

HB6 Sunlight Tower instructions



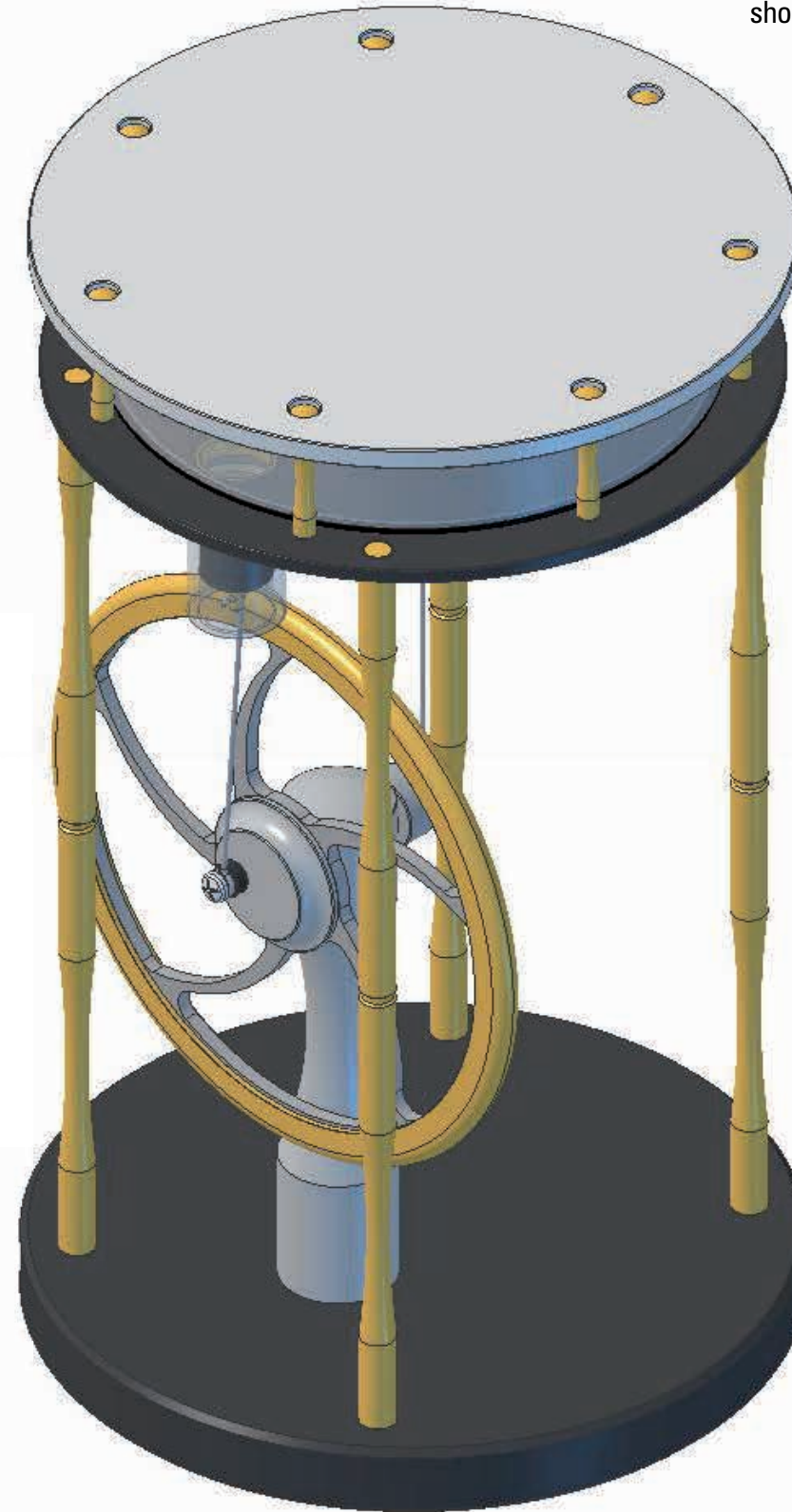
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This document covers the following:

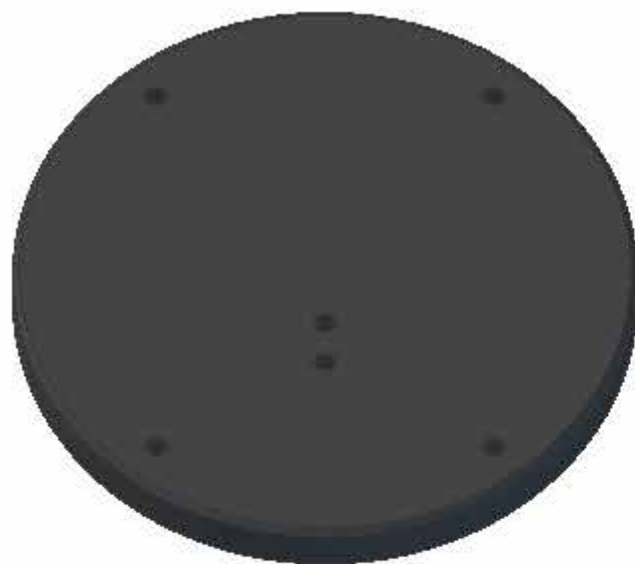
- [Tools required](#)
- [Parts list](#)
- [Assembly instructions](#)
- [Operating instructions](#)
- [Maintenance](#)



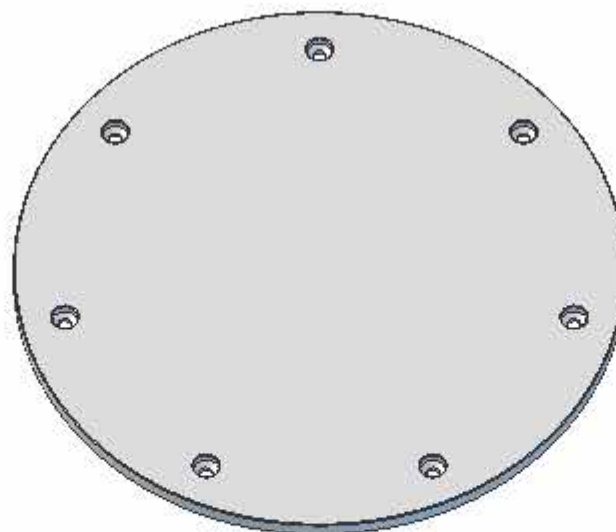
Tools you will need to
assemble your
HB6 Sunlight Tower
Low Temperature Stirling
Engine:

Cross-point screwdriver,
Flat-bladed screwdriver,
Elastic band, coffee/tea
mug.

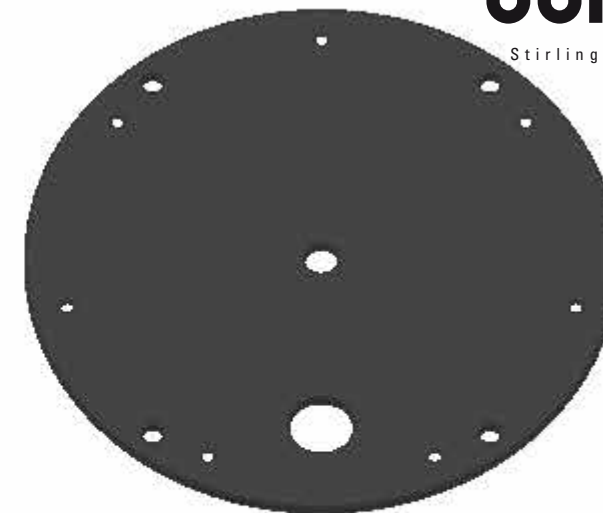




Bottom plate x1



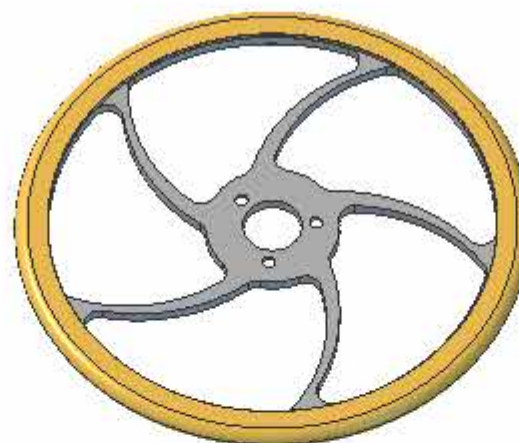
Top plate x1



Middle plate x1



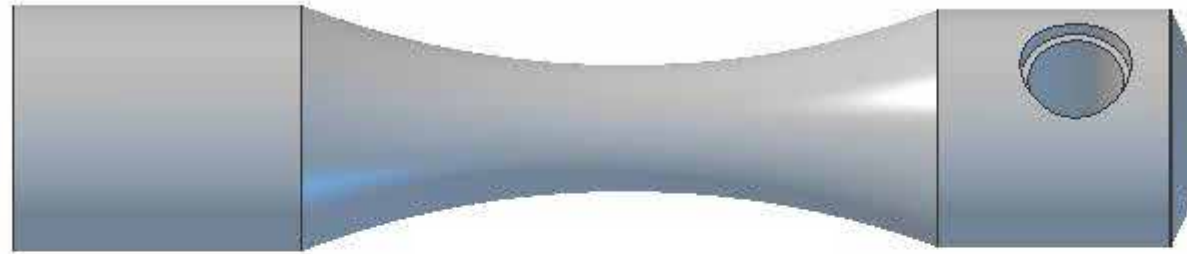
Chamber wall x1



Flywheel x1



Displacer x1



Main pillar x1



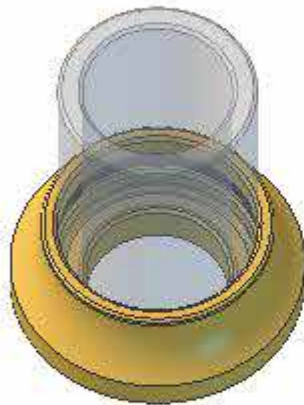
Ball-race bearing x2



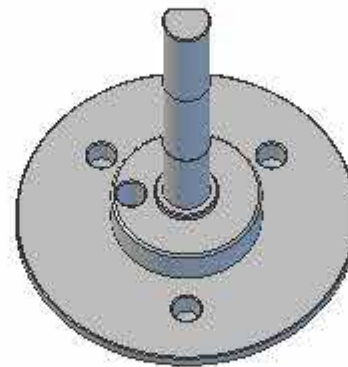
Piston x1



Crank x1



Cylinder x1



Hub/axle x1



Gland x1



M2x6mm roundhead x2



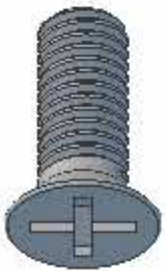
Conrod bush x2



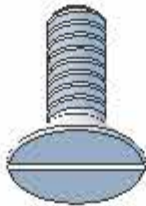
M2x4mm roundhead x1



13mm O ring x2



M3x8mm
countersunk x6



M2x6mm
countersunk x7



M2x4mm
countersunk x3



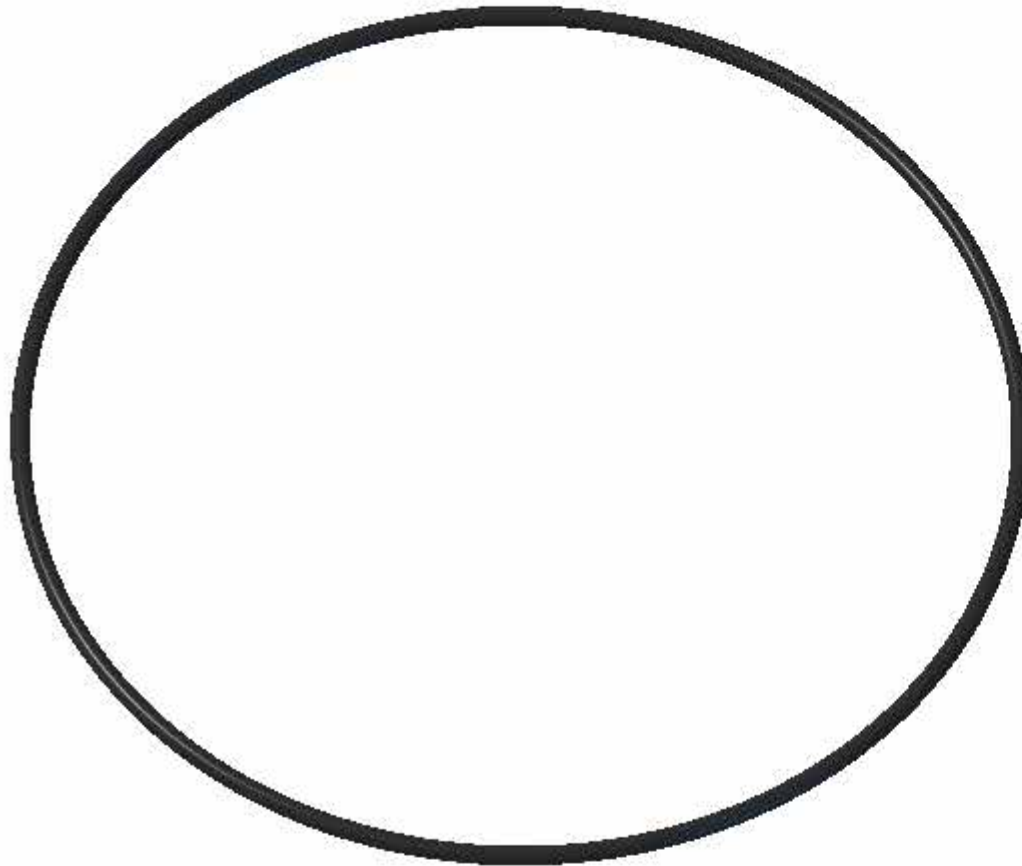
7mm O ring x1



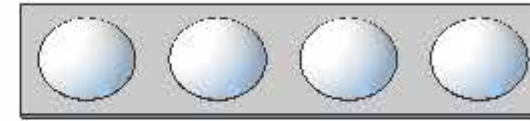
Gland stem x1



Chamber pillar x7



75mm O ring x2



Feet x4 (1 strip)

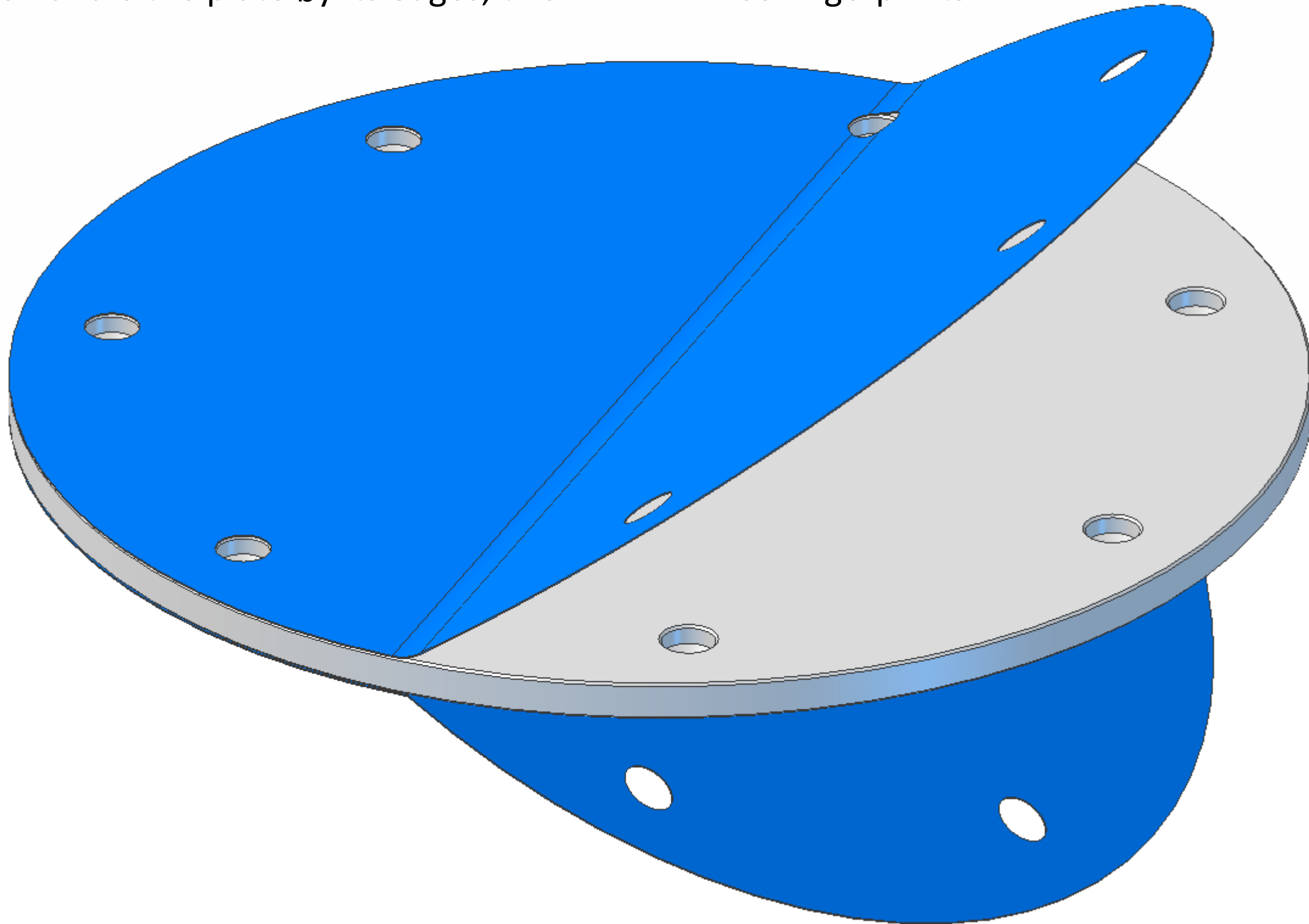


Conrod x2

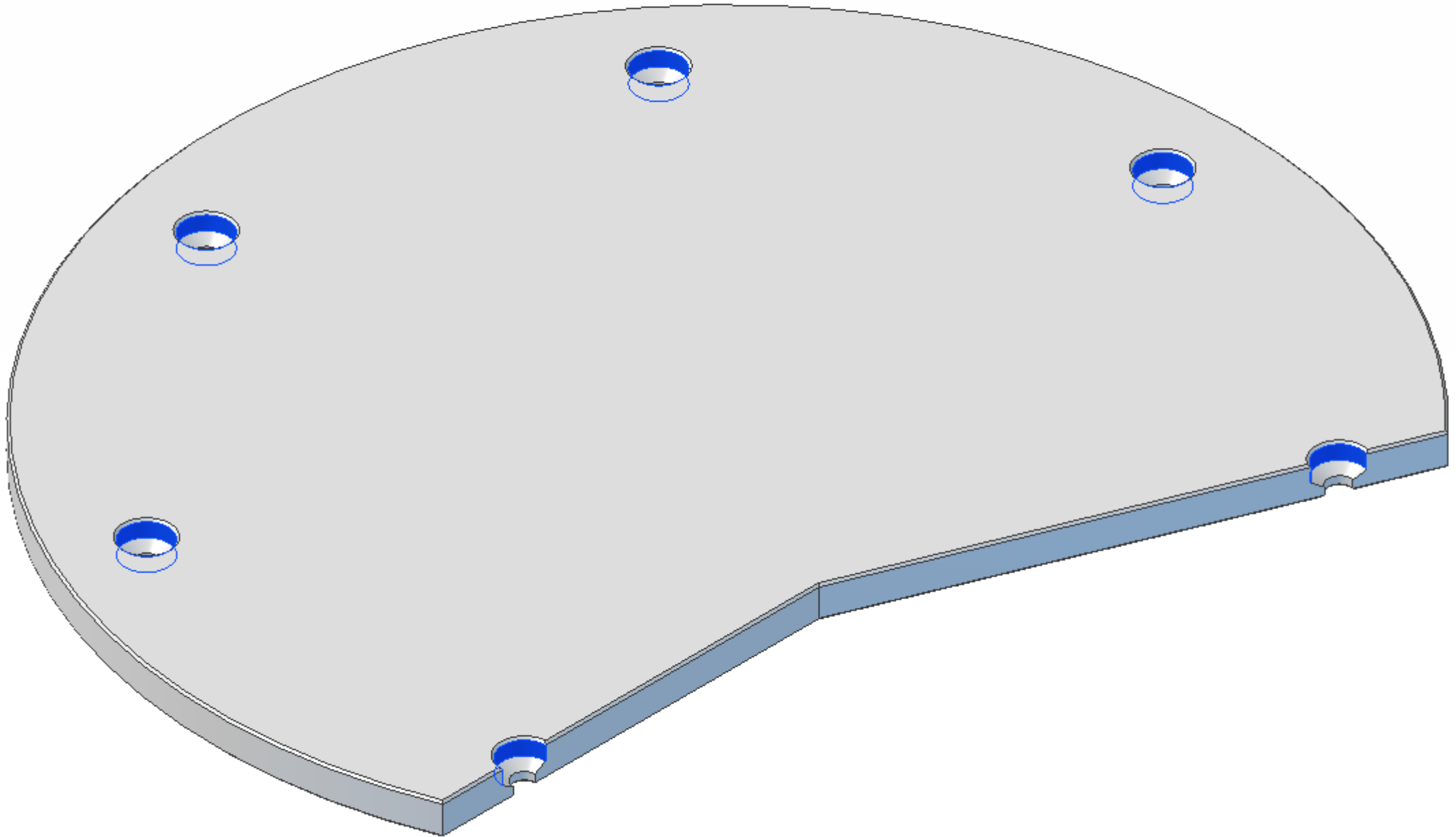


Leg x4

Remove the protective film from both sides of the top plate. Once you have removed the film try to handle the plate by its edges, this will minimise fingerprints.



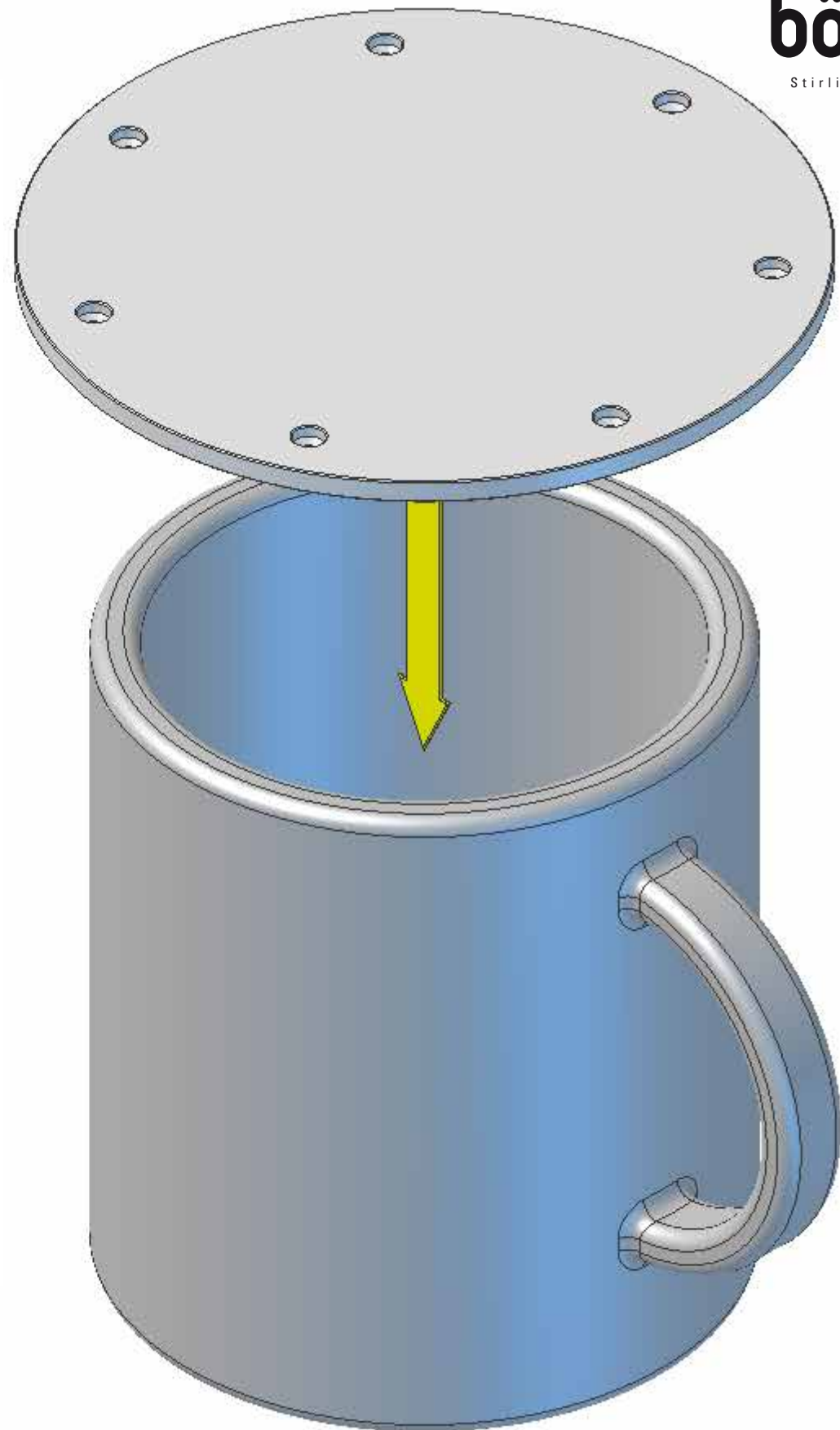
Locate the top side of the top plate. The top side is the side with the counterbores (opened out holes) on the seven holes as shown in the diagram.
Note, the plate is shown cut away for clarity.



Place the top plate over the top of a coffee mug, with the top side upwards.

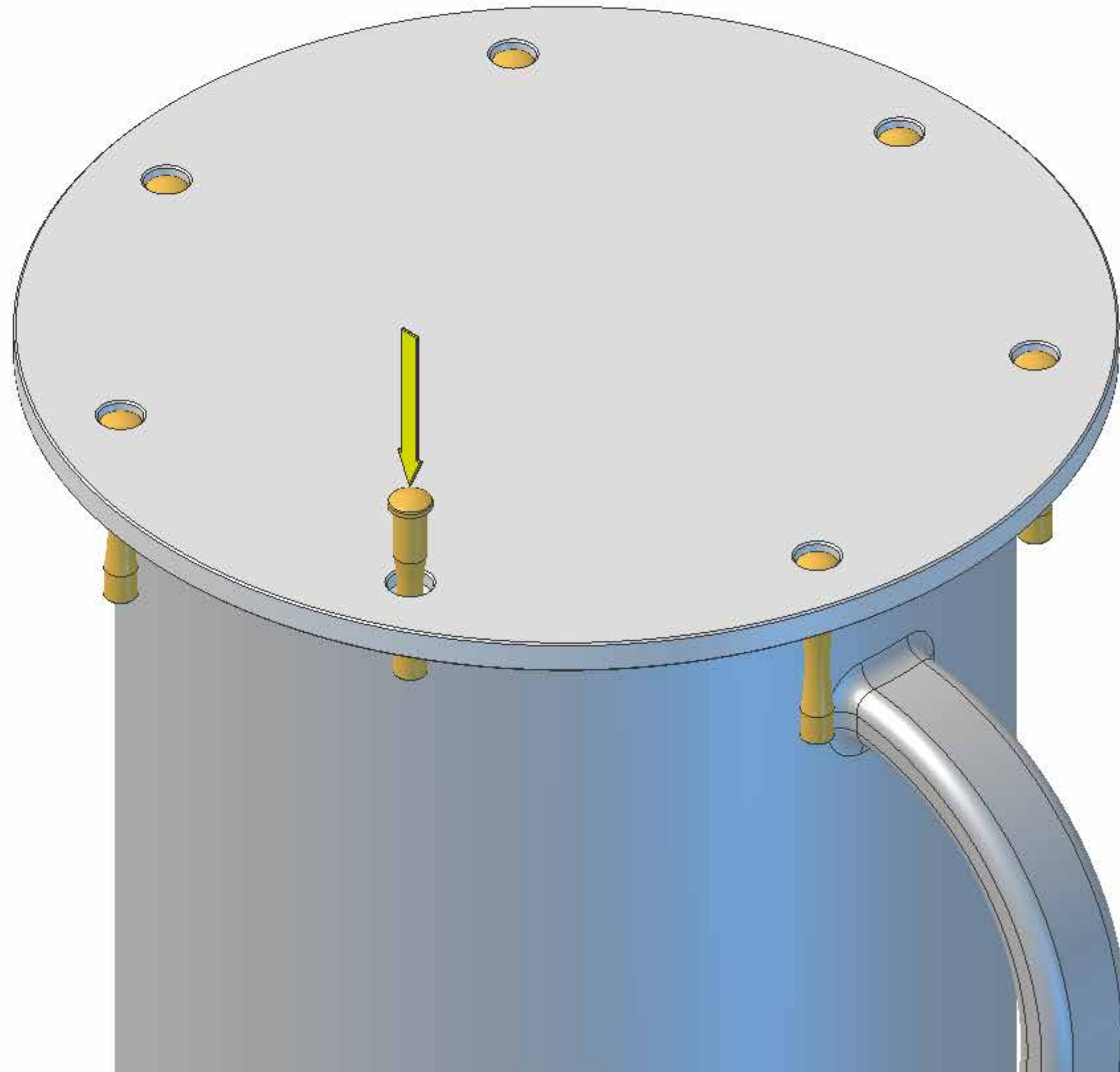
This will hold it still so that you can use both hands to perform the next few assembly stages.

