



Umikot - Planetary Gear Spirograph Espresso WDT Tool



redfoxdude

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Summary

Easy and consistent WDT for your espresso! Versions available for 58mm and 54mm baskets.

[Household](#) > [Kitchen](#)

Tags: [espresso](#) [coffee](#) [wdt](#) [wdttool](#) [espressoaccessories](#)
[coffeeaccessories](#)

WDT is an art. Its chaotic nature takes skill to master consistently.

Umikot is a Tagalog word which means: to spin; to turn around; to revolve; to rotate; to circle; to go around; to swirl; to gyrate.

In that spirit, this 3D printable tool utilizes a print-in-place planetary gear mechanism to create spirographic needle motion. Versions are available for 58mm and 54mm baskets.

This design is provided to you for free under a Creative Commons CC-BY-NC-SA license. Make and enjoy, but do not sell.

Check out the latest and greatest version featured by Brian Quan, and stay tuned for the release of the latest V2 design! (Delayed by bug in Bambu Studio which has prevented me from validating the final updates):

Make it your own! Custom needle depth, tweak tolerances, or remix! Easily export STLs and STEP. Check out the open source design on OnShape. (Note: when exporting STLs, make sure you select Units→Millimeter and Resolution→Fine.)

58mm workspace

54mm workspace

UPDATE July 15 2023:

1. Added tip for random z-seam for Upper Mech to improve smoothness and reduce snagging

UPDATE July 5 2023:

1. V2rc1 Upper Mech and Spin Ring - reduce lateral play and integrate spin grip
 1. Release candidate - needs more testing! Mine works great, but let's improve this together!
 2. Reduced radial forces on the gears help with binding issues
 3. The V2rc1 Spin Ring is bushing style. Lubricate with some paraffin wax for smooth action
 4. V2rc1 Spin Ring is NOT backwards compatible with previous versions of the Upper Mech

UPDATE May 29, 2023:

1. V1.7 Upper Mech and Spin Ring - Improved mechanism smoothness.
 1. Reduced helix angle for more forgiving print.
 2. Outer lip on Spin Ring to better stabilize and hold the gears at their ideal vertical position. V1.7 Spin Ring is backwards compatible with V1.6 Upper Mech.
 3. See updated assembly instructions for achieving good alignment ("Attach the spin ring and handle" step)

UPDATE May 20, 2023:

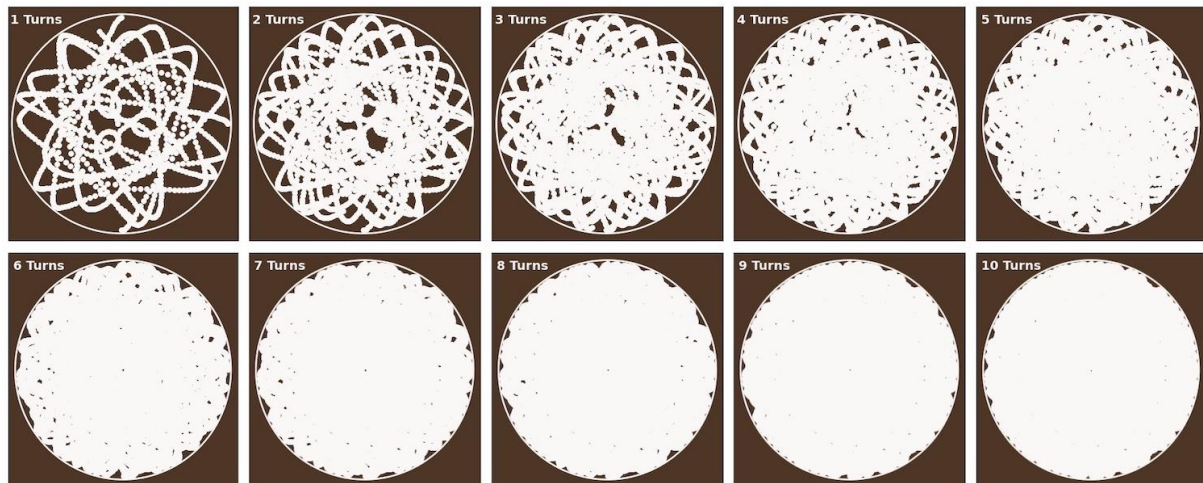
1. Compensate for material shrinkage, more forgiving basket fit (58mm)

UPDATE May 18, 2023:

1. Initial release of 54mm version for Breville machines! The magnet versions have not been tested for fit of the magnets - please let me know if you can test this. The hole tolerances may need to be tweaked.
2. V1.6 Upper Mech: Improved tolerance for both 58mm and 54mm. Calibration to achieve ~0.2mm XY tolerance is advised.

