the base. Tighten the screws.  $\bigcirc$  $\bigcirc$ 

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Screw two M2x6 countersunk screws through the base into the foot and tighten.

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The bearings have a shielded side and an open side.

Fit the bearings into the recesses in the cartridge with the open sides inwards.

(Note: cartridge is shown cutaway for clarity)

Fit the axle through the bearings.

Take care that the bearings do not get dislodged.





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Finger tight is sufficient.

Insert the conrod end of the axle assembly through the front hole in the manifold.



Manoeuvre and position the cartridge, axle and conrods so that the conrods are poking out through the side holes in the manifold.

Do not attempt to screw the cartridge into the manifold until the conrods are poking out through the side holes.

Through side hole

Through side hole



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Screw the cartridge into the manifold and tighten. It can help to wrap an elastic band around it for grip.

Make sure the conrods stay poking out of the manifold holes.



Align the engine as shown and push the base all the way down into the slot in the tray (highlighted blue).

Put a weighted object (book, empty coffee mug) on the other end of the tray for stability during the next few assembly stages.



In the next few assembly diagrams the foot, base, strut and tray will be hidden to provide greater clarity in the instructions.



Fit a piston over the hook on the end of the uppermost conrod.



Hold the piston still with a finger and thumb and push the open end of the tweezers over the brass fitting on the piston in the direction shown. This will hold the piston and conrod securely for the next few assembly stages.

Correct fitting\_





- 1. Hold the piston and conrod still and vertical with the tweezers.
- 2. Fit the piston into the glass tube inside the cylinder.
- 3. Lower the cylinder all the way down to the tweezers.

Note: cylinder shown cutaway for clarity.









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### 2. Piston into cylinder

- 1. Hold the cylinder conrod still and vertical.
- 2. slide the tweezers sideways off the piston.
- 3. Lower the cylinder onto the manifold.

Note: cylinder shown cutaway for clarity.

2. Slide tweezers





Clip one M2x4 roundhead screw into one end of the tweezers.

Note: the tweezers are symmetrical, you can clip the screw into either end.



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- 1. Rotate the cylinder so that the port is facing towards the back of the engine, away from the axle end.
- 2. Use the tweezers to insert the screw into a cylinder hole.
- 3. With the tweezers still attached screw the screw in a couple of turns.
- 4. Unclip the tweezers from the screw with a sideways pull.

Repeat for the other 3 cylinder screws.



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Remove the engine from the tray and re-insert the other way up.



Repeat the first piston/cylinder assembly stages to fit the second piston and cylinder.

Fit piston to conrod Fit tweezers to piston Fit port to cylinder Fit cylinder to piston Remove tweezers from piston Fit four screws to cylinder

After all these stages have been repeated you can remove the engine from the packing tray.



Gently rotate the axle end to check for correct assembly. As you rotate the axle end the pistons should freely move in inside the glass cylinder tubes.

If they do not move, or get stuck you will need to remove the relevant cylinder, check the piston is fitted correctly on the conrod and re-assemble.

Rotaté

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Slide freely

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Moisten front edge Very sparingly moisten the front edge of the port hole in one side of the manifold with very dilute soapy water for lubrication and use a coin to push a port all the way into the hole. As you push it in the red rubber O ring will compress slightly to provide an airtight seal. Repeat for the last port on the other side of the manifold. Wipe off any excess water afterwards.



Push a connecting tube onto the ends of the cylinder and manifold ports, make sure the tube bends smoothly as shown and that it does not fold at the bend.

Repeat for the cylinder and manifold ports on the other side.

Remove the backing from the 5 rubber feet and stick them over the dimples in the bottom faces of the base and strut.



Screw the stem into the manifold finger tight.

Final tightening will be done at a later stage.

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Make sure the inside of the slider and the outside of the stem are both scrupulously clean and free from grit or dust. The parts are a very close airtight fit and any foreign matter on either part will prevent correct assembly.

Fit the slider onto the stem and slide it all the way up to the red O ring. If the parts are both clean it should slide easily and freely.

If you feel any resistance or scratching as you slide it on take it off immediately, reclean and try again.

Scrupulously clean

Scrupulously clean







Screw one M2x6 countersunk screw through the retainer into the stem and tighten.

(Note 1: retainer is aligned with the chamfered side outwards) (Note 2: tightening the retainer screw also tightens the stem in the manifold)

Chamfered side outwards



Very sparingly moisten the inside front edge of the displacer with very dilute soapy water for lubrication and push it on to the O rings in the slider.

It should push all the way up to the blue highlighted slider edge.

It may take several pushes to get it flush with the edge.

Wipe off any excess water afterwards.

After fitting the displacer onto the slider the whole slider/displacer assembly should bounce gently on the stem as you tap it with a finger.



-Moisten inside edge

Check that the displacer is completely flush and perpendicular to the slider and that it falls under its own weight in both directions.

The inside of the displacer is almost airtight so the displacer will fall slowly.

If it does not fall or gets stuck part way you will need to remove the displacer and slider, check for grit or dust and re-assemble.