Try not to slide the plate on the top of the mug; this could scratch the underside of the plate.



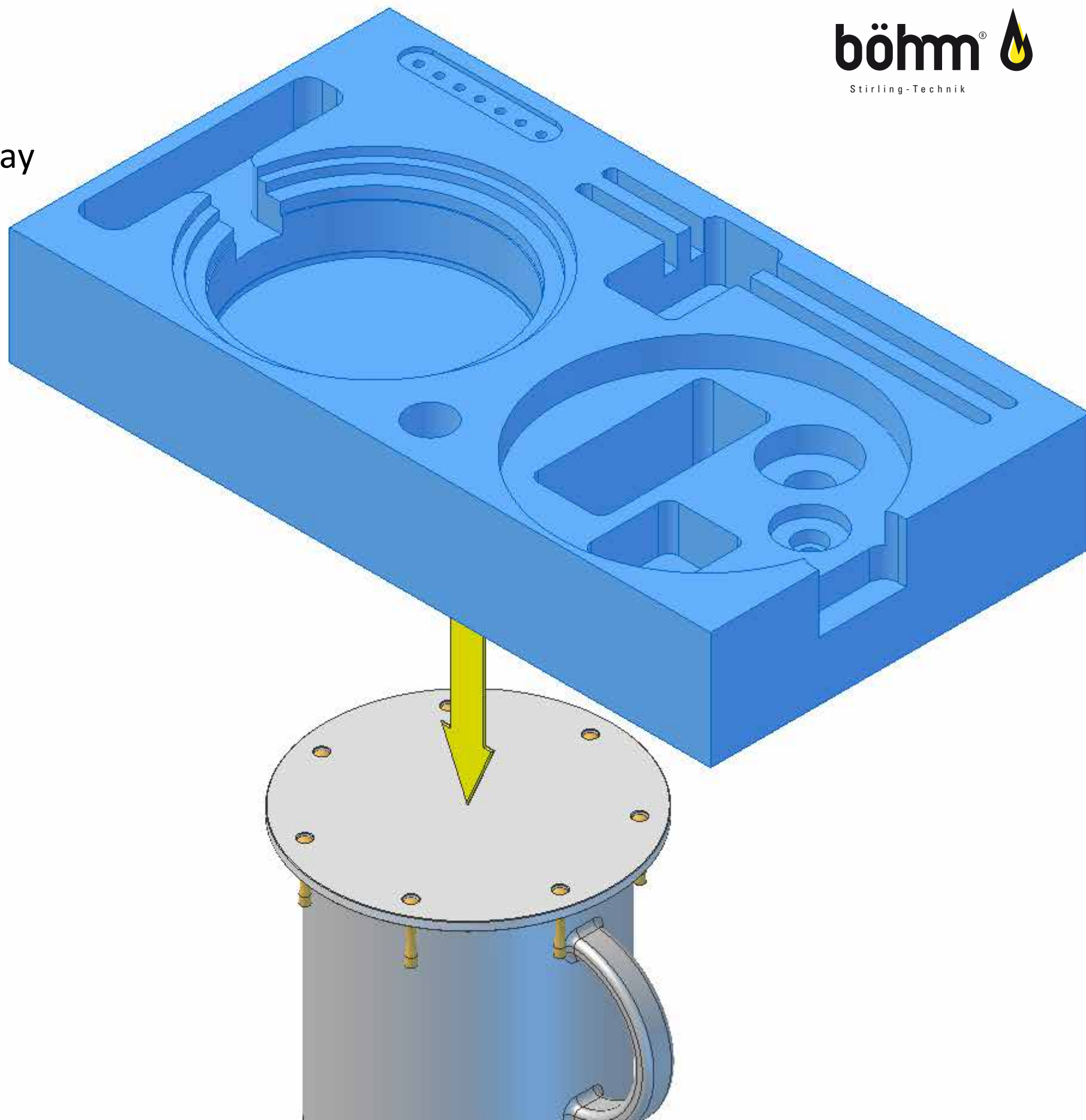
Insert seven brass chamber pillars into the seven holes in the plate; they should all be an easy fit.

The heads of the pillars will sit below the surface of the plate.



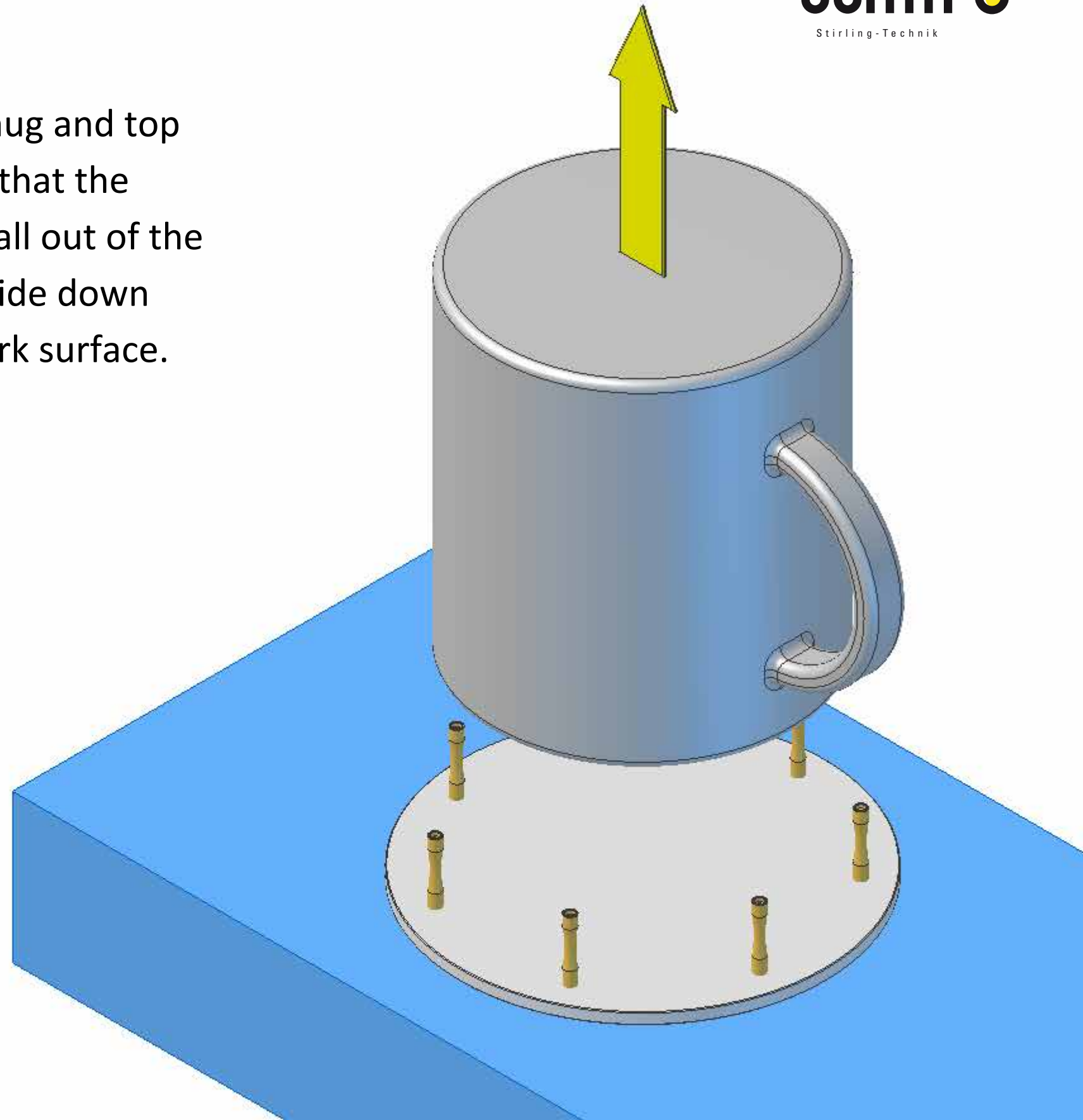
Lower the packing tray
onto the top plate.

Position the tray
centrally over the
plate.

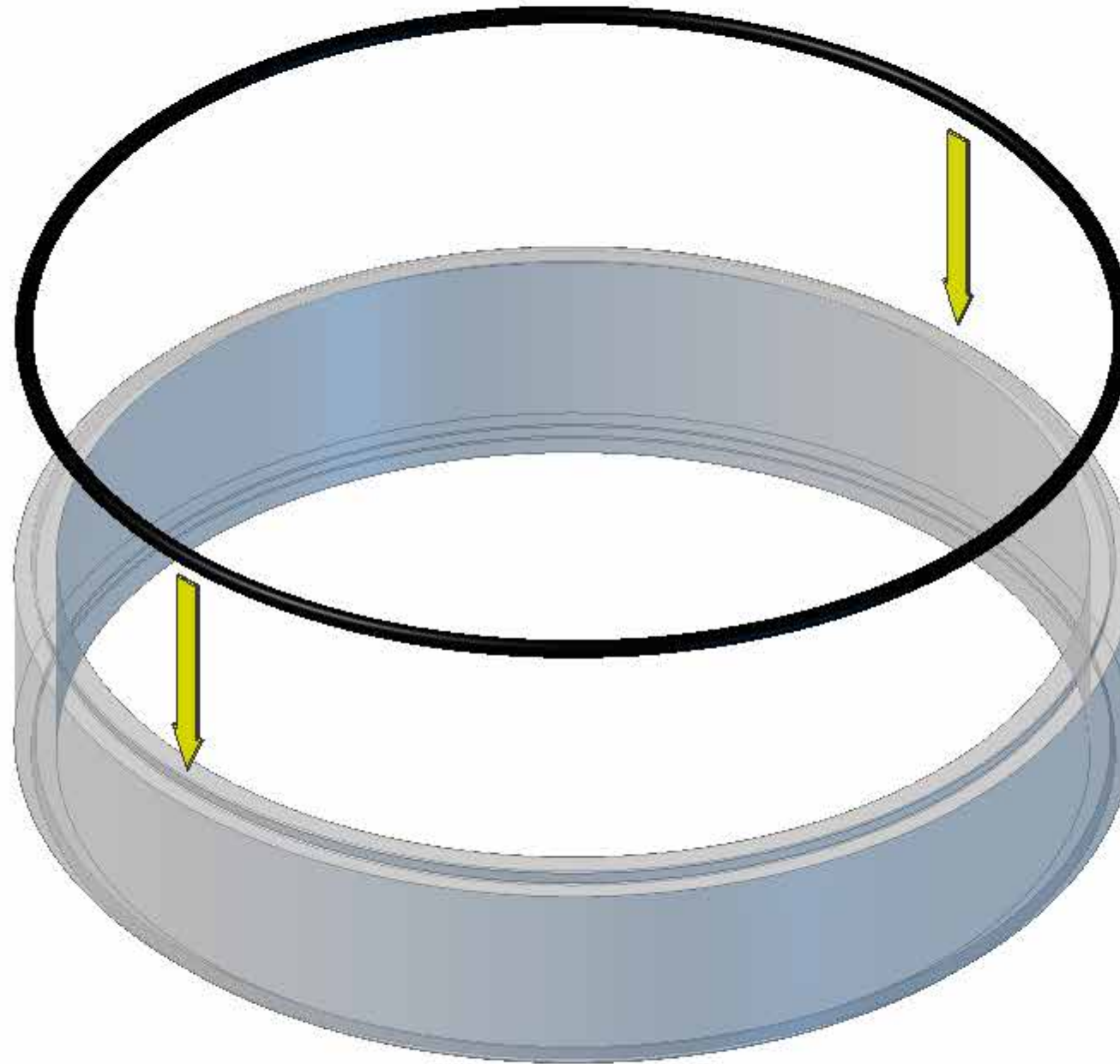


Hold the packing tray, mug and top plate firmly together so that the chamber pillars do not fall out of the plate. Carefully turn upside down and lower onto your work surface.

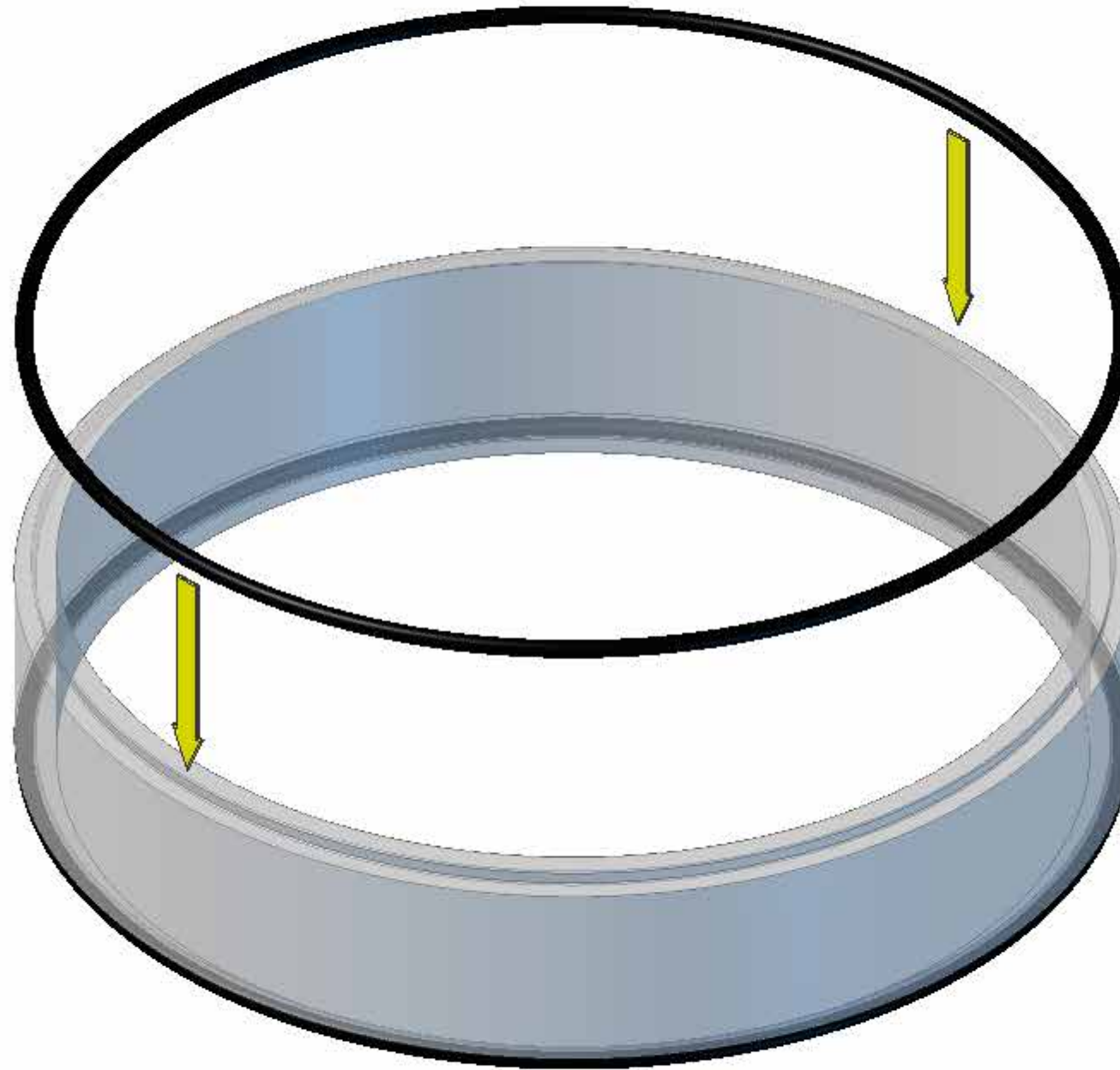
Remove the mug.



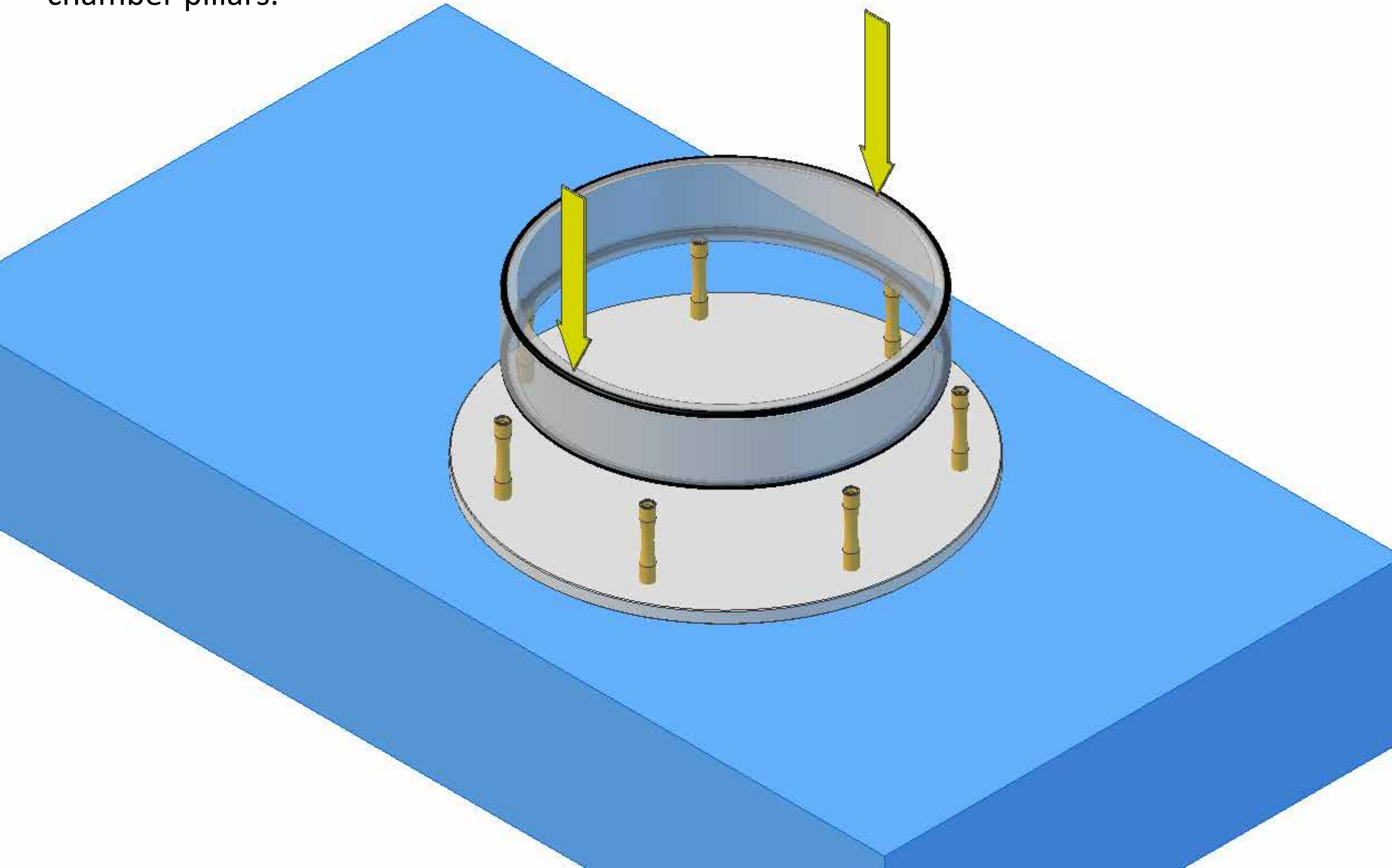
Wipe the chamber wall with a dry cloth to remove any fingerprints.
Stretch one 75mm O ring over the rebate on one end.



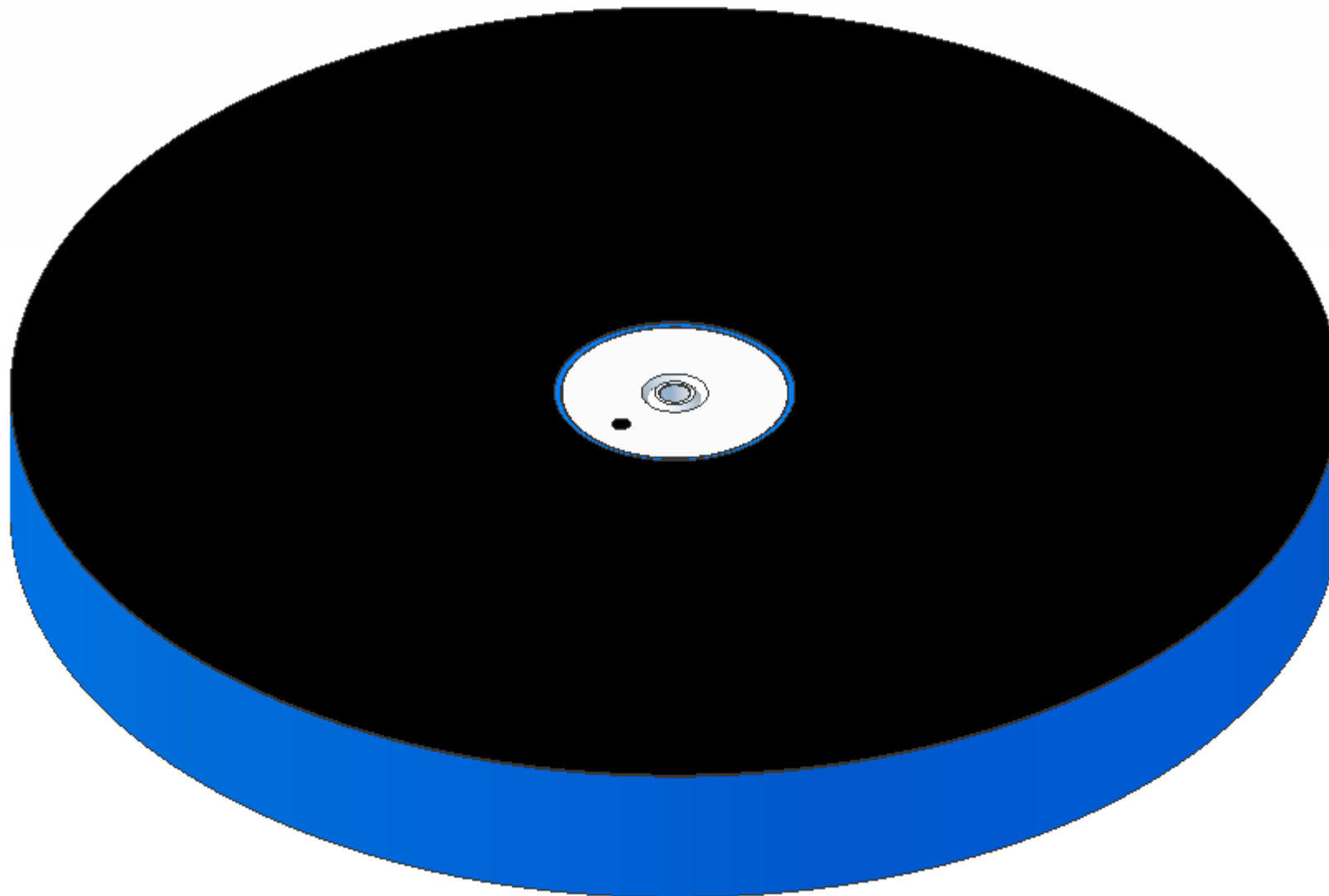
Stretch another 75mm O ring over the rebate on the other end of the chamber wall.



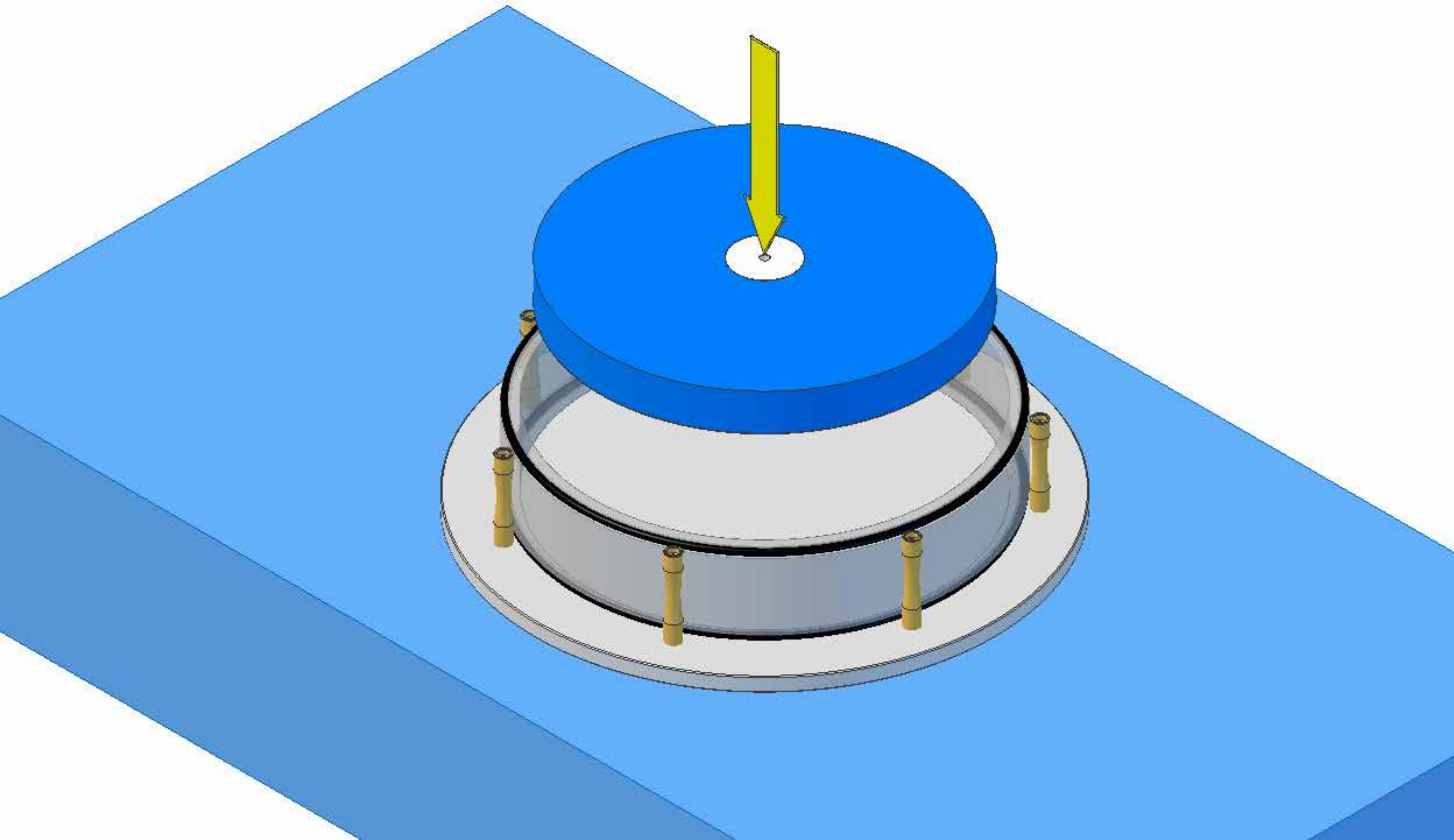
Carefully lower the chamber wall and fitted O rings onto the upturned top plate. Make sure the O rings stay seated in their rebates, and that you do not dislodge any of the chamber pillars.



One face of the displacer has been painted black, this is the top face.

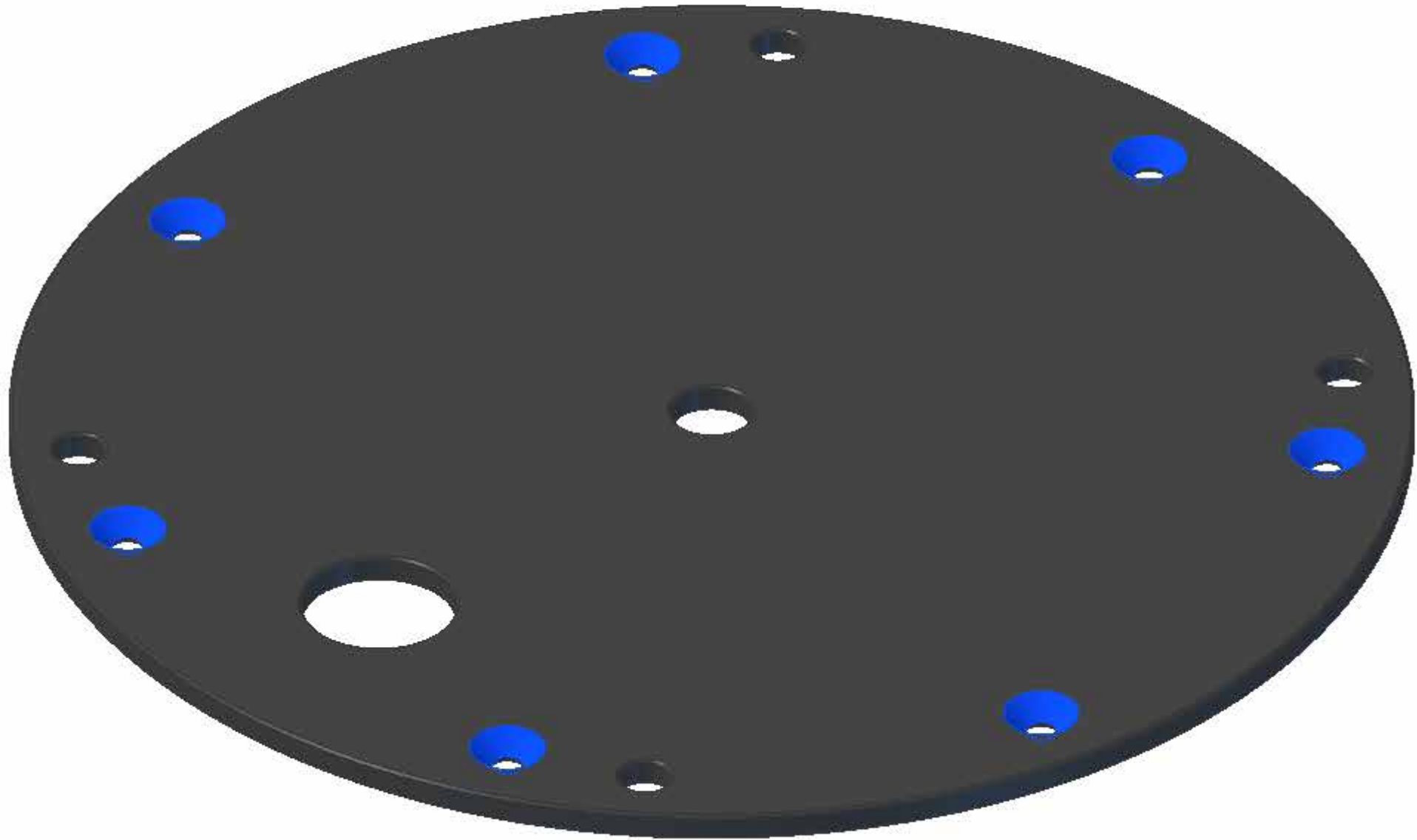


With the top face downwards, lower the displacer down into the engine.

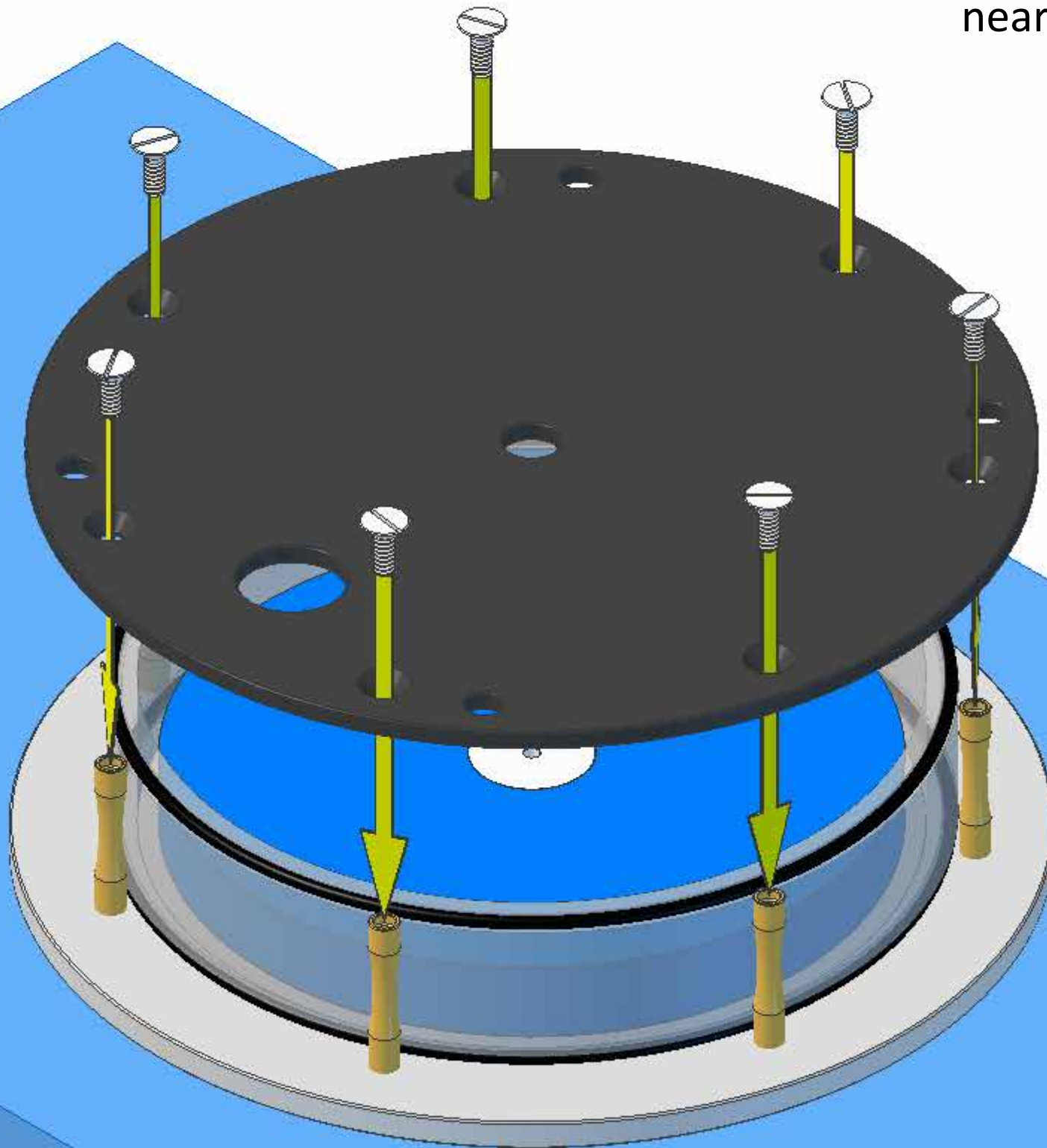


Locate the underside of the middle plate. The underside is the side with the countersinks on the seven holes as shown in the diagram.

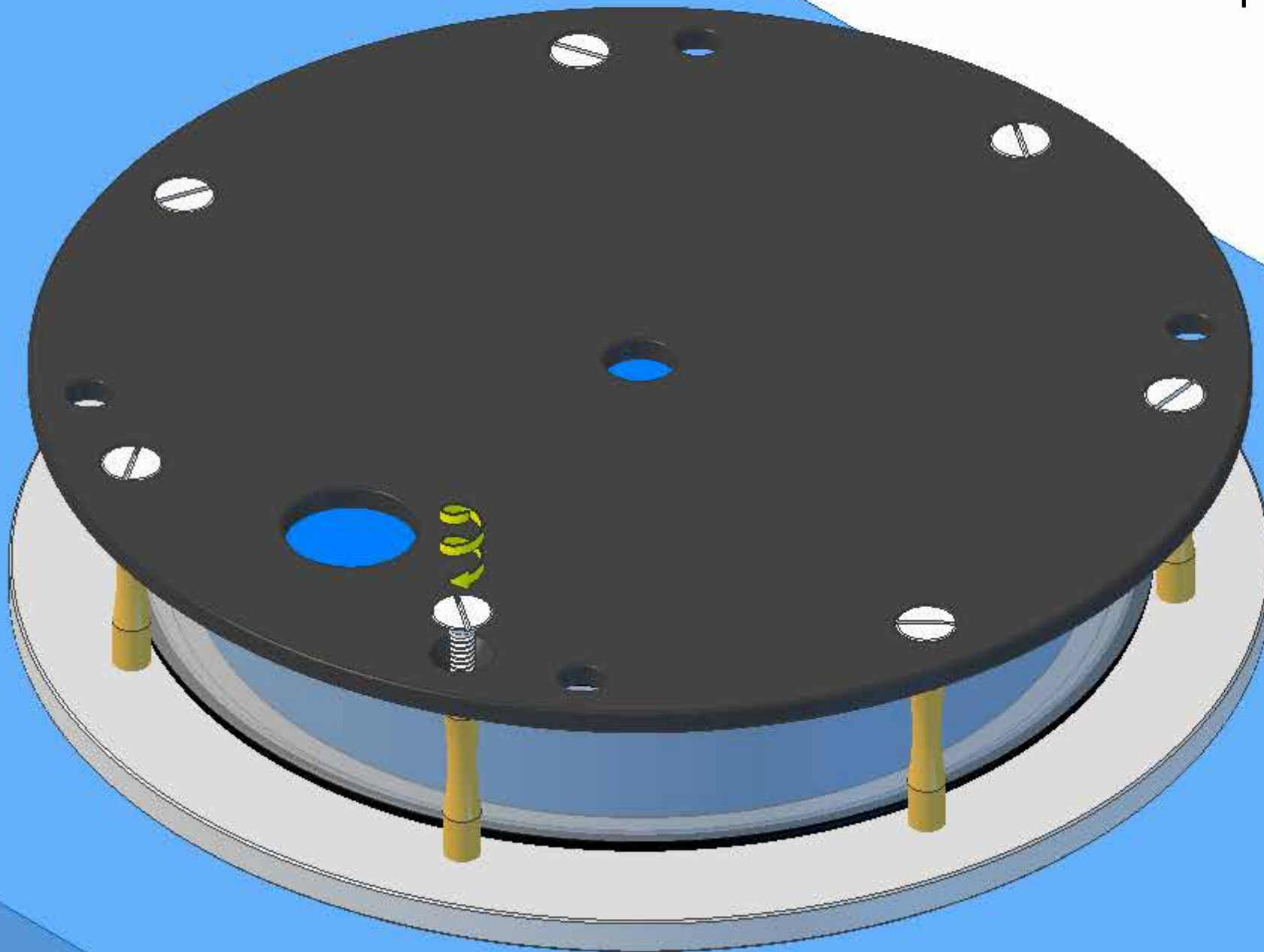
The middle plate has no protective film.



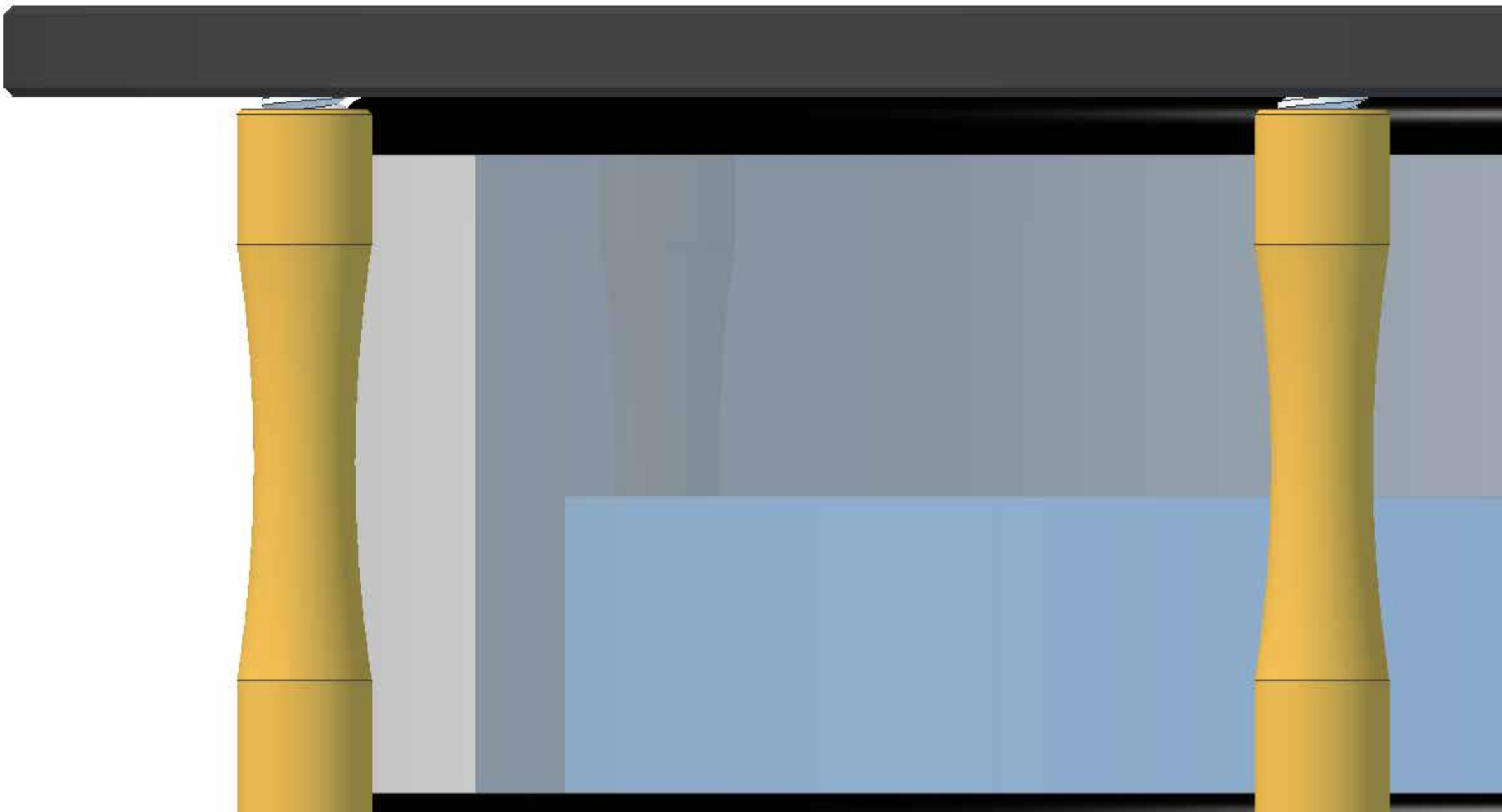
With the underside facing upwards, lower the bottom plate onto the engine. Align the holes in the base plate with the chamber pillars and start inserting seven M2x6mm countersunk screws. Screw each screw nearly all the way in.



When all the screws are in start to tighten them, you might need to pinch each pillar with thumb and finger to stop it spinning while you tighten the screws. Work around the screws in the order 1, 3, 5, 7, 2, 4, and 6. Tighten the screws sufficient to hold the plate in place without any sideways movement, any tighter is unnecessary and could damage the screws.



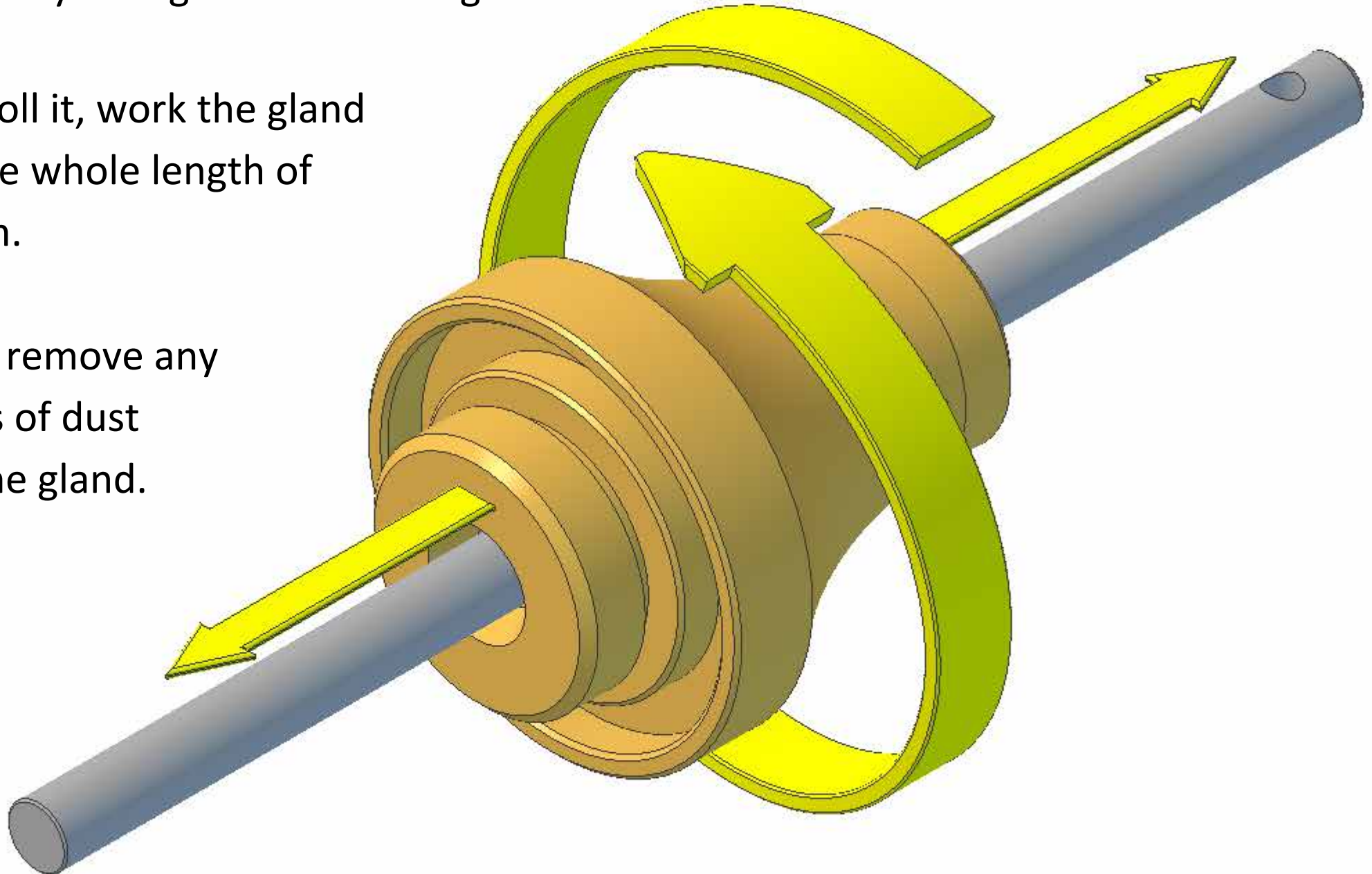
The chamber pillars are deliberately short and will not touch the bottom plate. This is so that they cannot conduct heat directly between the two plates and retard engine performance.



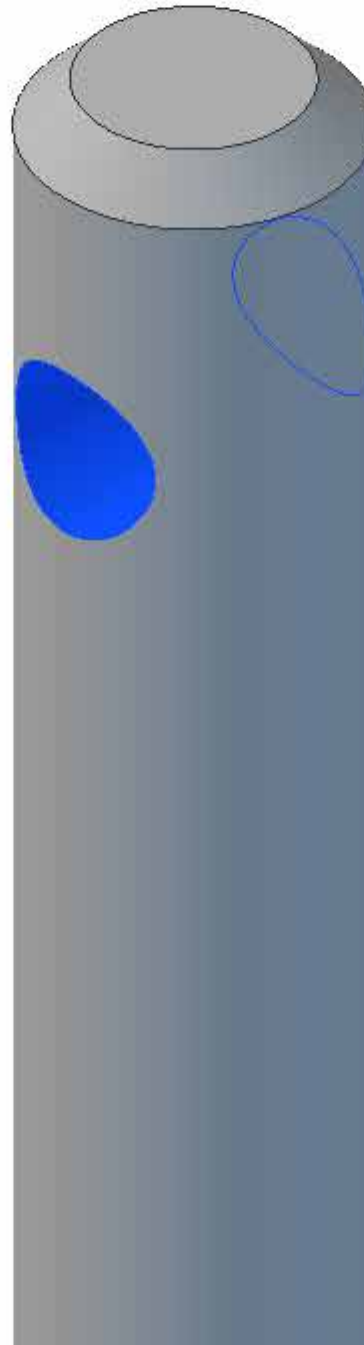
Slide the gland onto the gland stem, hold the stem between the thumb and forefinger of your left hand and roll the gland along the side of your right hand forefinger.

As you roll it, work the gland along the whole length of the stem.

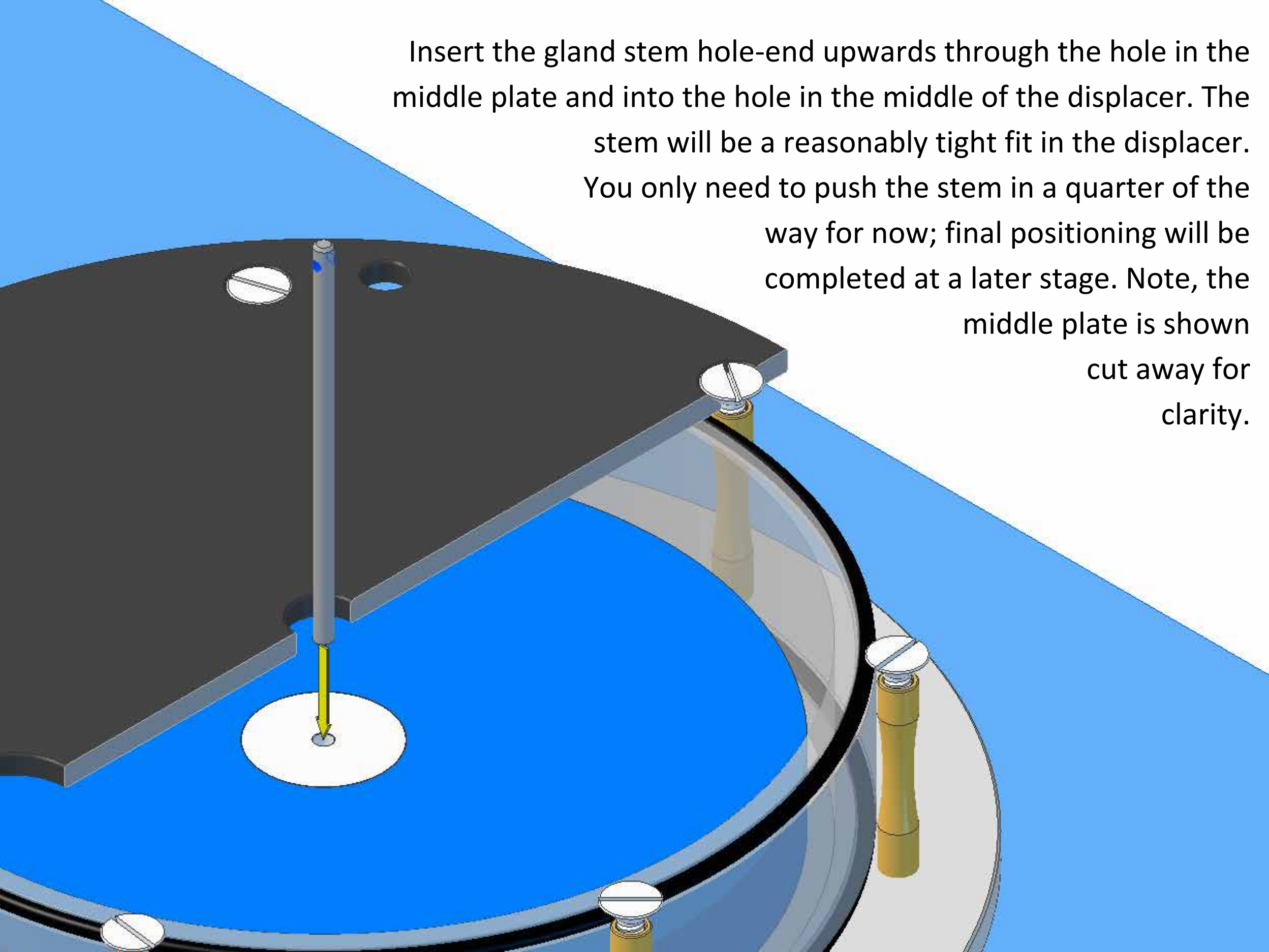
This will remove any particles of dust inside the gland.



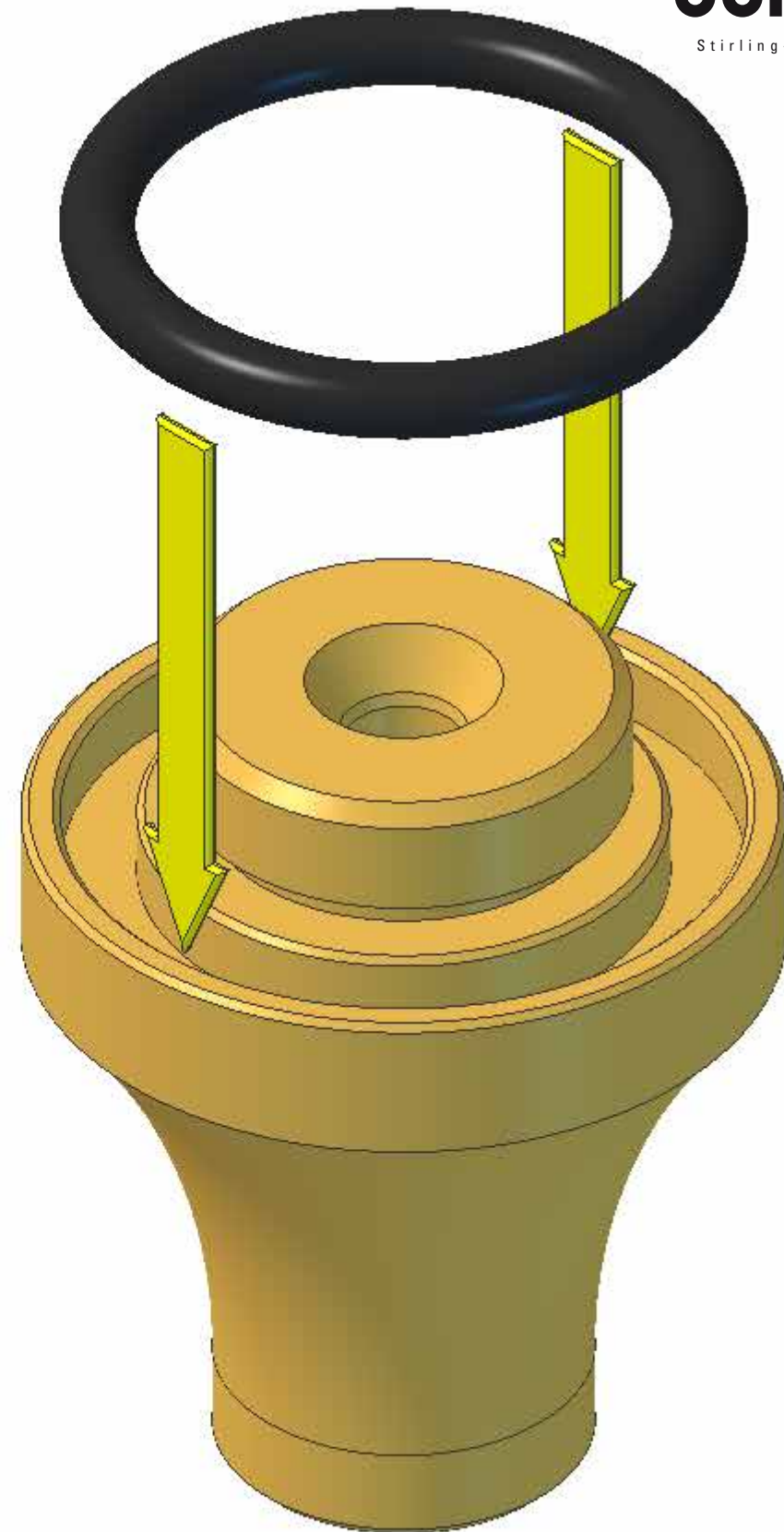
One end of the gland stem is plain and the other has a small through it. The hole-end should point upwards in the next assembly stage.