> Check displacer is flush with slider, no gaps

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Very sparingly moisten the inside front edge of the glass with very dilute soapy water for lubrication and wrap it in a couple of layers of paper towel for safety.

Push it on to the O rings in the manifold, A pushing and twisting motion works best. Do not wiggle it on, try to keep the glass perfectly straight and inline with the manifold or you risk chipping the front edge.

It should push all the way up to the blue highlighted manifold edge.

Wipe off any excess water afterwards.

Moisten inside edge



Align the slot in the fins downwards and carefully push them on to the glass.

The fins are quite flexible and will safely and securely hold on to the glass.

Push the fins all the way up to the step on the manifold.





Check that the glass is fitted correctly. With incorrectly fitted glass the displacer can rub on the inside of the glass and prevent the engine from running.

Spin the axle end gently with a finger and thumb, if the glass is fitted correctly the displacer should bounce along the stem by a couple of millimetres.

If the displacer doesn't bounce, adjust the glass and test until you do get bounce.







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# Fit the wick into the burner and

Your PROP engine is now fully assembled.

Operation, maintanance and troubleshooting instructions can be found on the next couple of pages.

If you need help with your engine you can email us at:

support@stirlingengine.co.uk



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### **SAFETY NOTICE:**

- All parts of the engine will be very hot while in operation and will take time to cool down after running.
- The flame produced by a steel wick can be almost invisible, ensure burner is extinguished after use.
- Make sure you have a suitable fire extinguisher to hand in case of emergencies.
- Never leave a running engine or naked flame unattended.
- Make sure children are fully supervised.

The engine uses Methylated Spirits or Denatured Alcohol as fuel.

Remove the burner cap and wick from the burner body and fill with fuel to the fill level AND NO MORE.

Re-fit the cap and wick and place the burner on the retaining magnet.



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1. Light the wick and allow 2-3 minutes for the engine to warm up.

2. Spin the propeller by twisting the nose cone, it migh take several spins to get the engine started. DO NOT strike the propeller blades to start the engine, this can unscrew the propeller from the axle.

The engine will run in both directions but will run more reliably with the propeller blowing the air forwards, pulling the flame towards the engine rather than blowing it away.





The engine has a displacer that is not mechanically connected to the power pistons and therefore will sometimes surge up in speed and then slow down over and over.

In this situation the burner can be moved outwards to reduce the heat going into the engine, which should give smoother operation.

After the engine has been running for a few minutes the speed might drop slightly because the engine chassis has warmed up.

In this situation the burner can be moved inwards to increase the heat going into the engine, which should increase speed again.

The engine is not designed to run for extended periods of time. As a Stirling engine, it relies on a temperature difference between the end of the glass cylinder and the brass fin block. After about 10-15 minutes of running the heat from the flame will have transferred along the glass and into the brass fin block, thereby reducing the temperature difference to the point where the engine will not run.

In this situation the engine should be allowed to cool naturally before running again.

## DO NOT USE EVER COLD WATER TO COOL THE ENGINE, THIS CAN CRACK THE GLASS!

If the engine struggles to run at all then you will need to check that there is free movement and no air leaks.

Spin the propeller cone gently with a finger and thumb, the displacer should bounce along the stem by a couple of millimetres.

If the displacer doesn't bounce, or the propeller doesn't spin, check that the conrods are fitted into the pistons correctly and that the ports and connecting tubes are properly pushed together.

## ALWAYS WAIT UNTIL THE ENGINE HAS COMPLETELY COOLED BEFORE ADJUSTMENT!



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The commonest cause of a non-running engine is misaligned glass, cuasing the displacer to rub.

Thios can be difficult to test for with the usual bounce test because the bounce test only moves the displacer by a couple of millimetres and not along the whole length of the stem.

Allow the displacer to fall under its own weight to its full extension. There will be a 5mm gap between the end of the displacer and the inside of the glass dome when it is at full extension. If it doesn't fall this far then the glass will need adjusting.

The best course of action is to make tiny adjustments to the glass position and keep testing. Remember to check for sideways misalignment as well as up and down.

## ALWAYS WAIT UNTIL THE ENGINE HAS COMPLETELY COOLED BEFORE ADJUSTMENT!





## **Maintenance**

The cranks are supplied pre-oiled and should normally need no further lubrication.

But sometimes dust can accumulate on the conrod joints, which might impede performance.

In this case the conrod joints can be brushed clean with a small, soft paintbrush and a tiny drop of very thin sewing machine oil (or 3-in-1) can be applied.

It must be stressed that only the smallest amount of oil should be be applied. Dip the end of a pin in the oil and then shake the excess off. Rotate the propeller cone and lay the end of the pin against each conrod joint.

Wipe any excess off with a paper towel.





Our workshop is located in the Thames Valley, United Kingdom and is staffed by a skilled team of 9 designers, machinists and assemblers. We have 4 CNC mills, 3 CNC lathes and 3 CNC mill-turn centres.