Insert the gland stem hole-end upwards through the hole in the middle plate and into the hole in the middle of the displacer. The stem will be a reasonably tight fit in the displacer. You only need to push the stem in a quarter of the way for now; final positioning will be completed at a later stage. Note, the middle plate is shown cut away for clarity.



Fit one 7mm O ring into
the groove in the bottom
of the gland.

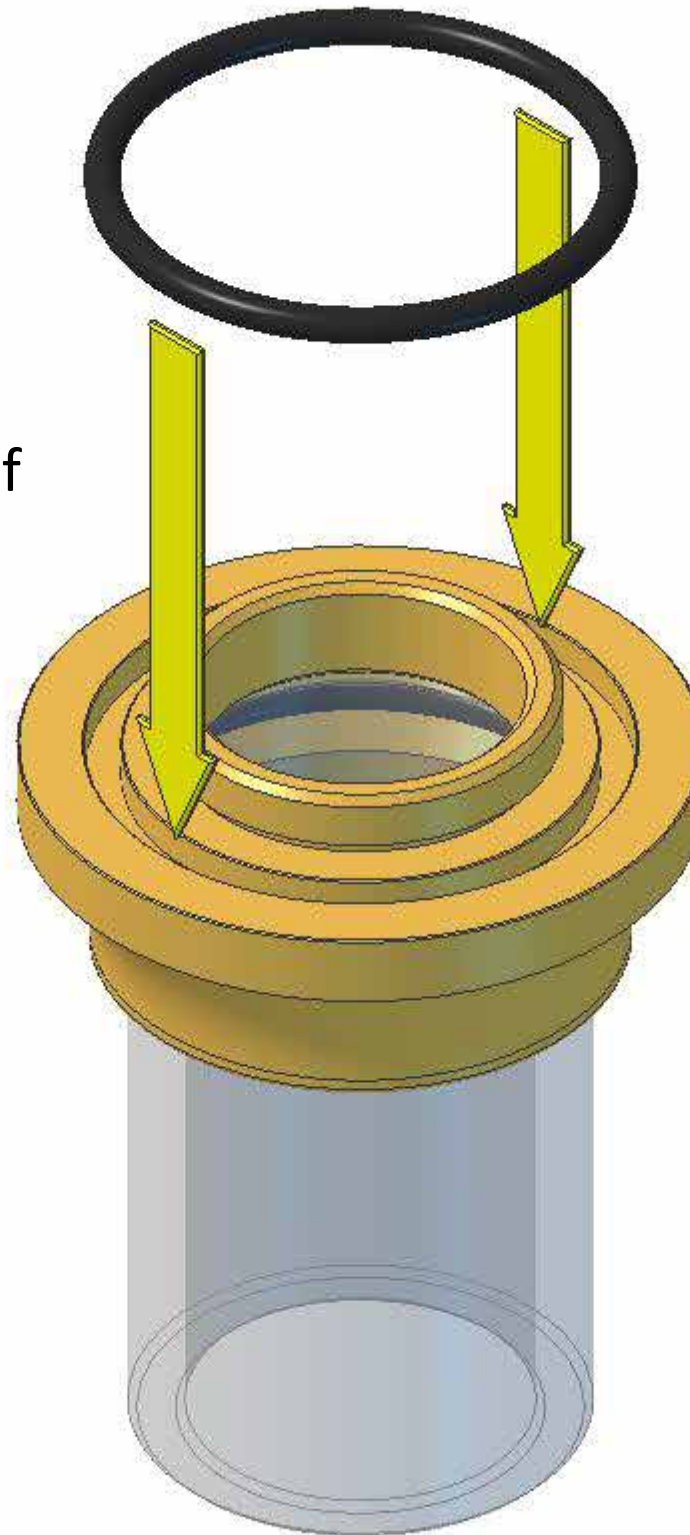


Slide the gland over the gland stem, screw it into the top plate and fully tighten, you might need to wrap an elastic band around it for grip. Make sure that the O ring does not become pinched or fall out of its groove.

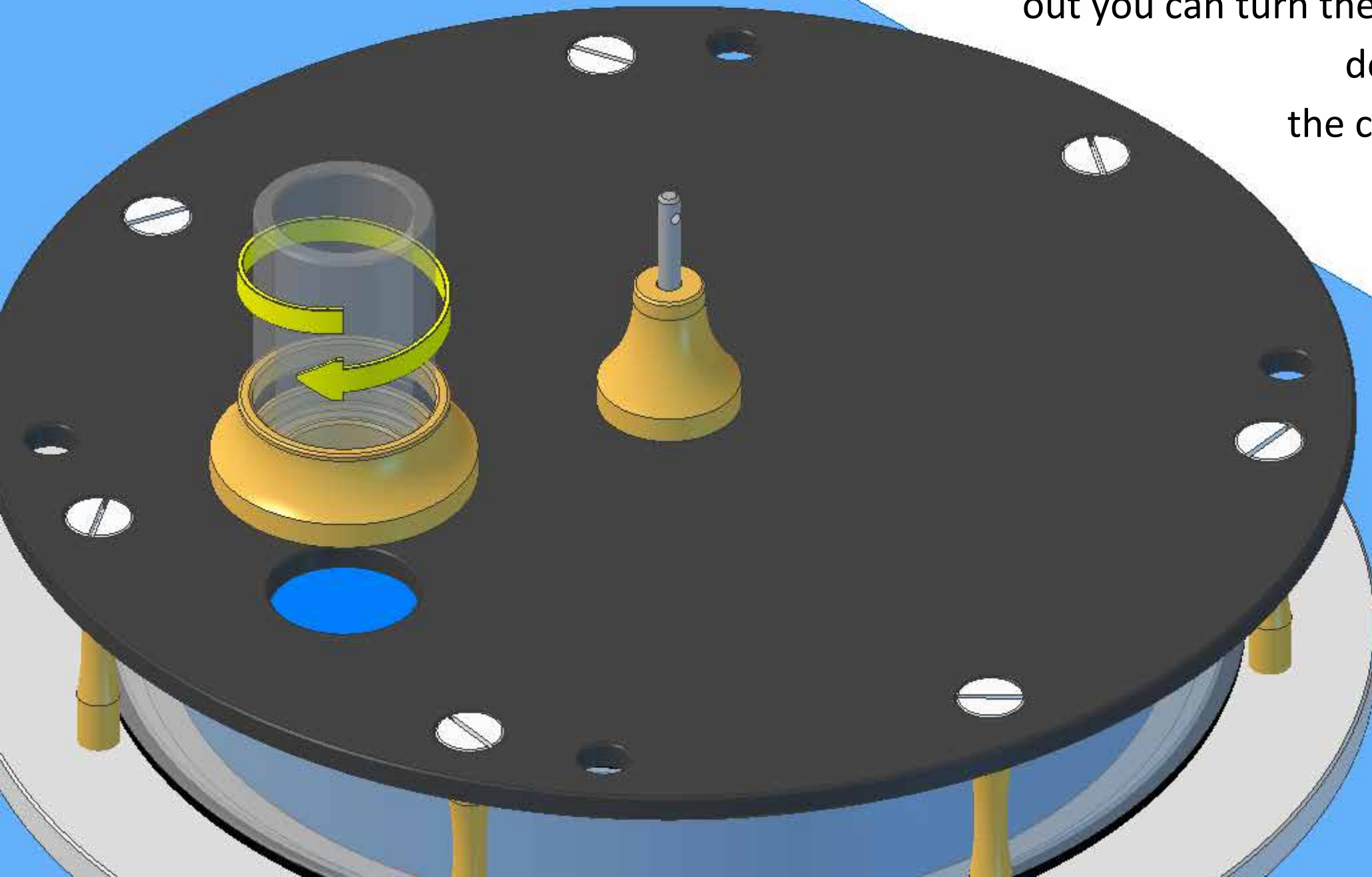
If you have trouble with the O ring falling out you can turn the engine upside down and screw the gland in from underneath.



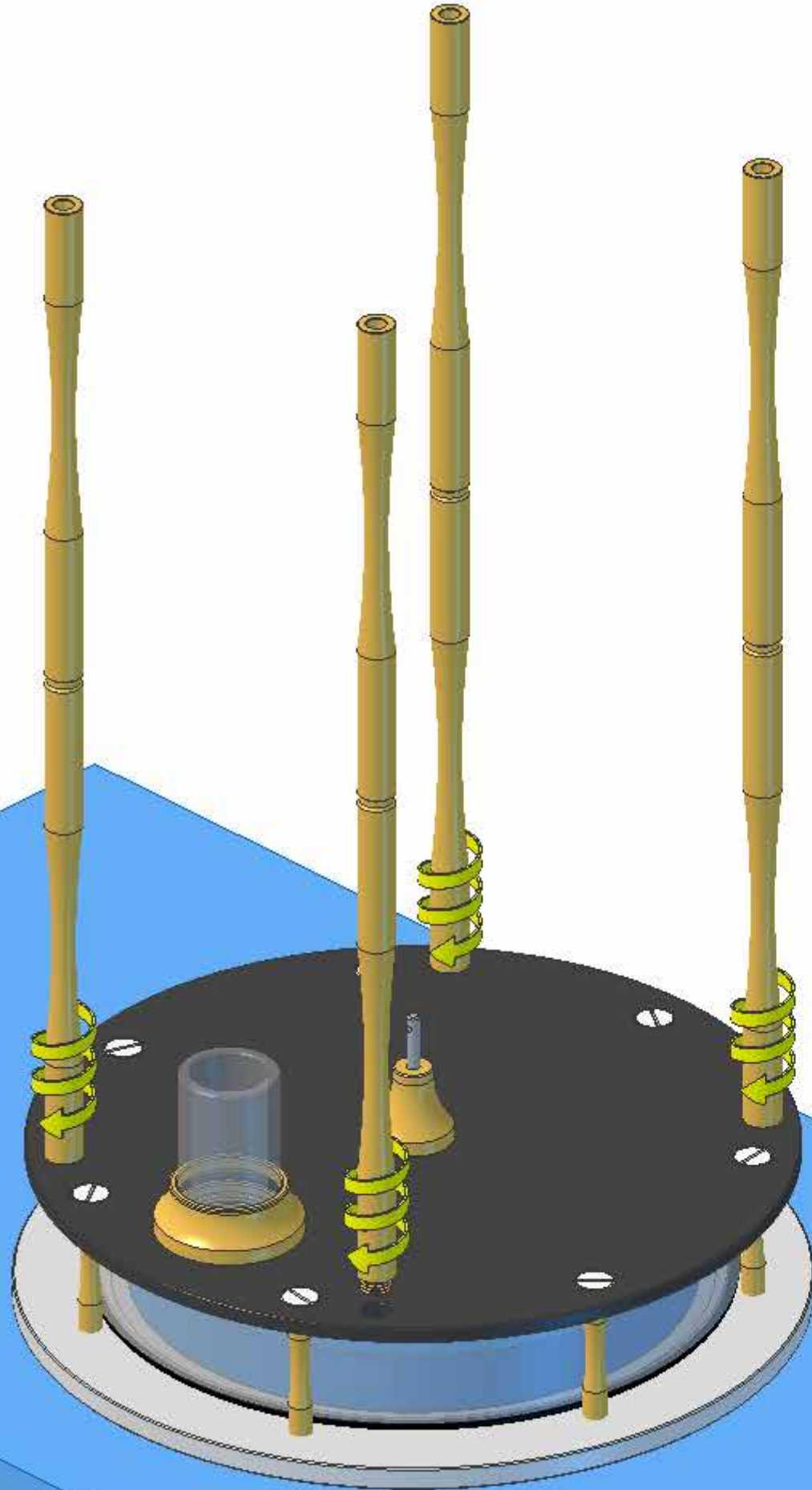
Fit one 13mm O ring into
the groove in the bottom of
the cylinder.

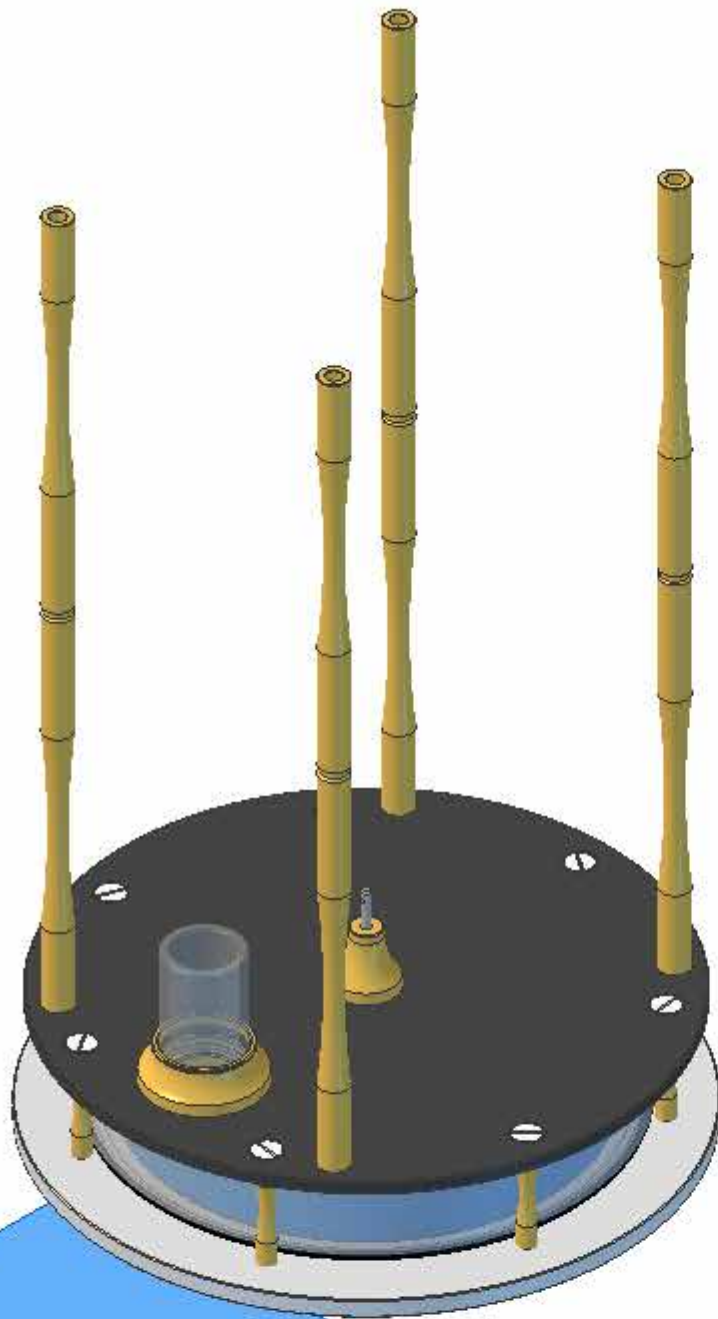


Screw the cylinder into the middle plate and fully tighten, you might need to wrap an elastic band around it for grip. Make sure that the O ring does not become pinched or fall out of its groove. If you have trouble with the O ring falling out you can turn the engine upside down and screw the cylinder in from underneath.



Screw four legs into the four holes in the middle plate and fully tighten, you might need to wrap an elastic band around them for grip.

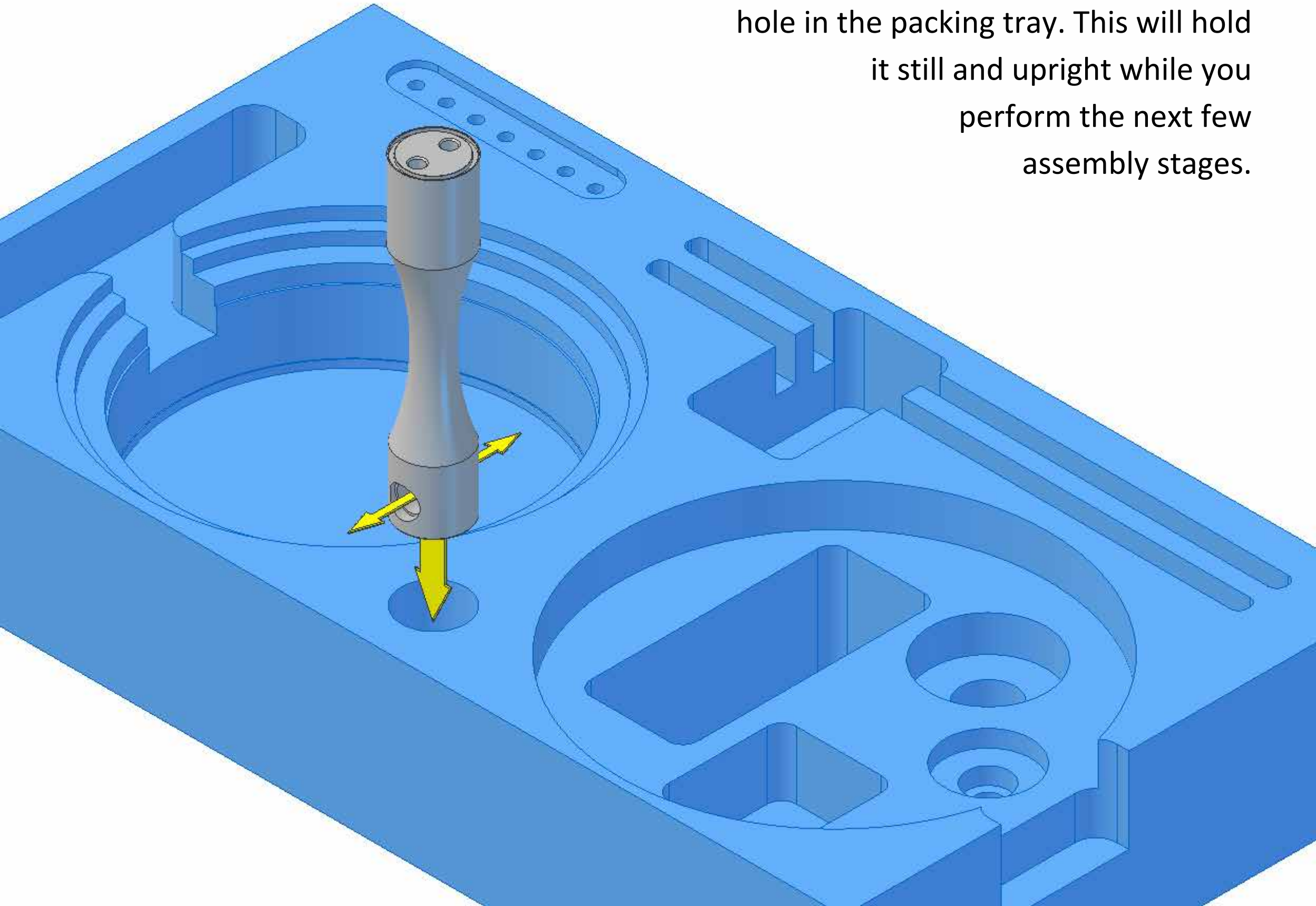




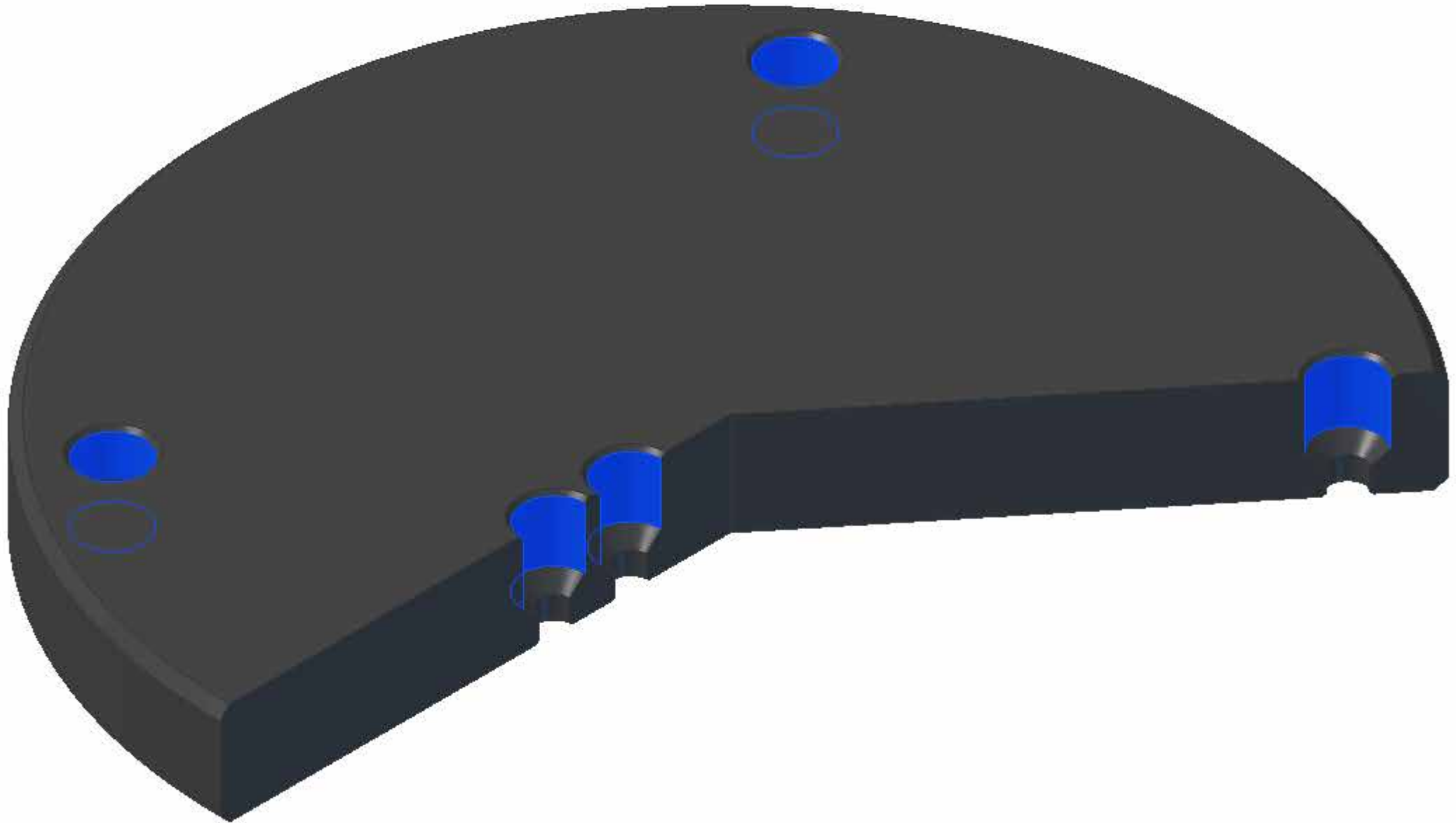
Remove the engine from the packing tray; you will need the tray for the next few assembly stages.

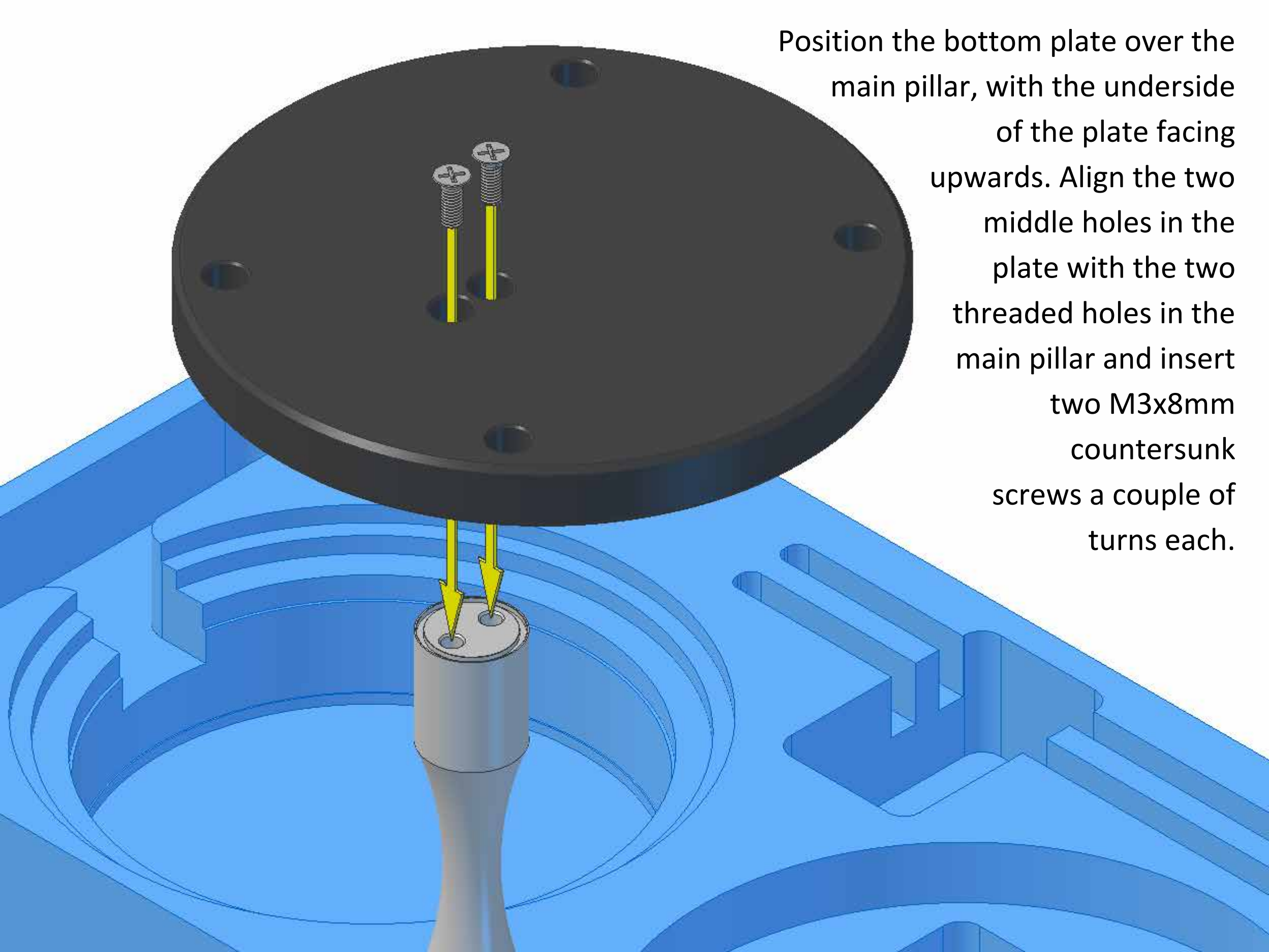
To avoid scratches on the top plate put the engine down on a cloth or paper towel.

Align the hole in the main pillar as shown in the diagram and push the pillar into the hole in the packing tray. This will hold it still and upright while you perform the next few assembly stages.



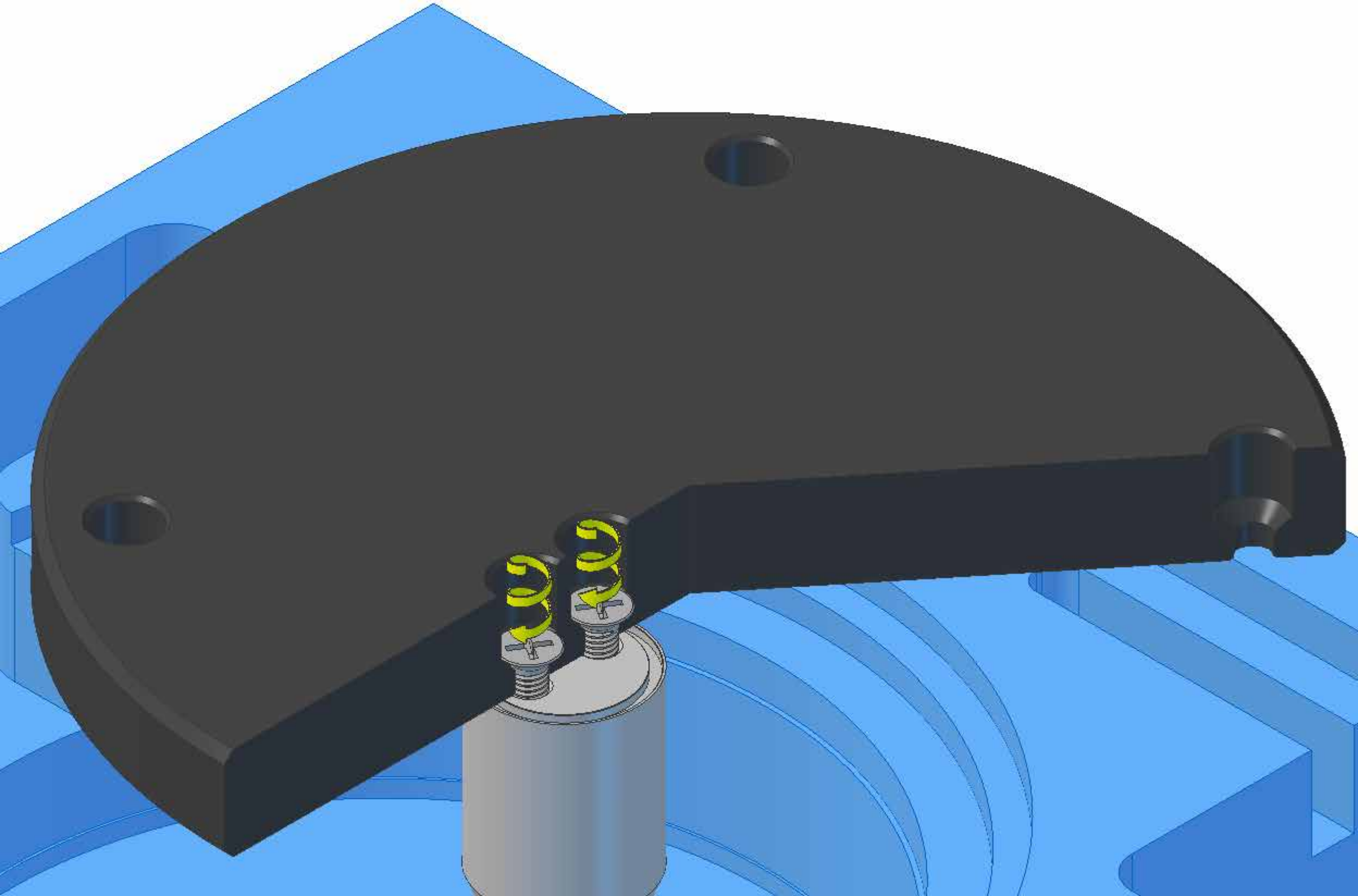
Locate the underside of the bottom plate. The underside is the side with the counterbores (opened out holes) on the six holes as shown in the diagram. Note, the plate is shown cut away for clarity.



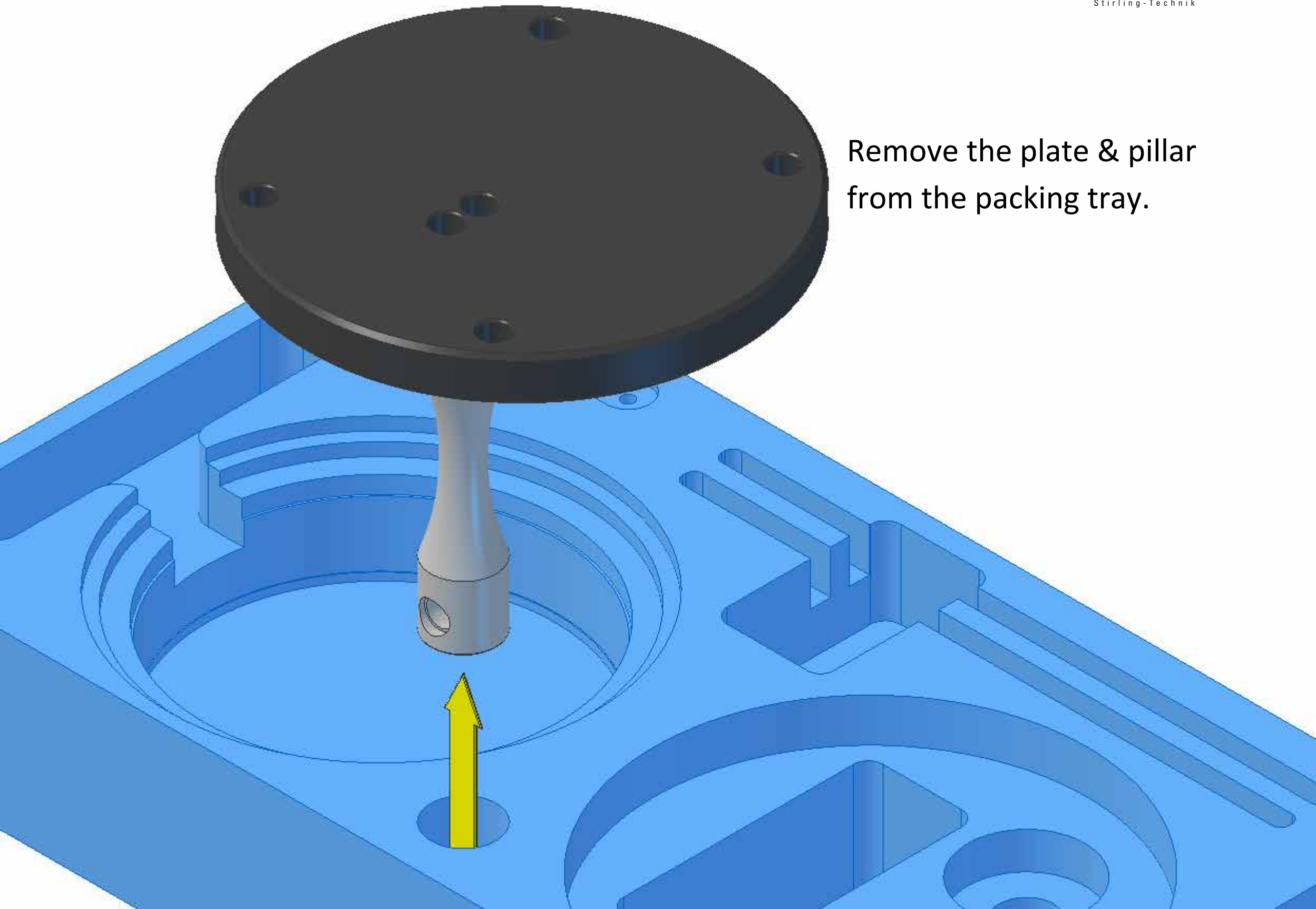


Position the bottom plate over the main pillar, with the underside of the plate facing upwards. Align the two middle holes in the plate with the two threaded holes in the main pillar and insert two M3x8mm countersunk screws a couple of turns each.

Screw the screws in until they both lightly touch the shoulders inside the holes, then fully tighten. Note, the plate is shown cut away for clarity.



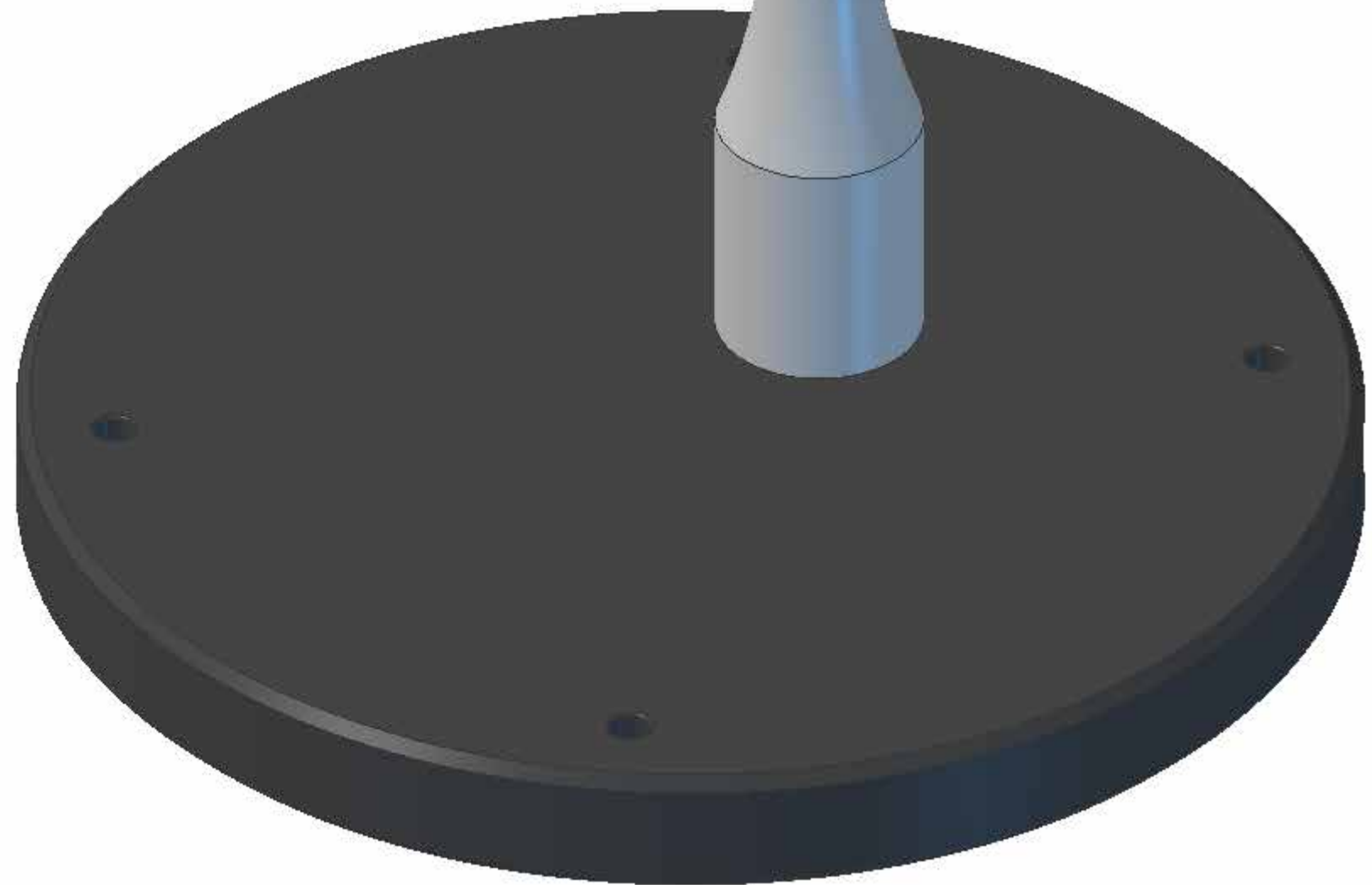
Remove the plate & pillar
from the packing tray.



Fit two ball-race bearings into the recesses in the top of the main pillar.

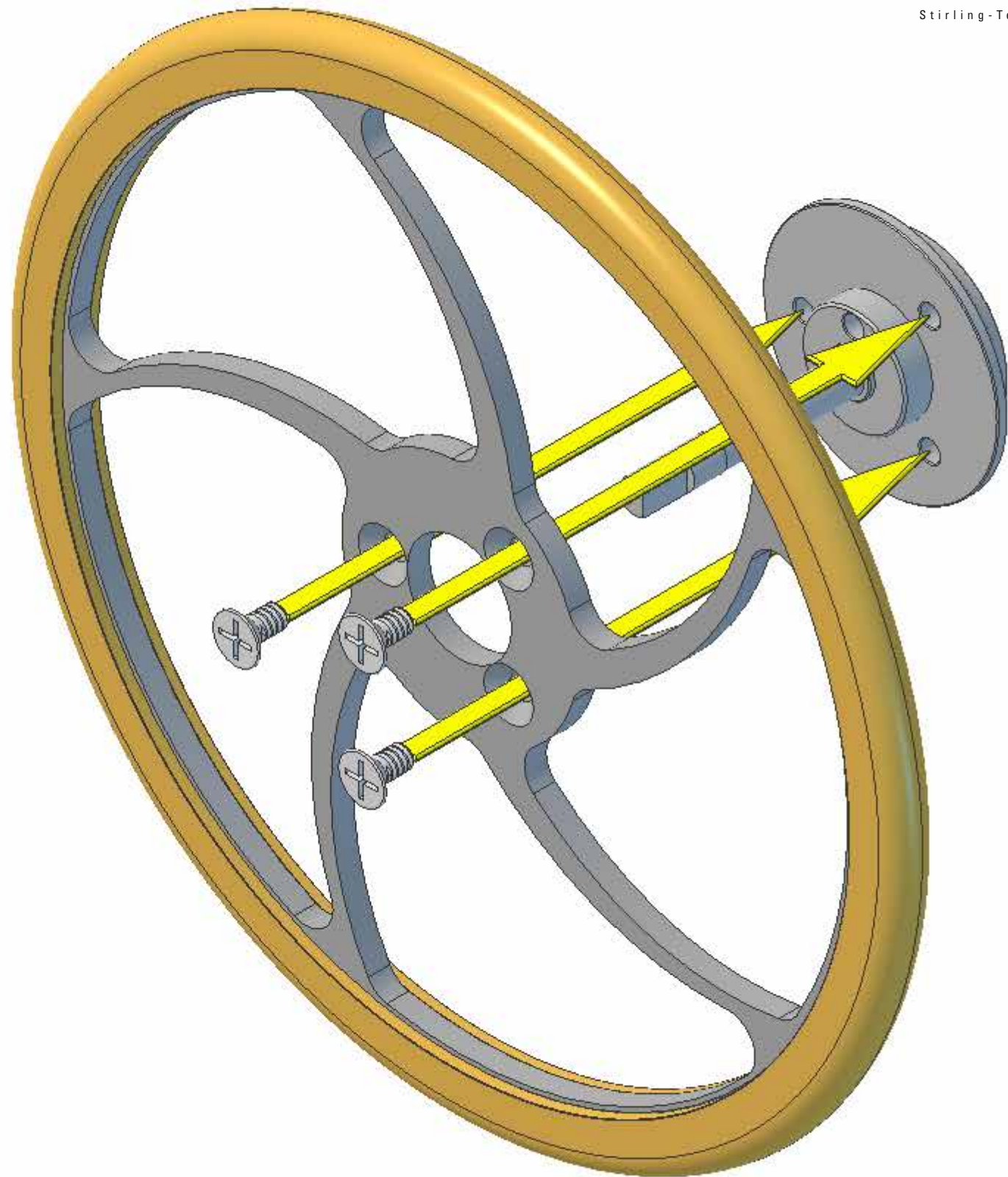
The bearings have a dust shield on one side and are open on the other.

The shielded sides should face outwards after fitting.

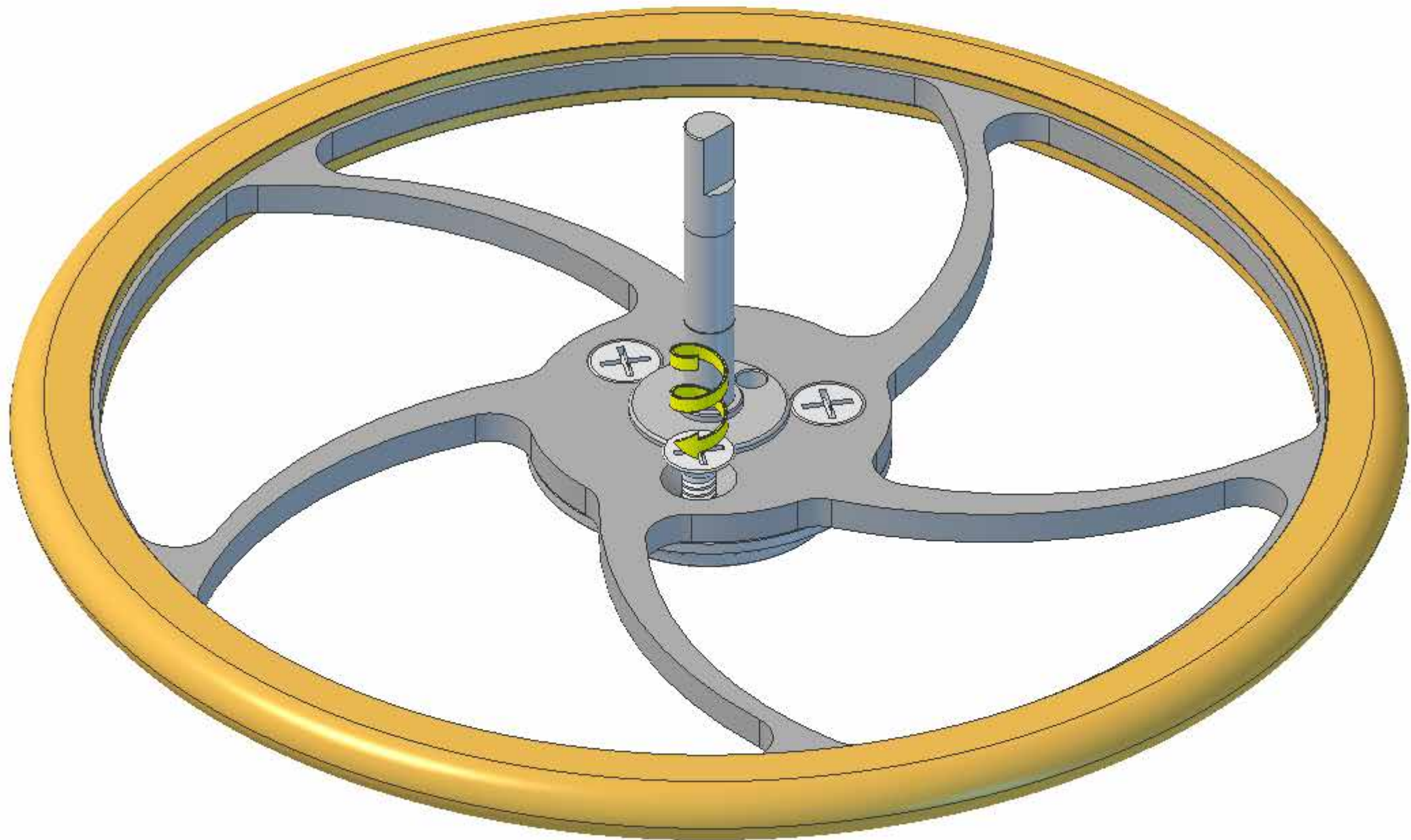


Fit the hub/axle into the flywheel. Screw in three M2x4mm countersunk screws a couple of turns each.

The three holes in the flywheel and hub are spaced so that there is only one way that they will all line up together. This ensures the flywheel counterweight is in the correct position. Note, the three holes in the flywheel are countersunk on one side; this side should be positioned as shown in the diagram.

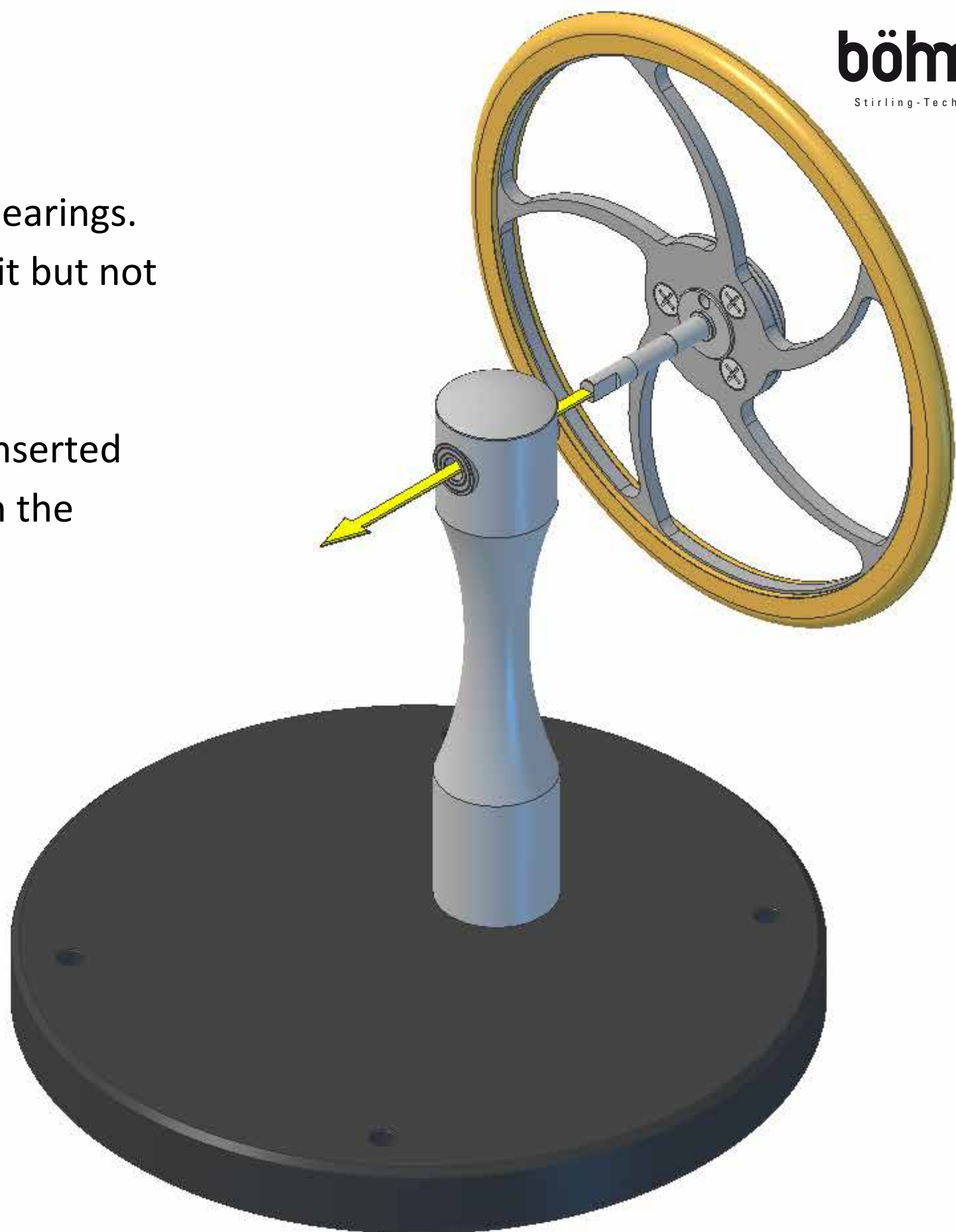


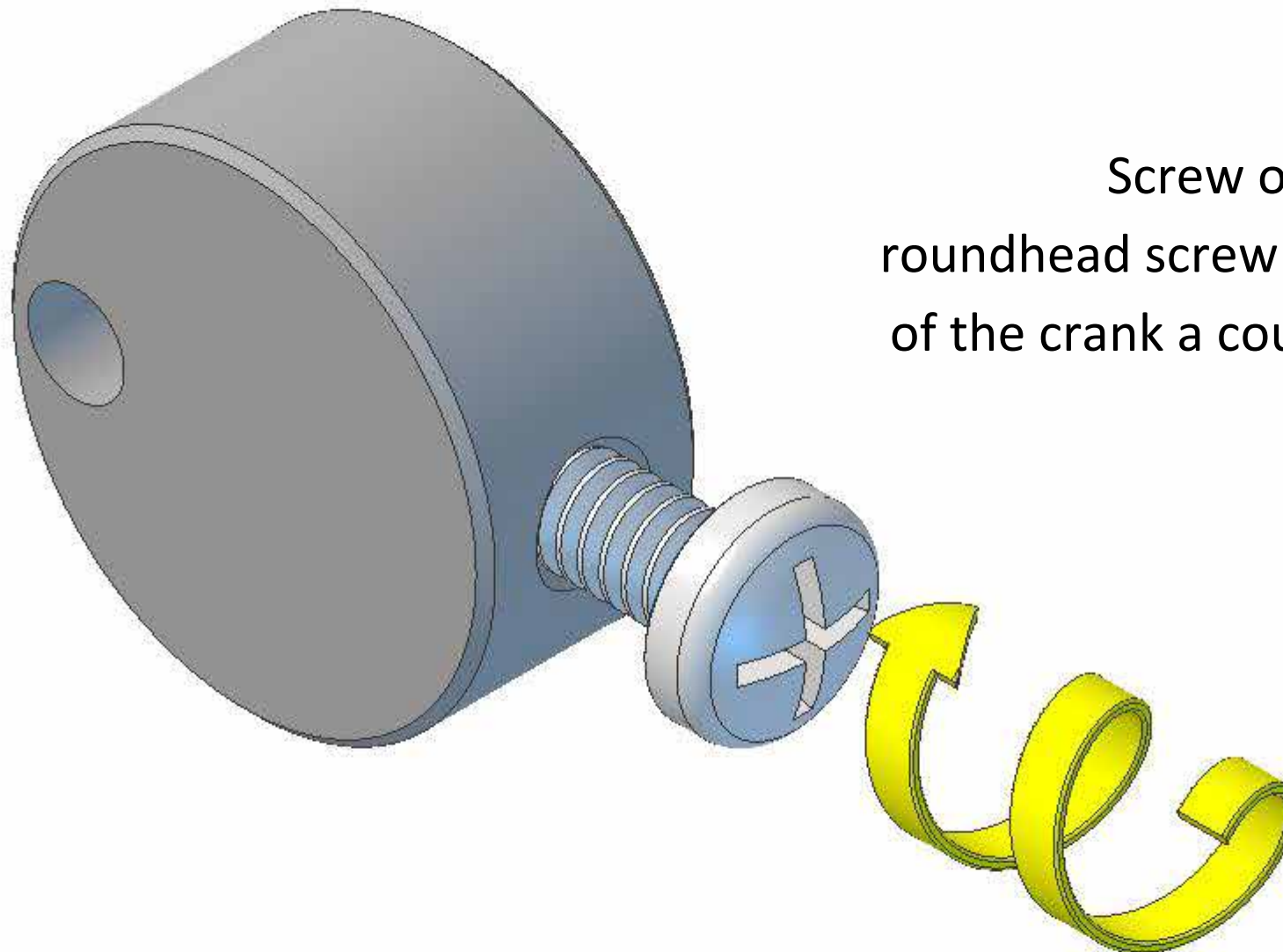
Screw the three screws in until they all lightly touch the flywheel, then fully tighten.



Slide the axle through the bearings.
The axle should be a good fit but not
tight in the bearings.

Make sure that the axle is inserted
from the direction shown in the
diagram.

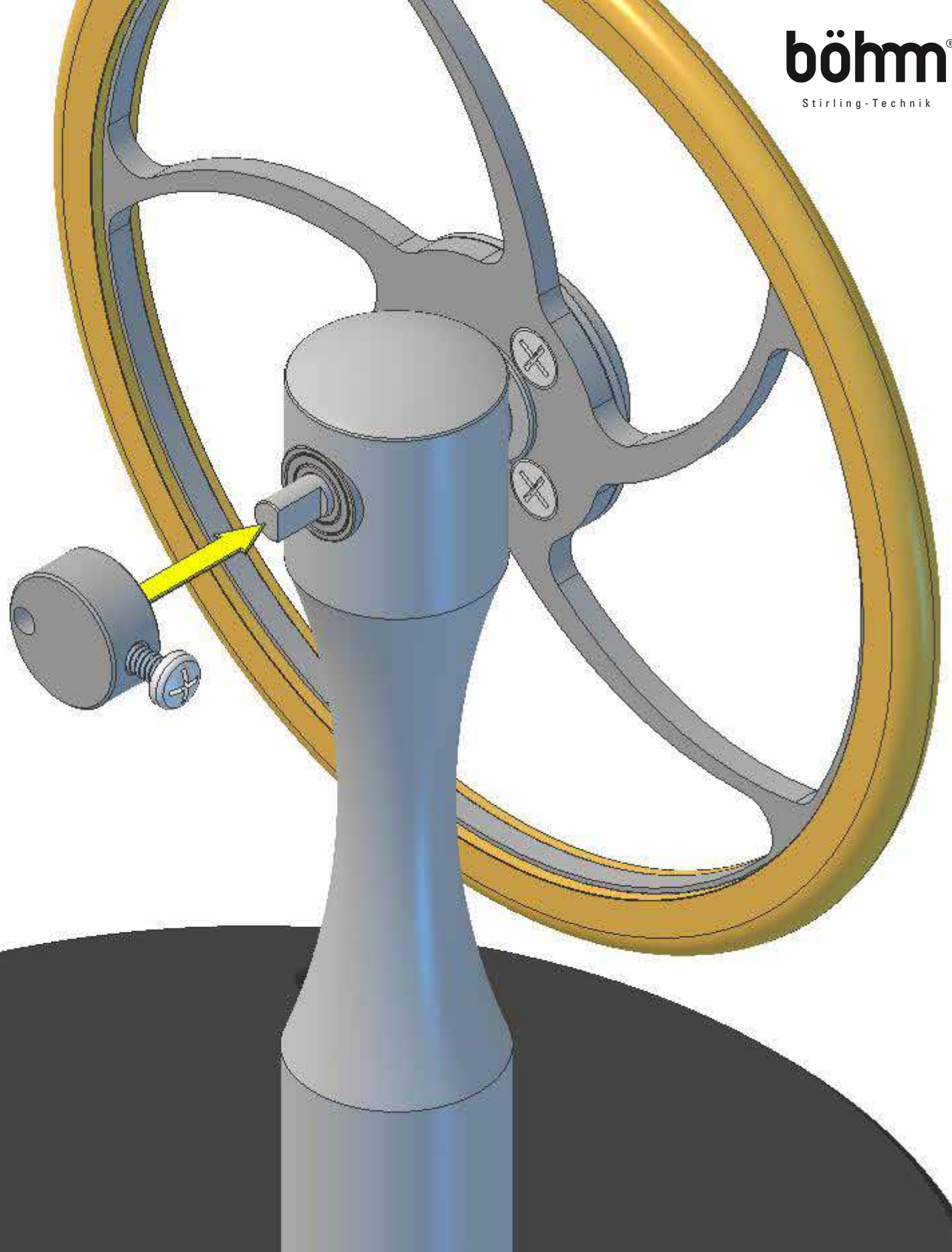




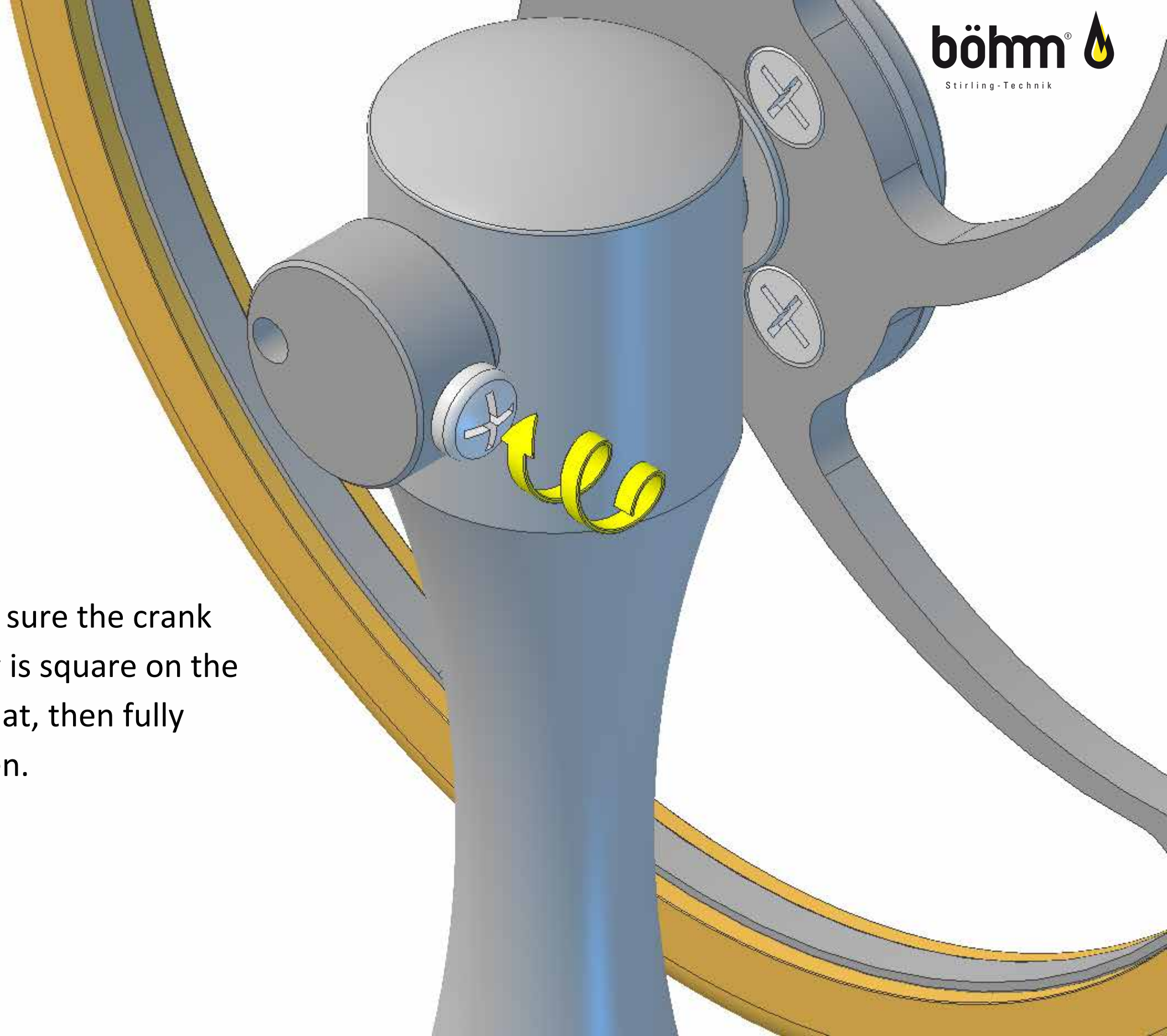
Screw one M2x4mm
roundhead screw into the side
of the crank a couple of turns.

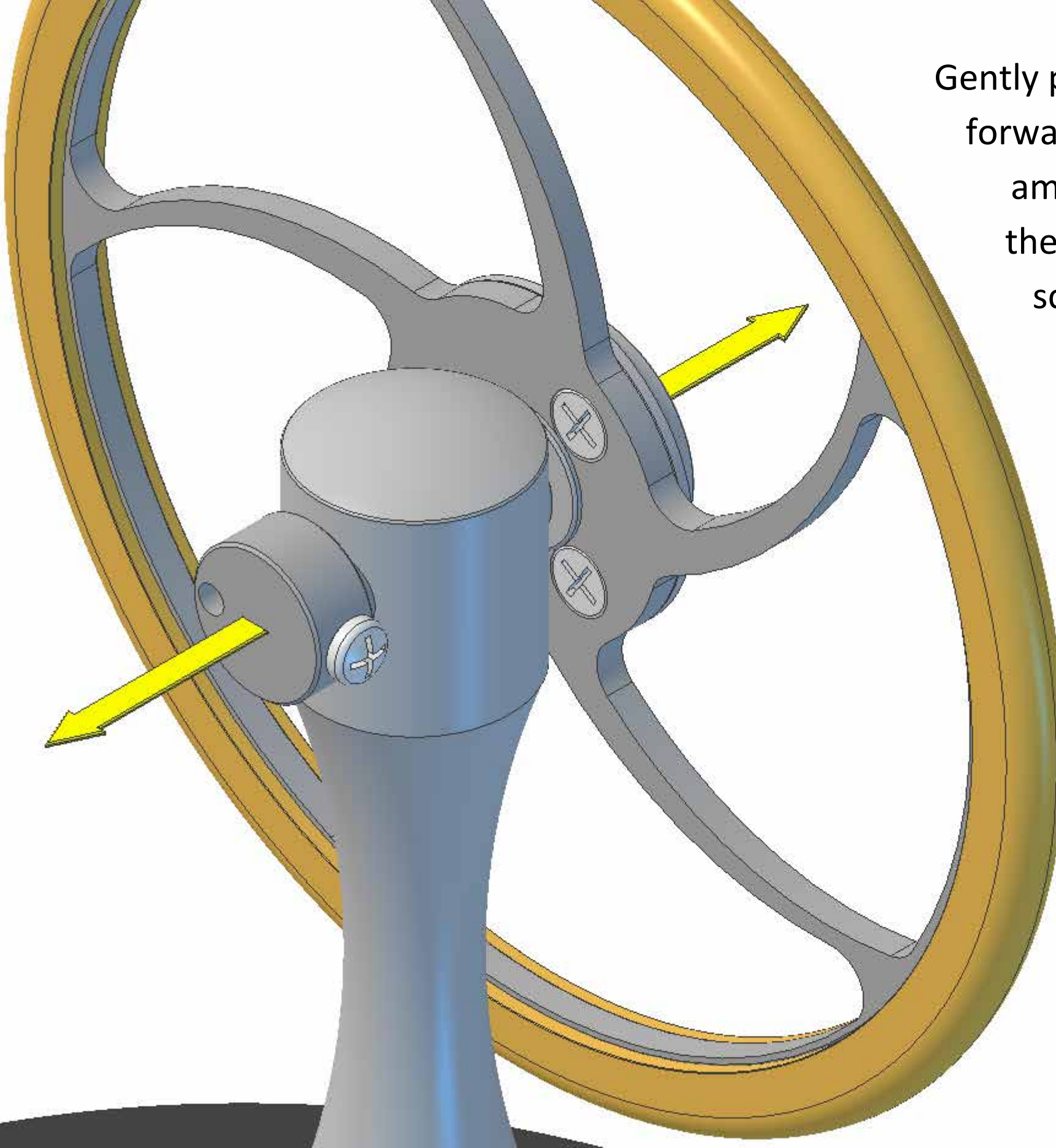
Slide the crank onto the end of the axle. The crank should be a good fit but not tight on the axle.

Note: the screw in the side of the crank must screw onto the small flat on the end of the axle.



Make sure the crank
screw is square on the
axle flat, then fully
tighten.

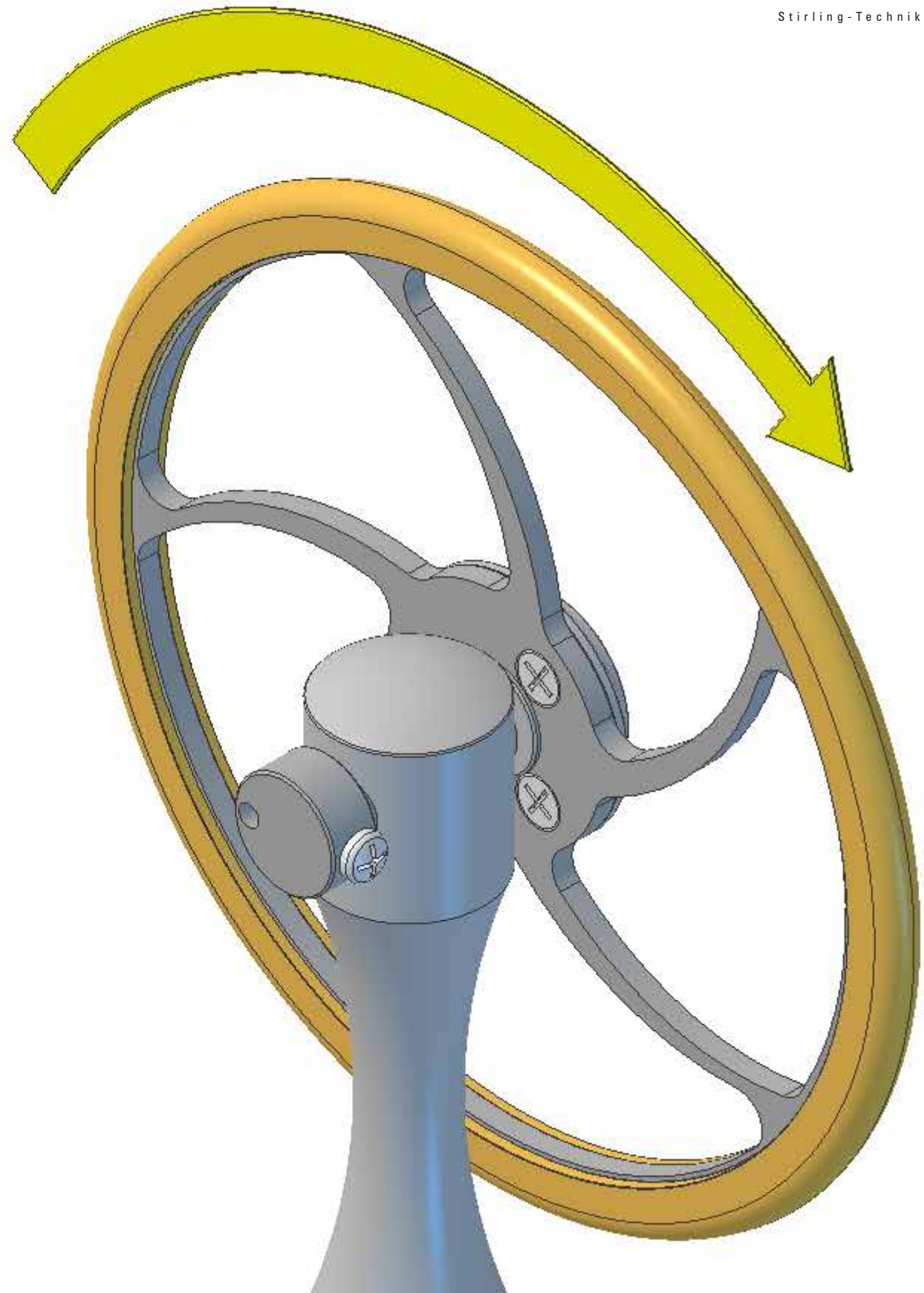




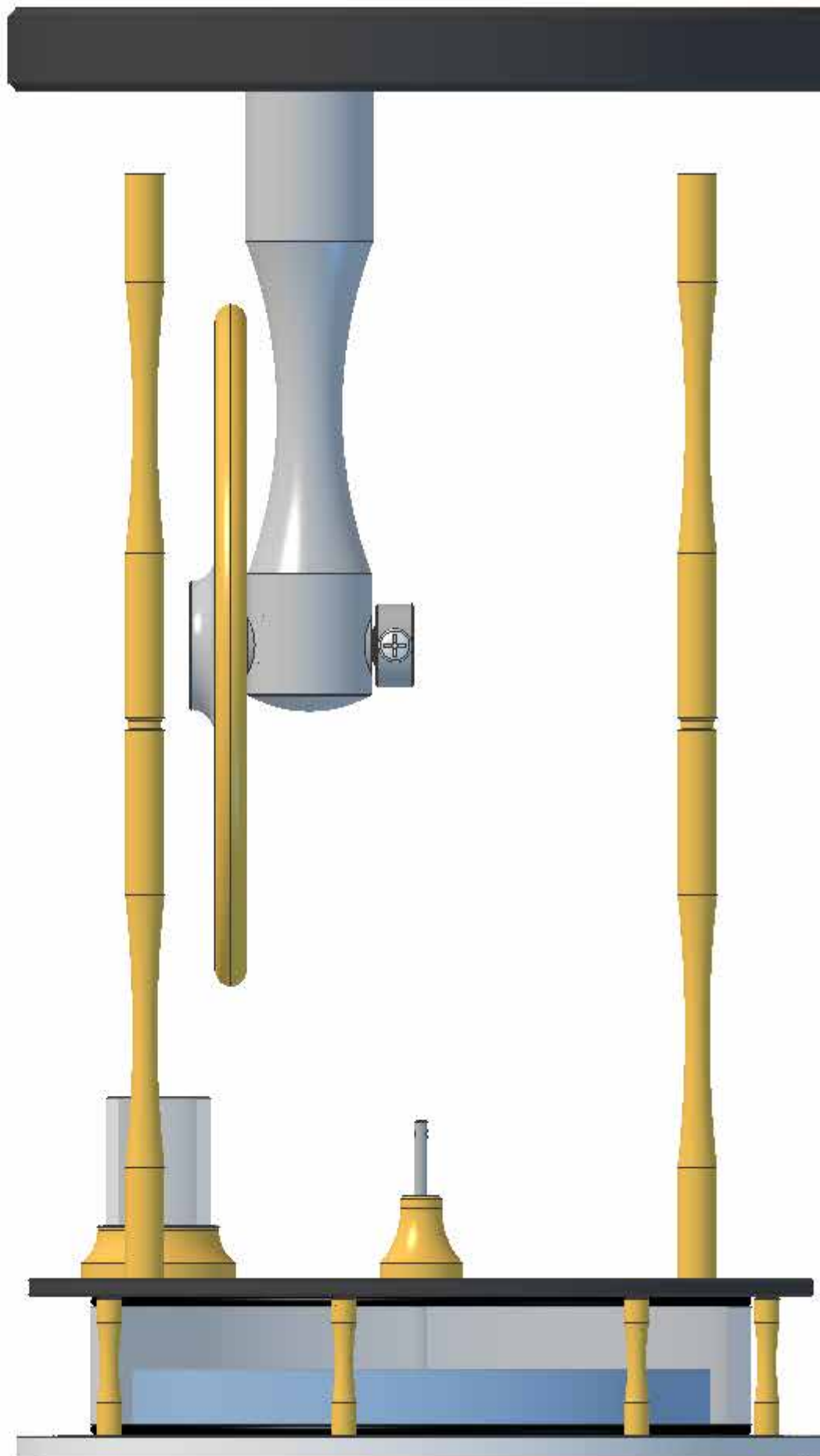
Gently push the flywheel back and forward, there should be a small amount of movement here. If there is not, slacken the crank screw, move the crank out a fraction and tighten. Make sure that when tightening the crank screw again it stays located on the small flat section on the axle.

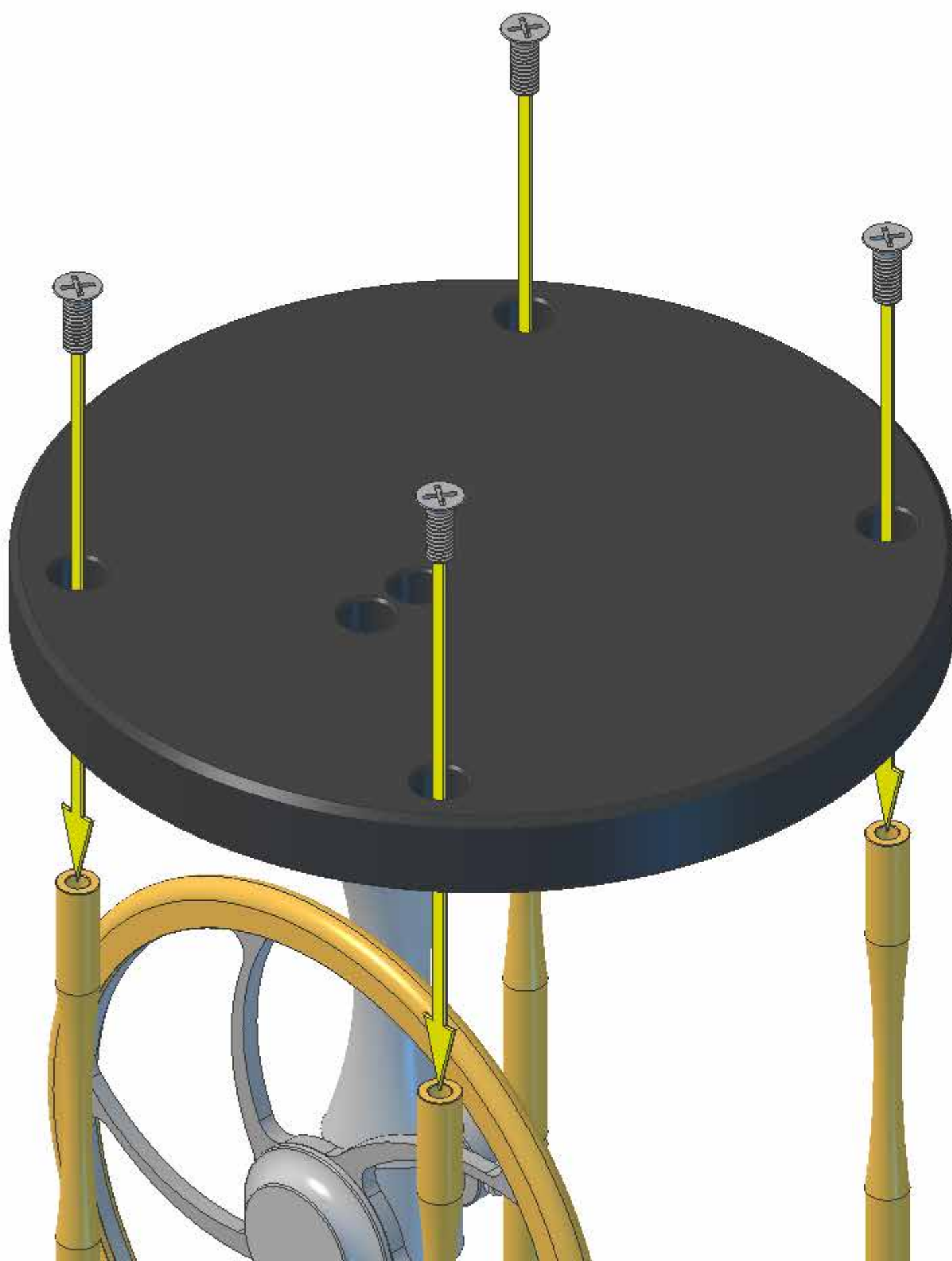
Give the flywheel a sharp spin; it should keep spinning for several minutes.

If it does not then you will need to go back and move the crank out a fraction more.

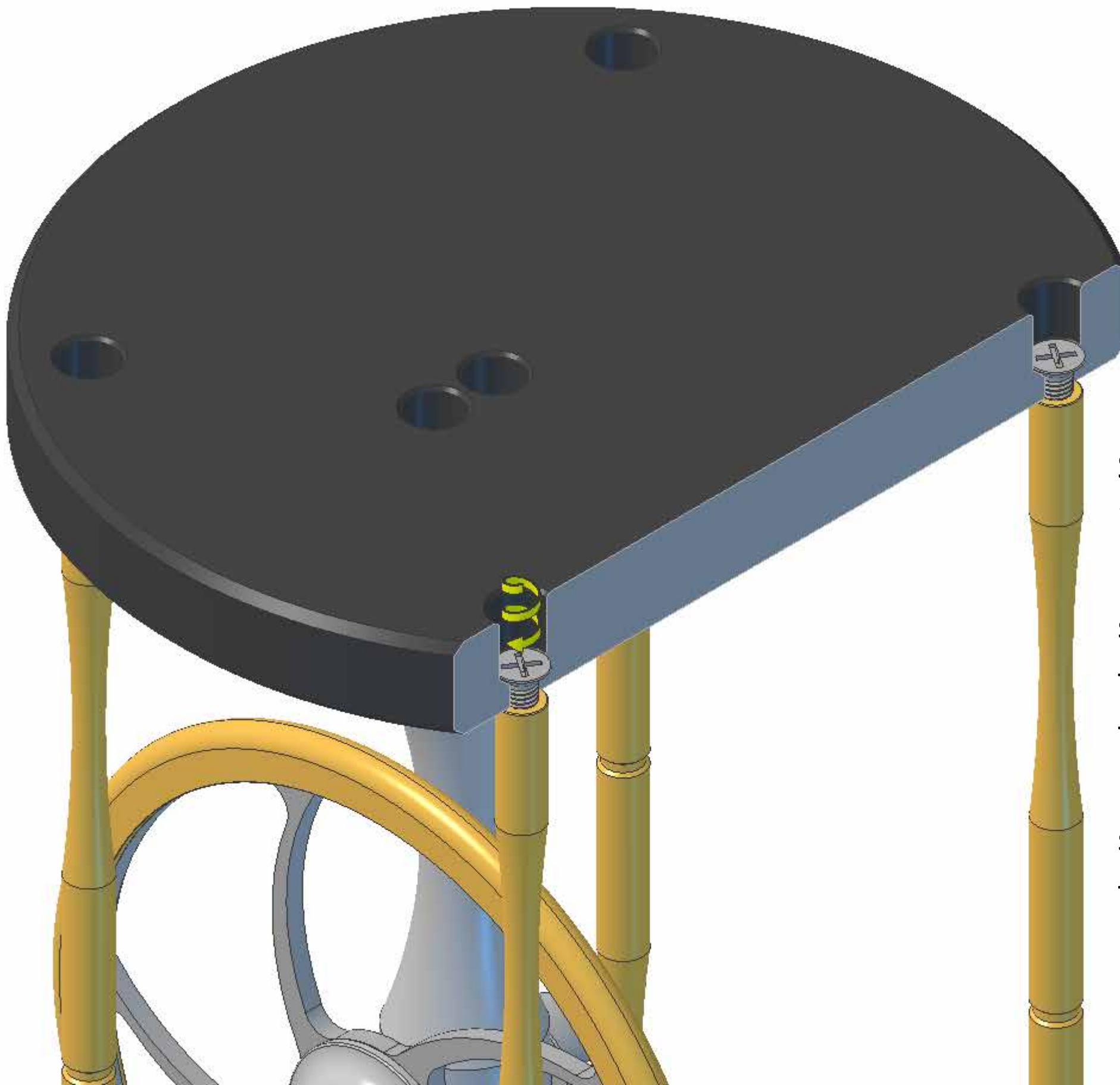


For the next stage, make sure that the main pillar is positioned midway between the gland and cylinder. This should put the flywheel close to the cylinder, as shown in the diagram.





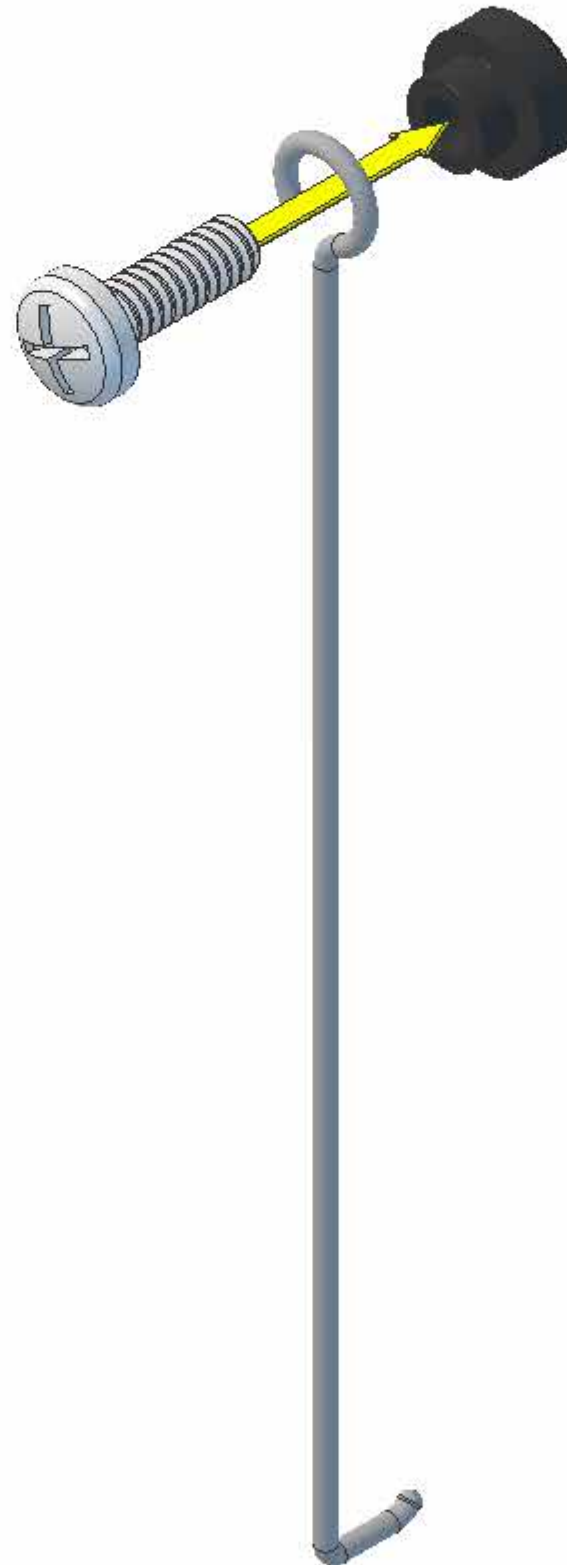
With the underside facing upwards, lower the plate, pillar & flywheel onto the upturned engine. Align the holes in the plate with the holes in the four legs and start inserting four M3x8mm countersunk screws. Screw each screw nearly all the way in.

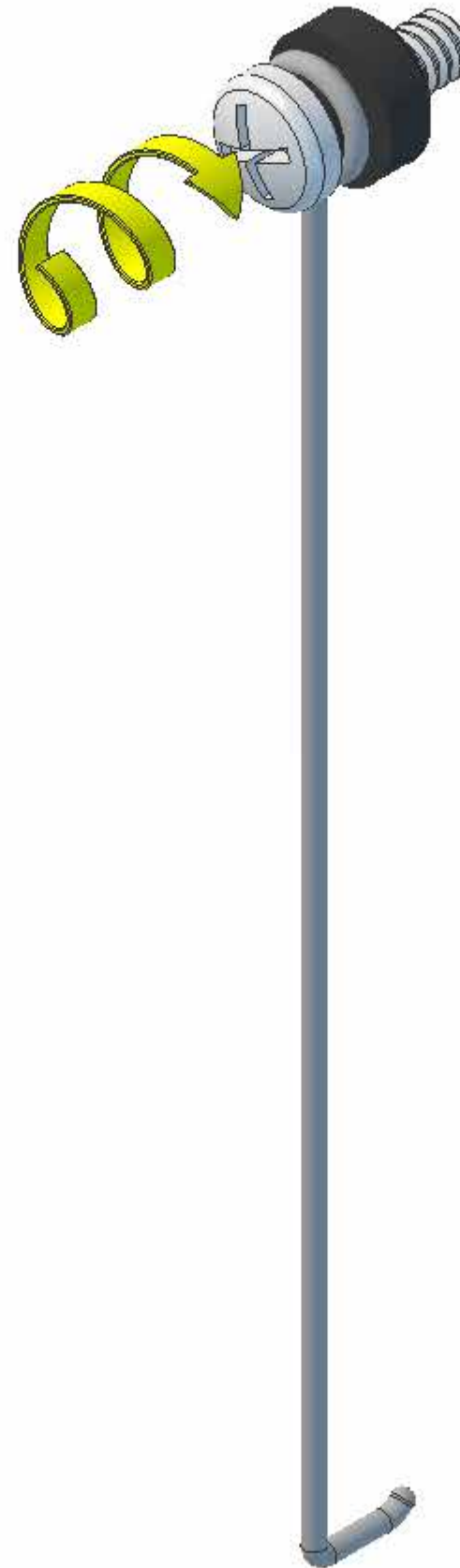


Screw the screws in until they all lightly touch the shoulders inside the holes, then fully tighten.
Note, the plate is shown cut away for clarity.

Fit one conrod onto one conrod bush and secure with one M2x6mm roundhead screw. The screw only needs screwing in a couple of turns at this stage.

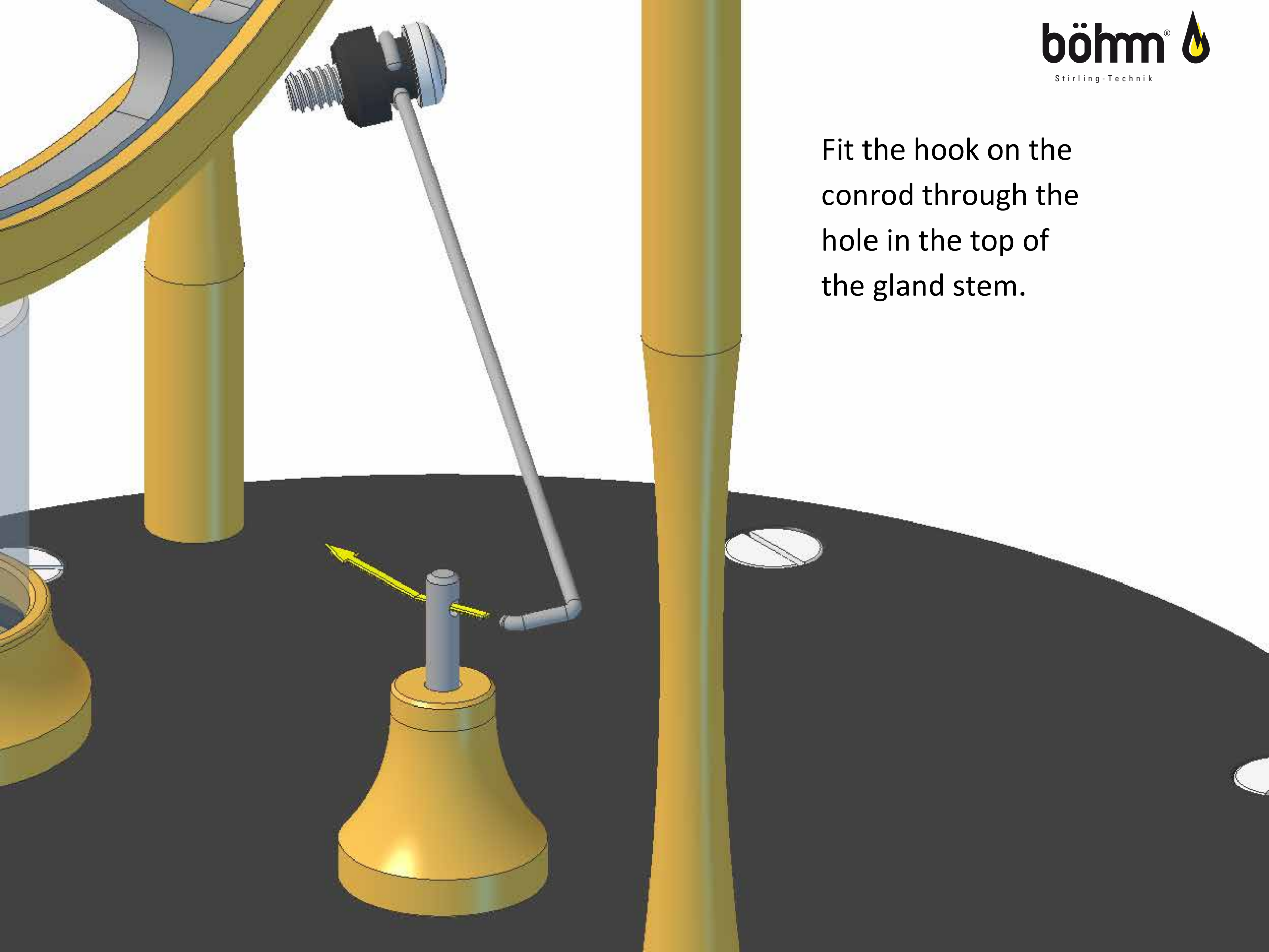
Note: the hook on the bottom of the conrod should be aligned as shown in the diagram.



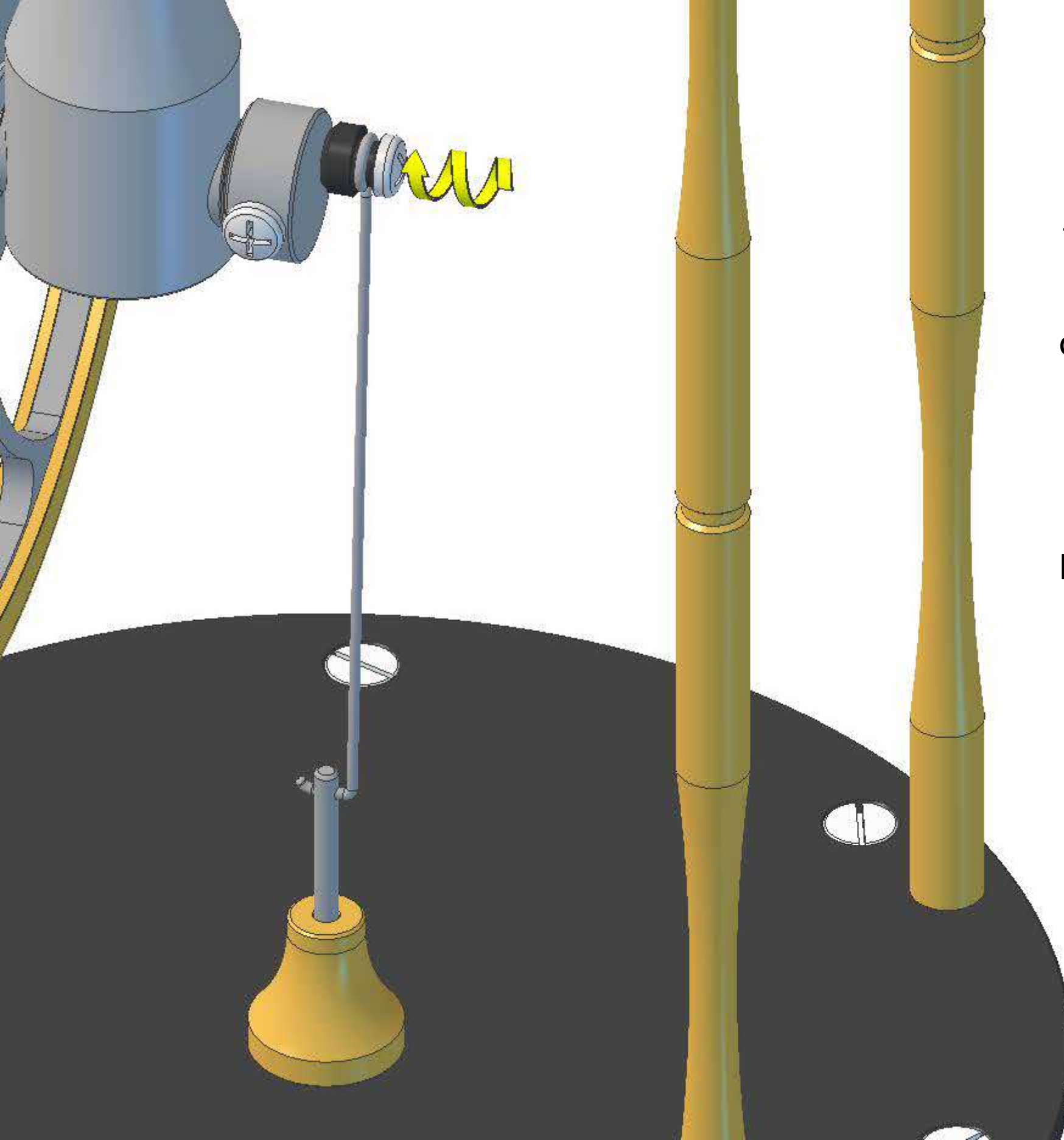


Screw the screw in until it just touches the bush. Do not over-tighten or you could cause the bush to expand and pinch the conrod eye, which could prevent your engine from running.

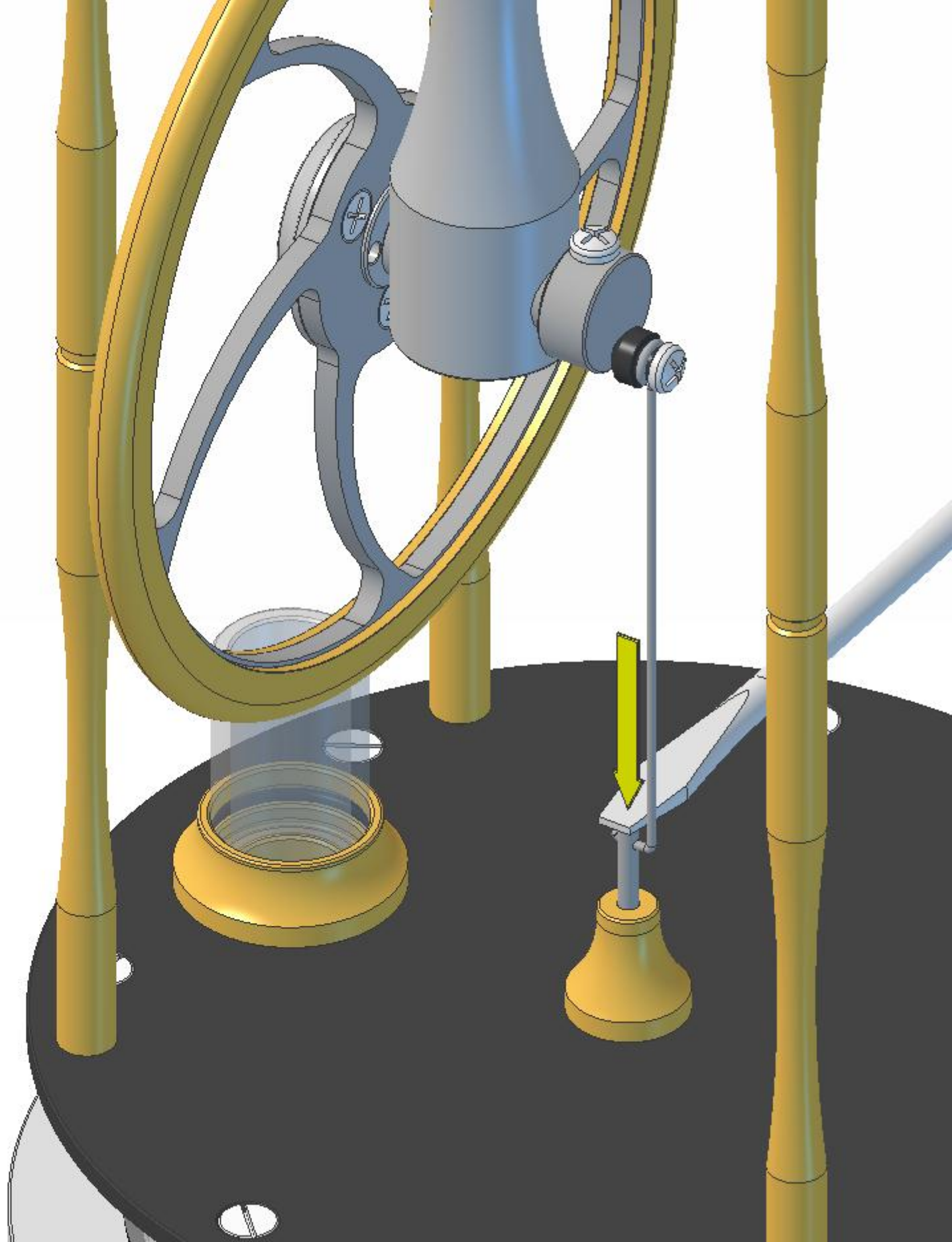
Fit the hook on the
conrod through the
hole in the top of
the gland stem.

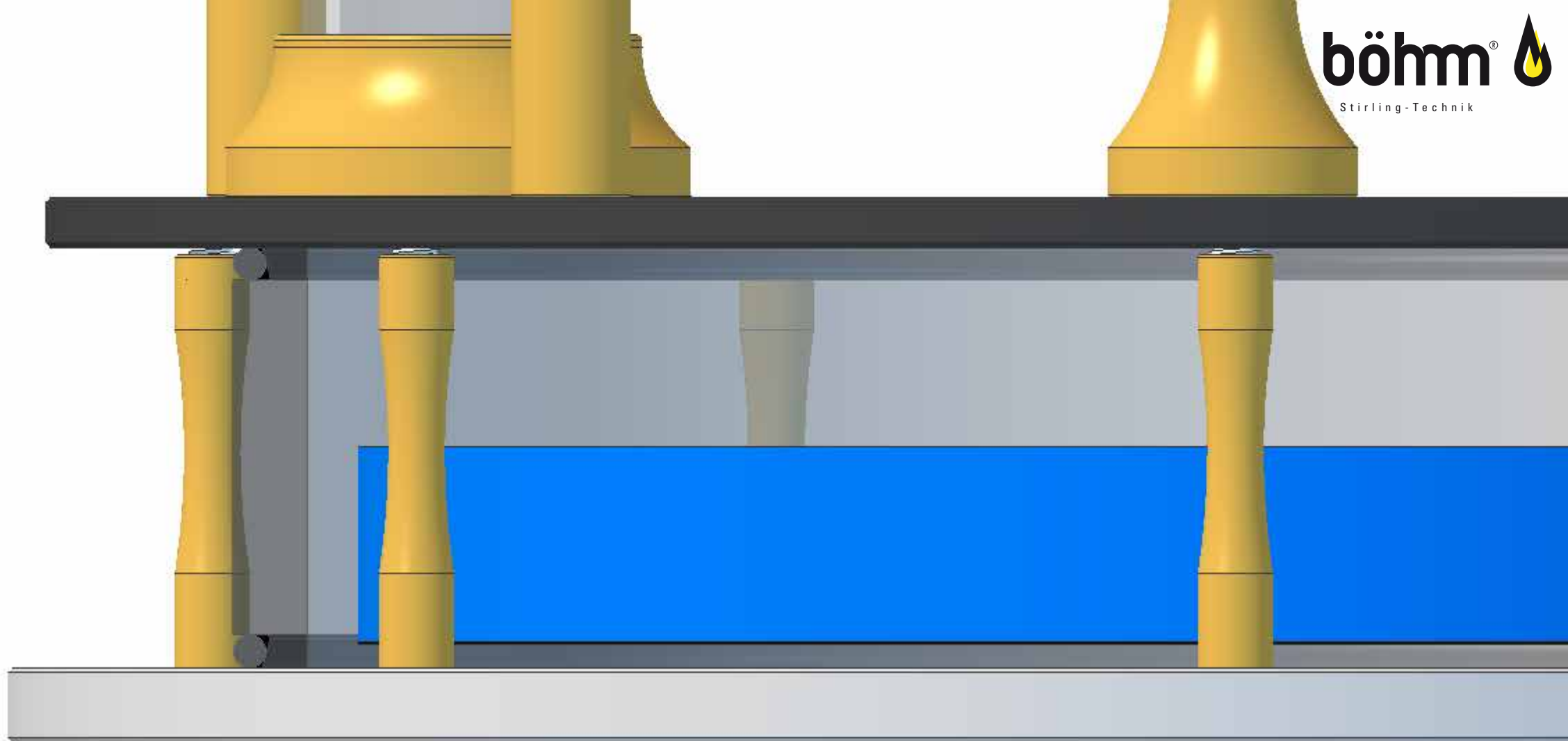


Screw the conrod screw into the hole in the front face of the crank. Tighten only sufficient to lock, over-tightening will cause the conrod bush to expand and pinch the conrod eye, which could prevent your engine from running.



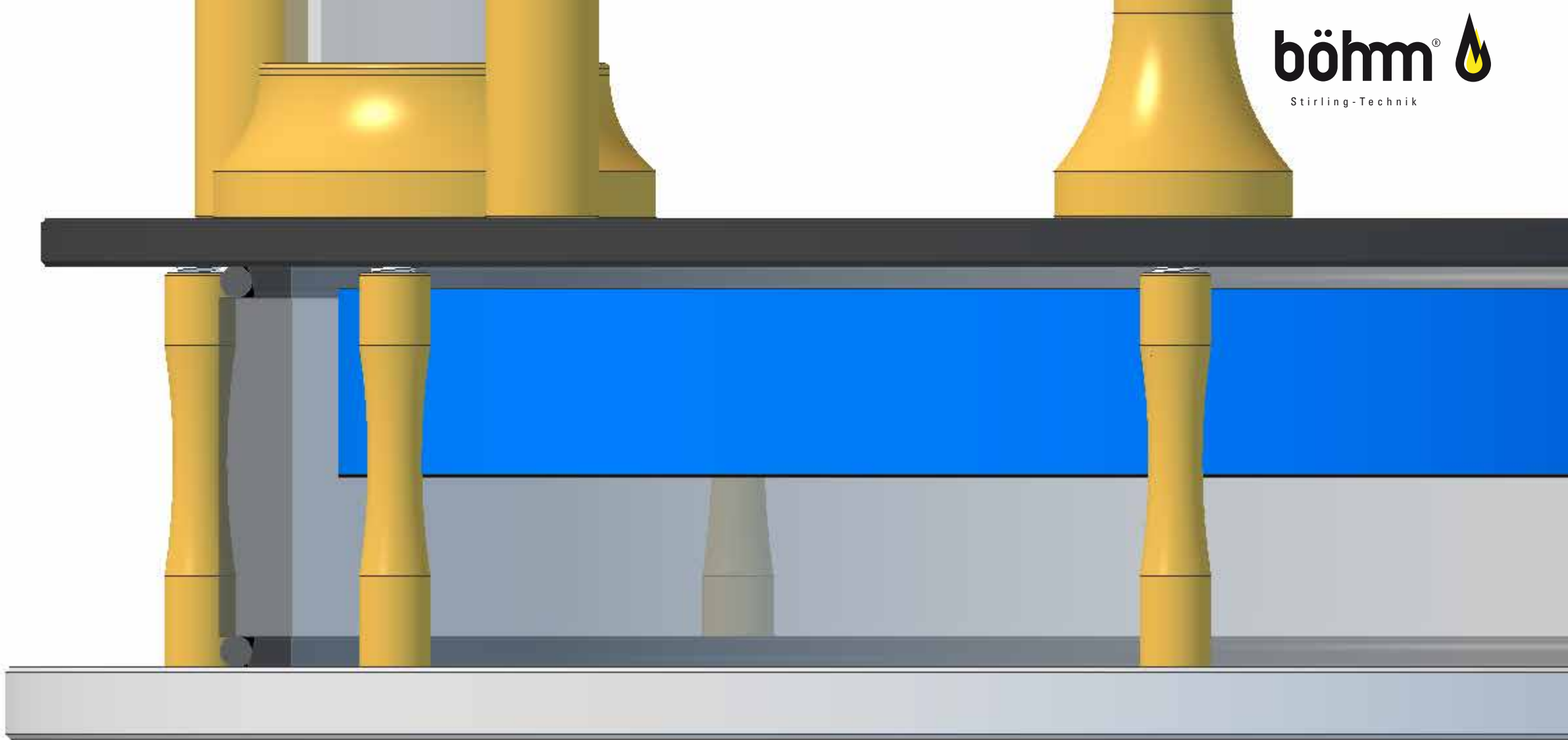
Gently press downwards on the top of the gland stem with the side of a flat screwdriver until the crank and conrod are at their lowest position. This will press the stem into the displacer and set the displacer to its correct position in the chamber. There is a small amount of flex in the conrod, you should be able to take advantage of this and "over-press" the top of the stem so that when you release the pressure on the screwdriver the displacer lifts off the bottom plate slightly.





Slowly rotate the flywheel to move the displacer up and down in the chamber. Check that it does not touch the top plate (the top plate is at the bottom in the diagram). If it does touch you can go back and press the top of the gland stem some more.

Note, the chamber wall and 75mm O rings are shown cut away for clarity.

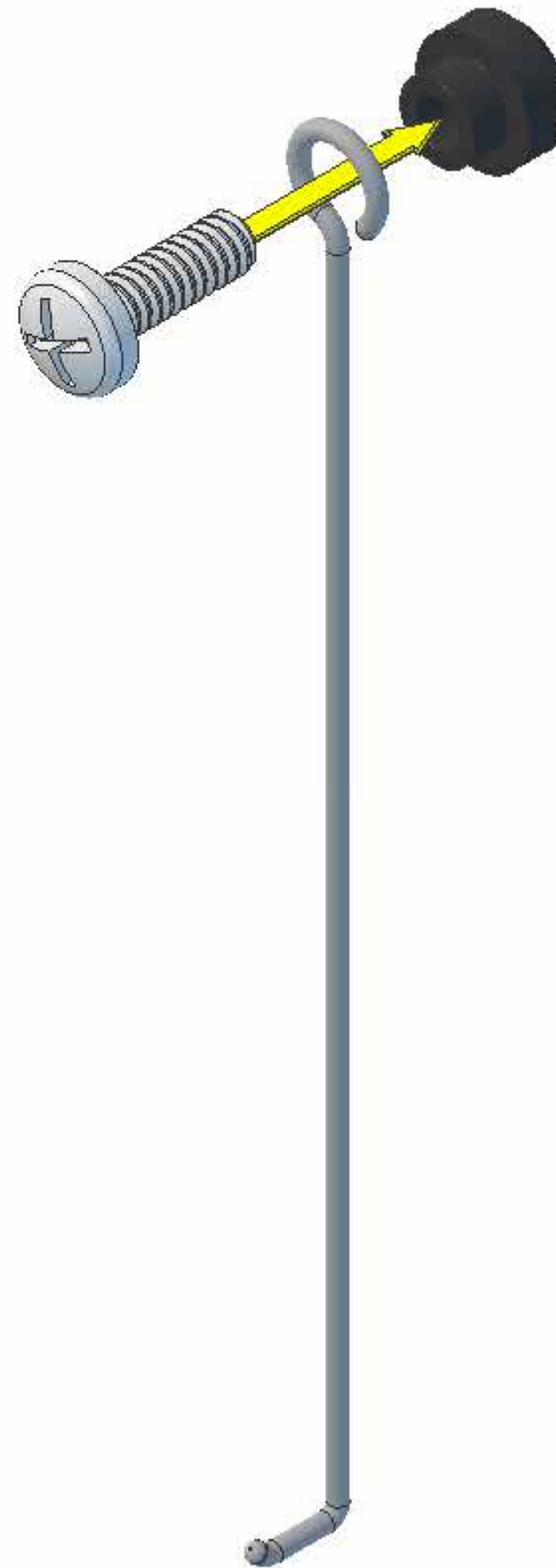


Check that the displacer does not touch the middle plate. If it does you will need to unscrew the top of the conrod from the crank, leave it hooked in the gland stem and use it to pull the stem up in the displacer a small amount. Be careful not to bend the hook on the bottom of the conrod when doing this. Ideally the displacer should have an even gap at the top and bottom of its stroke. Re-check and adjust until the displacer does not touch either plate.

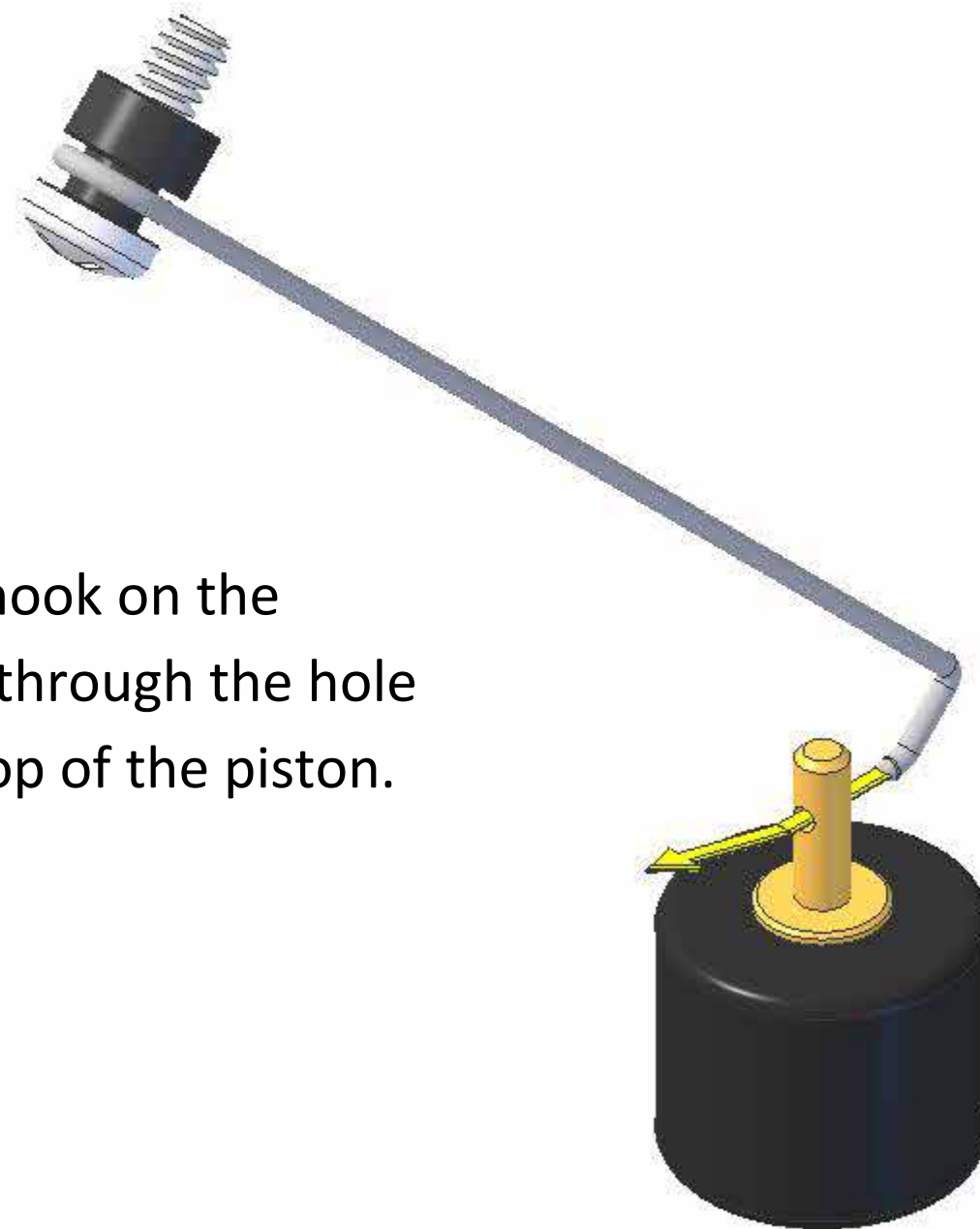
Note, the chamber wall and 75mm O rings are shown cut away for clarity.

Fit one conrod onto one conrod bush and secure with one M2x6mm roundhead screw. The screw only needs screwing in a couple of turns at this stage.

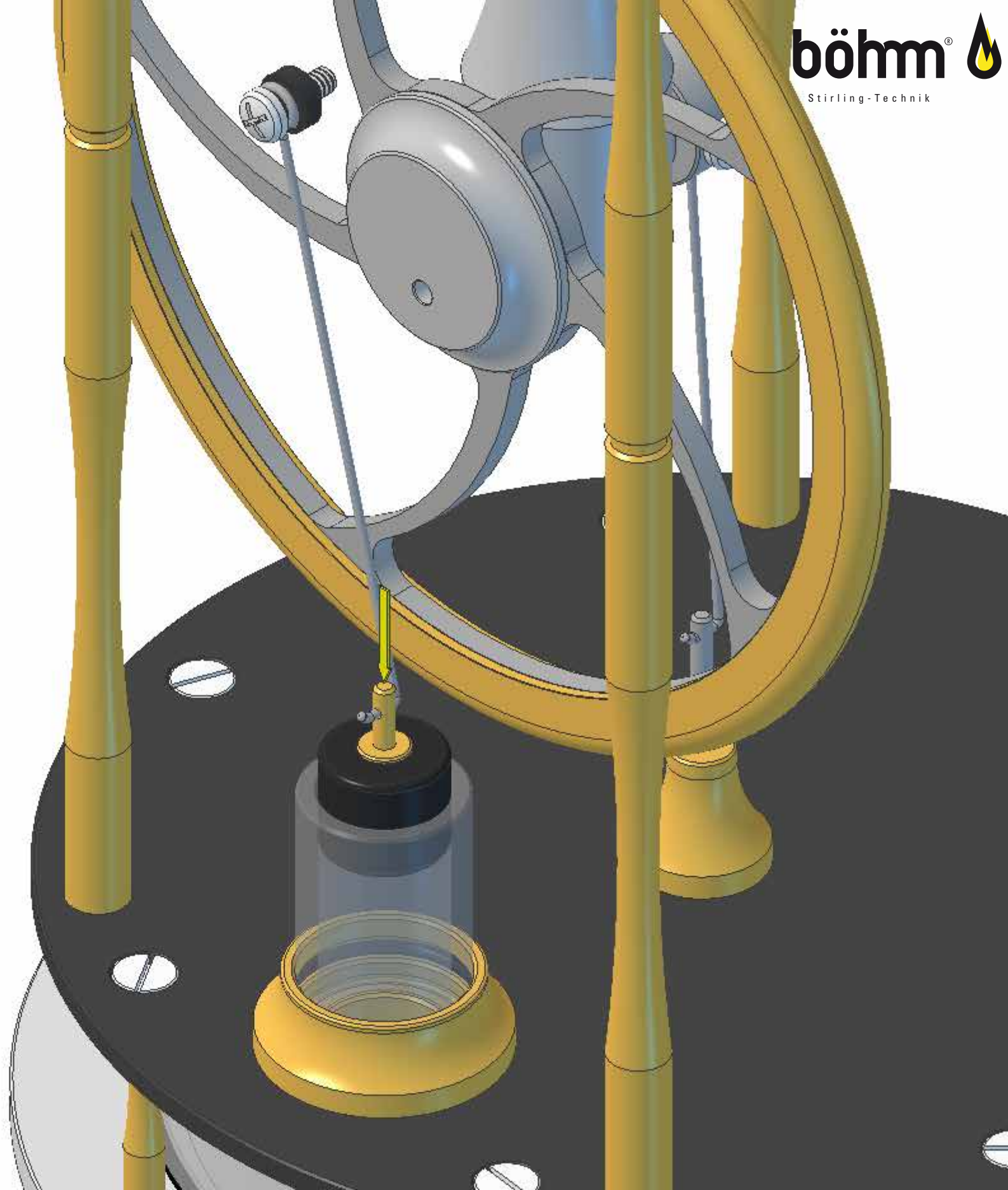
Note: the hook on the bottom of the conrod should be aligned as shown in the diagram.



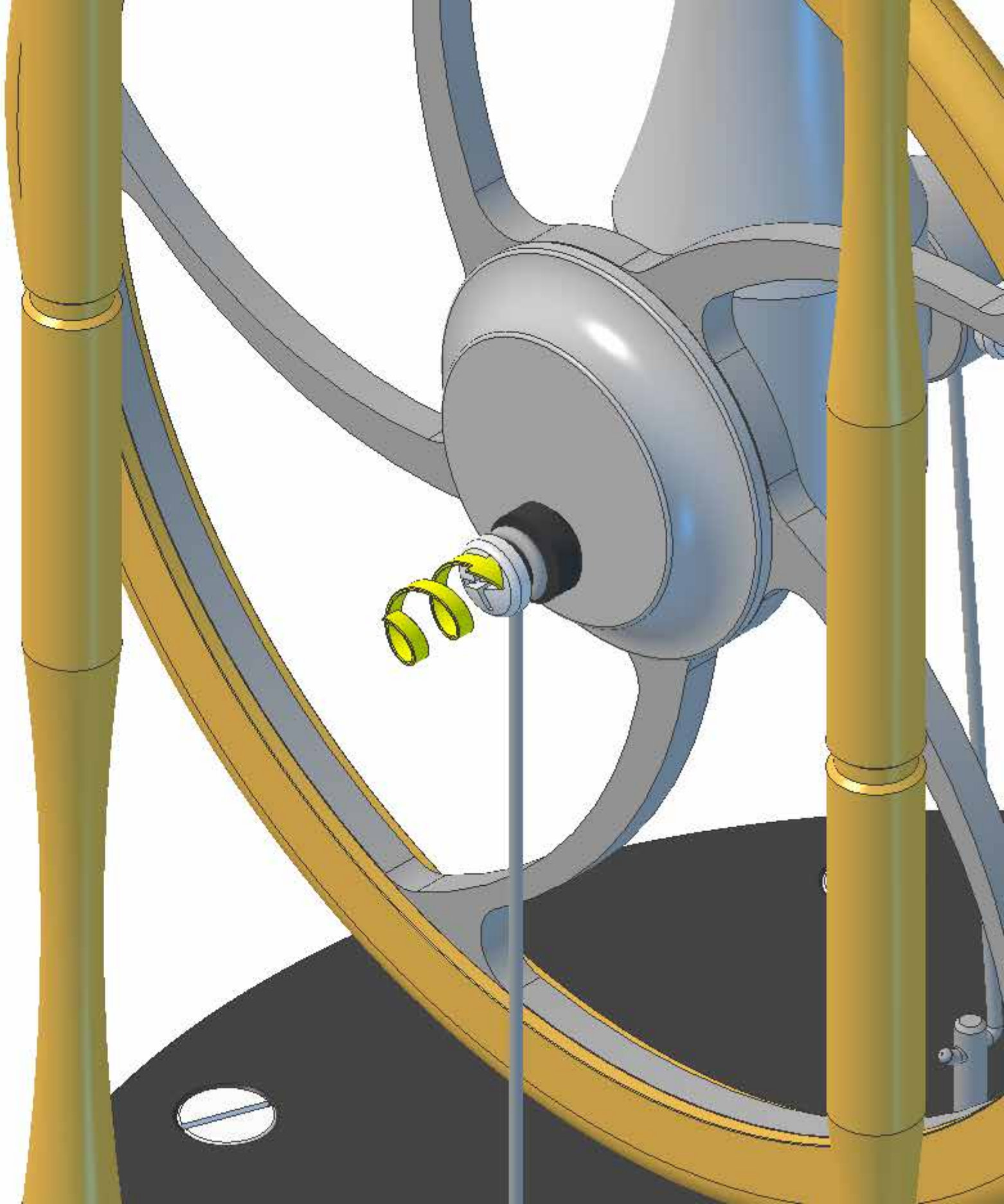
Fit the hook on the
conrod through the hole
in the top of the piston.



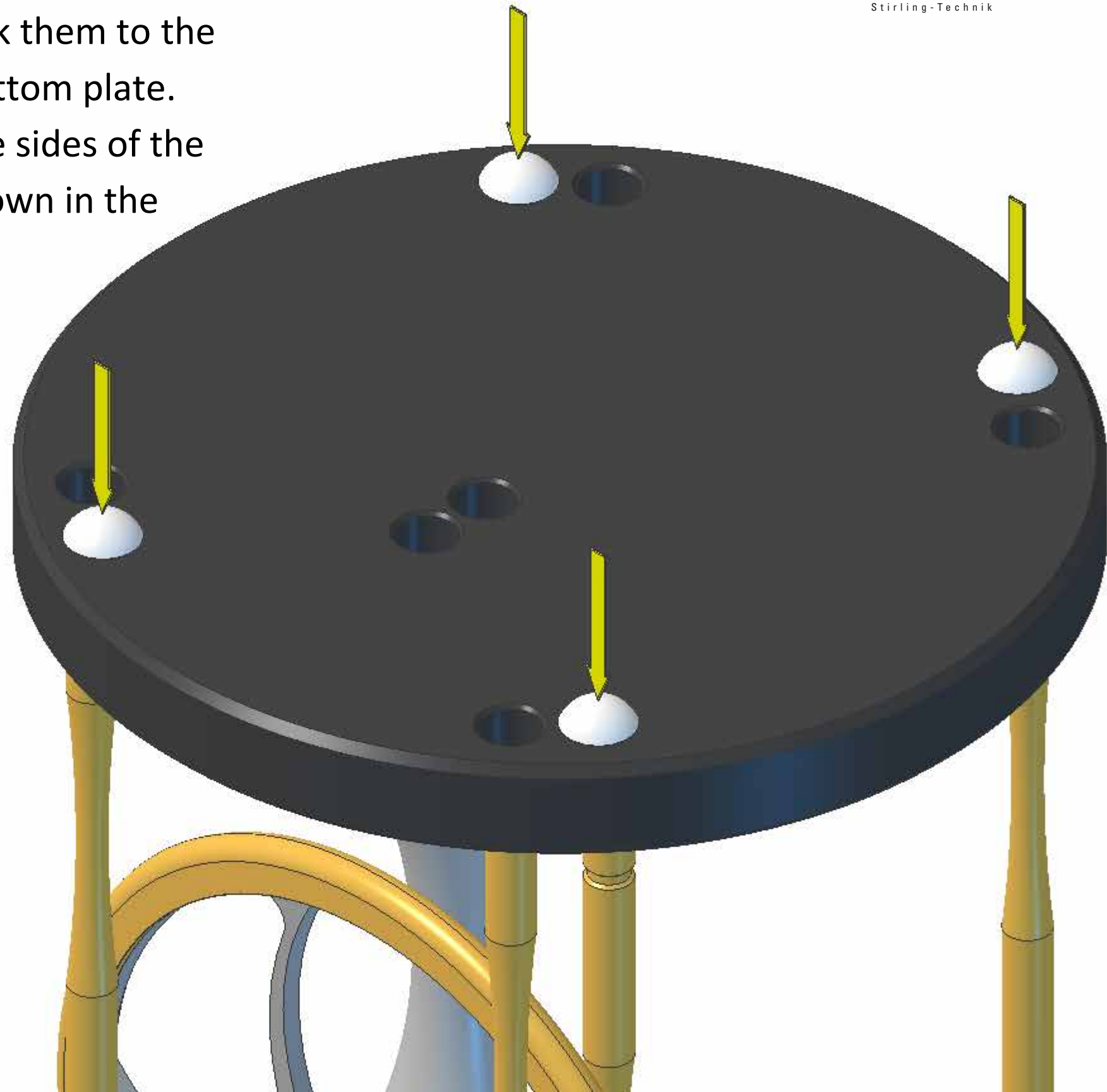
Slide the piston and
conrod into the cylinder.
Some air pressure should
be felt as you slide it in.



Screw the conrod screw into the hole in the front face of the hub. Tighten only sufficient to lock, over-tightening will cause the conrod bush to expand and pinch the conrod eye, which could prevent your engine from running.



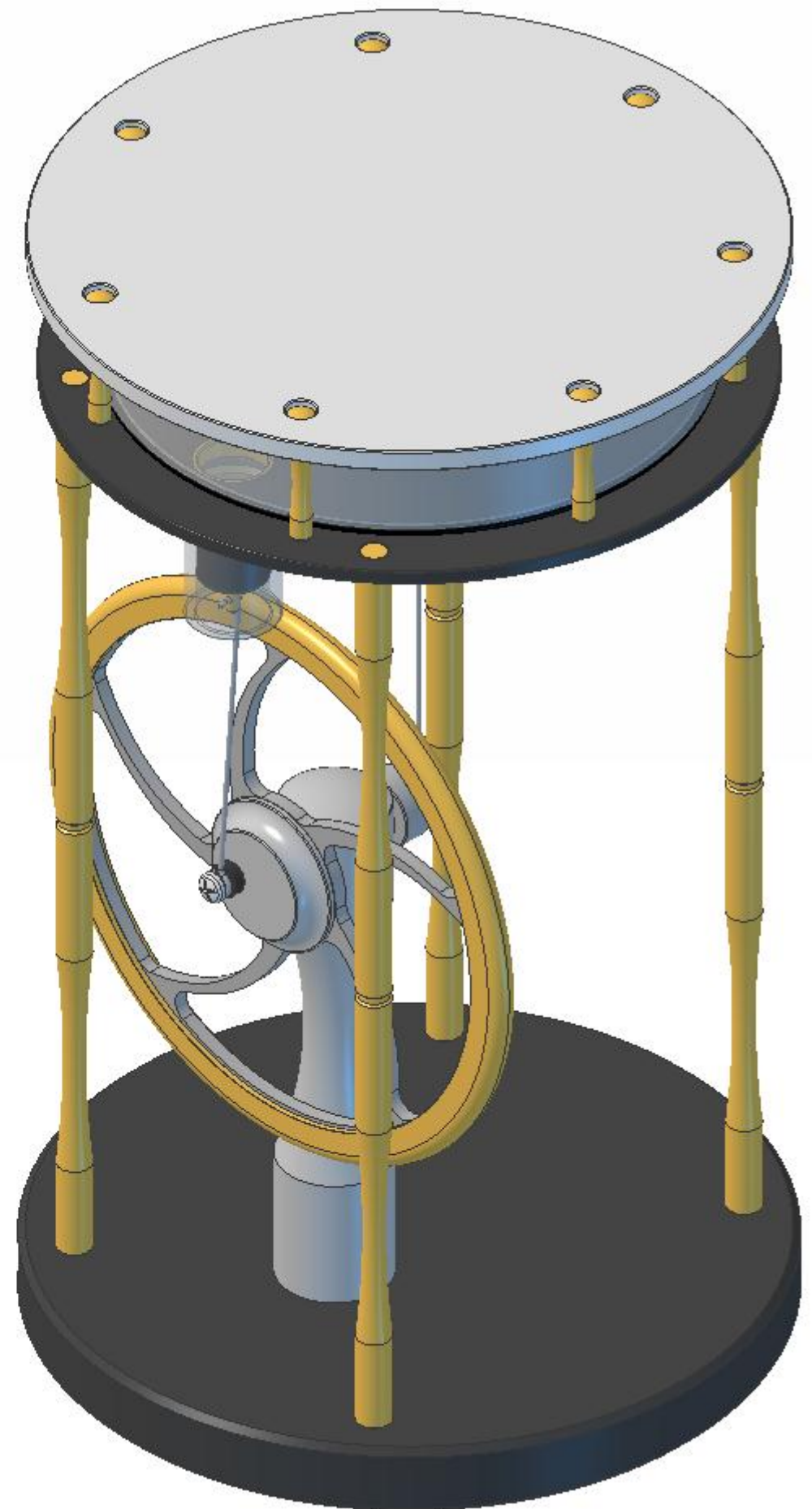
Peel the backing off the four rubber feet and stick them to the underside of the bottom plate. Position them to the sides of the four leg holes as shown in the diagram.



Your engine is now fully assembled.

Check that the flywheel rotates fully, a small amount of resistance will be felt on rotation due to the air pressure inside the main chamber. Check the piston does not bump into the bottom of the cylinder and re-check the displacer does not bump into either plate.

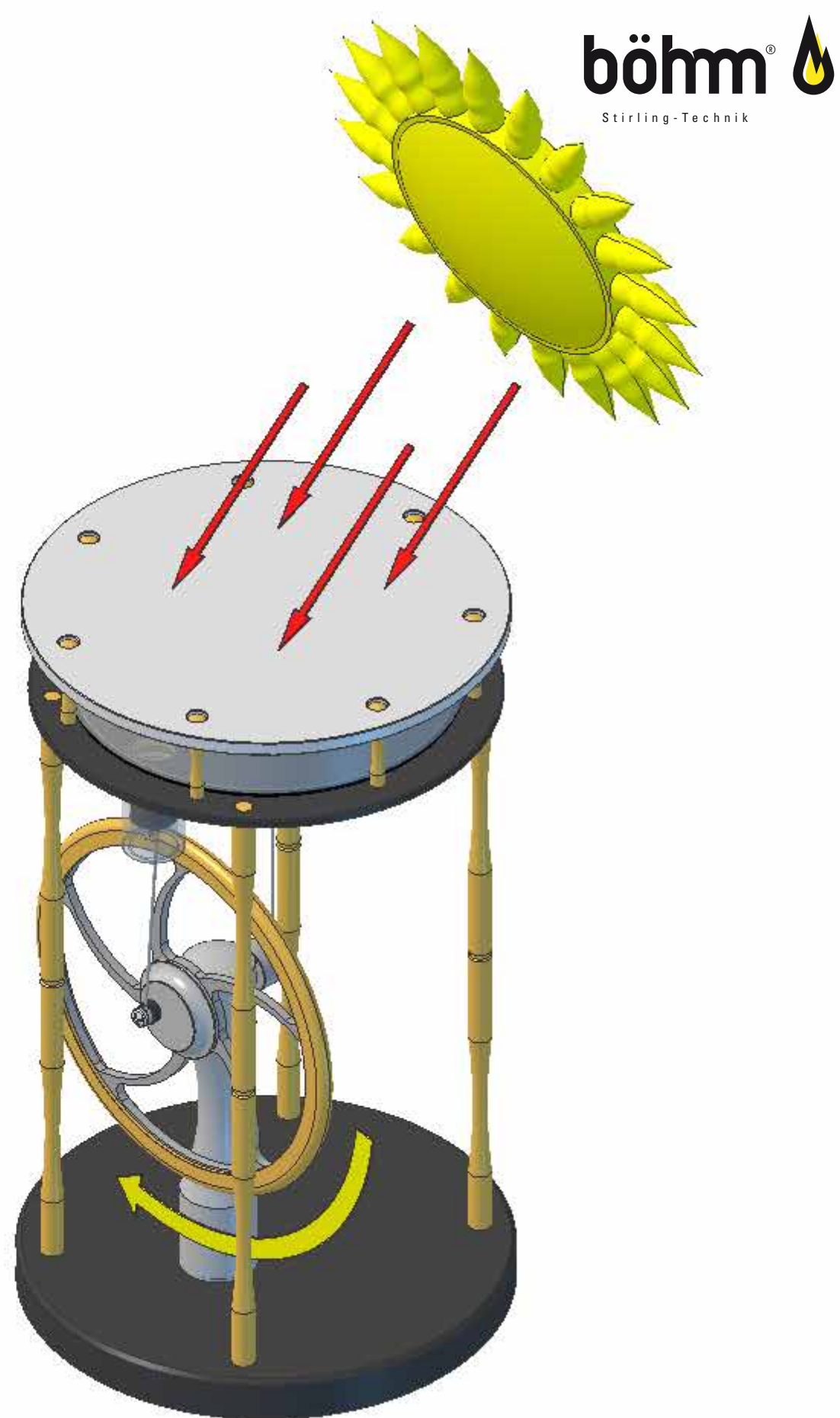
Once you have made these final checks you are ready to operate your engine.



The HB6 has been designed for running under sunlight or a warm lamp. The engine is not self-starting; you will need to give the flywheel a little spin to get it going. After the engine has been under your heat source for half a minute to a minute gently spin the wheel and it should carry on running.

The engine will run equally as well upside down, and can run on hand heat, and a wide variety of other heat sources, including Digital TV box, adsl modem, table lamp, hot water - tea or coffee.

The engine will operate in reverse if you place a small bowl of ice on the top, this is because Stirling engines operate on a temperature difference, and it doesn't matter if the top plate is warm, as in conventional running, or the top plate is cool, as in ice running.

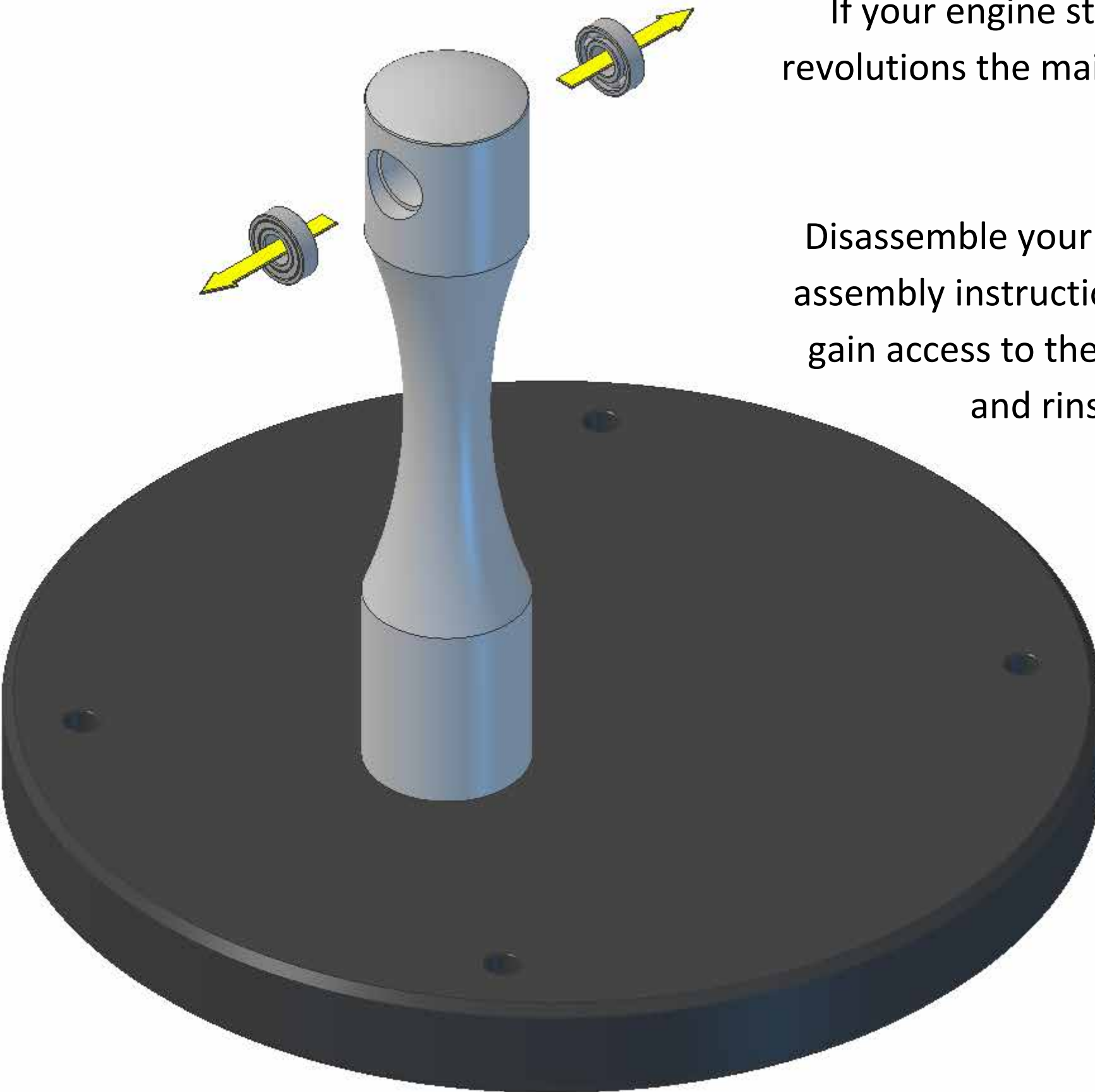


The engine only requires a very small temperature difference between the top and middle plates to operate, anything hotter than hot water WILL damage it. DO NOT place it on or under any high temperature heat source (cooker, wood burning stove, candle etc.). This will melt a number of parts on the engine.

If you wish to operate your engine on hot coffee or tea you must operate the engine upside down, with the engine on top of your mug and NOT with the mug on top of the engine. You must also allow the liquid to cool for a couple of minutes first. DO NOT put hot water on top of the top plate, this is very unstable and could tip over.

The hottest heat source that you should use for your HB6 engine must not be hotter than 75°C (167°F).





If your engine stops suddenly after a few revolutions the main axle ball-race bearings might need cleaning.

Disassemble your engine (by following the assembly instructions backwards) until you gain access to the bearings. Remove them and rinse in Methylated spirit or Denatured alcohol. Then either blow dry with compressed air or allow to dry naturally on an absorbent cloth or paper towel.

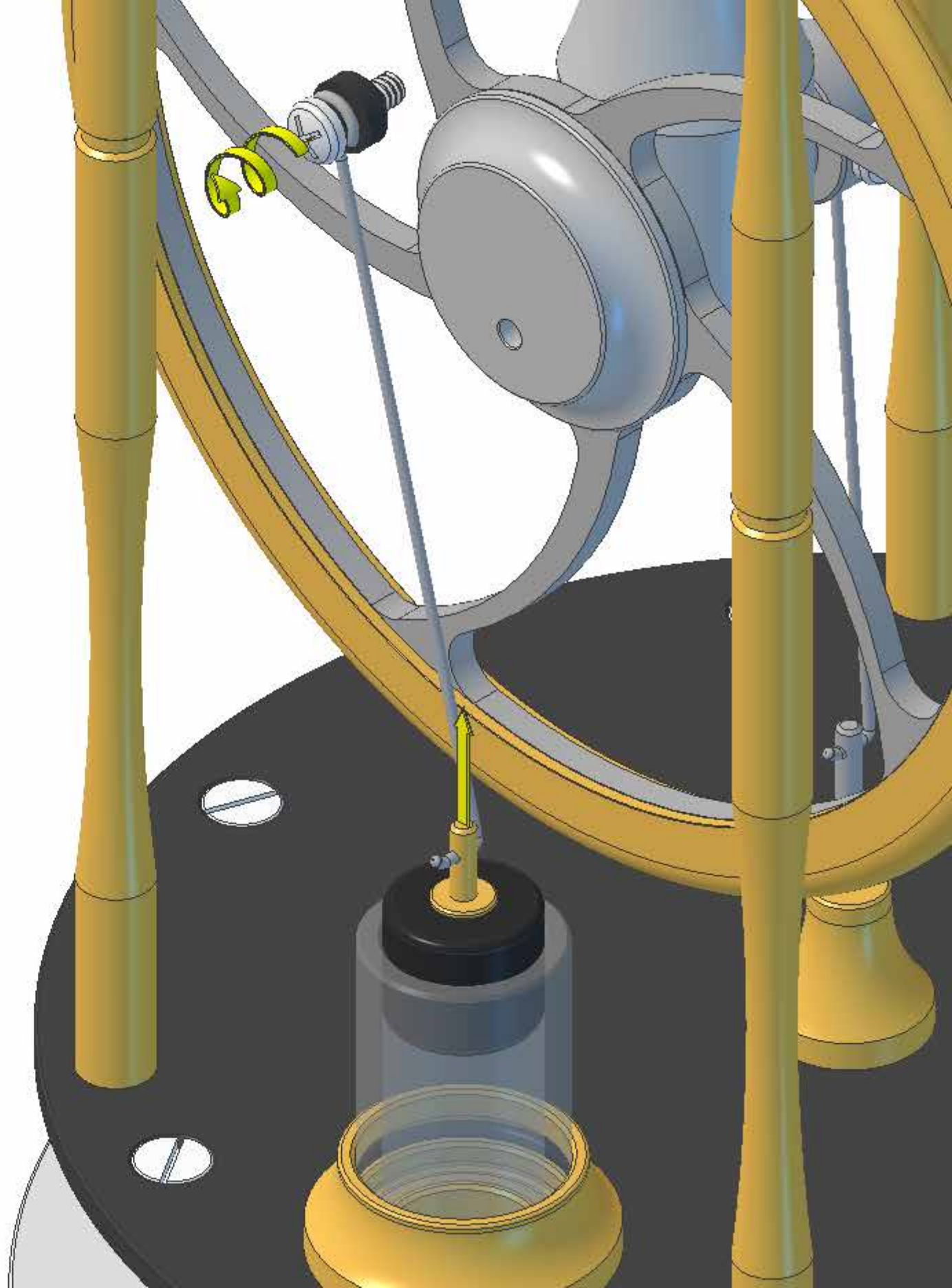
Follow the assembly instructions to reassemble your engine.

If your engine is running slower than usual you might need to clean the piston and cylinder.

Unscrew the conrod screw from the hub and slide the conrod and piston out of the cylinder.

Wipe the piston with a paper towel and clean the inside of the cylinder with a rolled up paper towel or cotton bud.

Make sure there are no stray fibres on the piston or in the cylinder and re-fit by sliding the piston into the cylinder (some air pressure will be felt, this is normal) and screwing the conrod screw into the hole in the face of the hub.



If your engine is running slower than usual you might need to clean the gland stem.

Rotate the flywheel until the displacer stem is at its highest point, and wipe the stem with a cloth.