A common problem with many commercially available WDT tools is that they utilize concentric motion, which creates trenches in the coffee. The spirographic pattern avoids needles crossing the same path, with the goal of a more homogeneous particle distribution.

I have optimized the needle pattern for even coverage, and no more than 8 rotations of the handle should be necessary. Two different needle lengths provide deep and top of the bed distribution.



The needles are inserted from the top and are replaceable, and the base is swappable, allowing for configurable needle depth for different baskets, without needing to change out the needles. Optionally, you can print versions of the base that can house eight magnets and/or include a flange to interface with the portafilter lugs. A little de-bossed label to indicate a given base's depth is included for easier identification.

Instructions

Gather your parts and materials.



For the non-printed things, you will need:

- 5x M3 x 12mm flathead/countersunk screws (if you have non-flathead/countersunk screws you would like to use, [check out these alternative parts](#))
- 10x 0.35mm acupuncture needles with a 30mm handle (I used the same as the popular 9-prong tool, 0.35x75mm from [aliexpress](#))
- [OPTIONAL] magnets for the each base you wish to print
 - 8x 5x3mm for 58mm version
 - 16x 3x3mm for 54mm version
- Cheap flush-cutters you don't mind dedicating to needle cutting, or even better, a hardened cable cutter
- Screw-driver/Allen-key for the M3 screws
- A 3D printer

Print your parts!

I printed mine with PLA. You may want to print the Base part with PETG.

Personally, the contact time with the hot basket/portafilter has been short enough that I have not had issues with PLA - however, PETG, with its higher glass transition temperature, would certainly have reduced risk of softening.

Settings:

- 0.2mm layers
- 4 top/bottom layers
- 2 walls are sufficient
- 11% gyroid minimum (consider higher for more heft!)
- No supports
- Concentric top pattern for Spin Ring V2rc1
- Random z-seam for Upper Mech can help with snagging and improve smoothness [Thanks to zumicroom in EAF]

The gears and needle holes require a good calibration (0.2mm XY print-in-place tolerance) and good quality filament!

Printed Parts:

- 1x Upper Mech
- 1x Spin Ring
- 1x Handle (see Handle Options below)
- 1x Base (see Base Options below)
- 1x Stand (see Stand Options below)

Choose the corresponding files for 58mm or 54mm. Assembly process is identical!

Note: V2rc1 Spin Ring is compatible only with V2rc1 Upper Mech.

Handle Options

The Handle is available in Small and Large. Which to use comes down to preference.

The pictured Umikot is fitted with a Small, which is good for small hands or those that want a delicate-operation feel (that is my personal preference, but go with what feels good for you!)

Base Options

The Base part is available in different versions for:

- Various needle depths
- With or without holes for magnets (Magnet/NoMagnet)

- With or without a flange that interfaces with the portafilter lugs (Lug/NoLug)

Pick the needle depth that fits your 58mm basket. The filenames include the depth (i.e. Umikot - Base **25mm** Magnet Lug.stl). See below for some common needle depths.

If you want to put the eight 5x3mm magnets in your base, be sure to print the Magnet version. Otherwise, print the NoMagnet version. (Note that needle depths >27mm are not compatible with magnets. Consider offsetting with longer needles if you want deeper needles with magnets.)

If you are going with NoMagnets, or your basket is not magnetic enough to prevent Umikot from rotating during use (I found this to be the case with an IMS basket), and you do not want to hold Umikot down with one hand while operating with the other, print the Lug version with the flange. Otherwise, print the NoLug version. (Note that the default Lug files support PF lugs <27mm wide. For a more tailored fit, or for wider lugs like on some La Marzocco portafilters, check out the OnShape links to generate different widths.)

I prefer versions without magnets, as it is easier to gently lift Umikot after distribution without disturbing the grounds. You may like the feeling of the magnets and the easier one-handed use they provide - pick what you like!

Common 58mm basket needle depths are:

- 15g basket
 - 21mm
- 18g basket
 - 23mm
- 20g basket
 - 25mm
- 22g basket
 - 27mm
- 25g basket
 - 30mm
- Sworks 18-20g basket
 - 23mm
- Weber Workshops 18-22g basket
 - 24mm
- Pullman 19-20g basket
 - 25mm

Common 54mm basket needle depths are:

- Stock Breville/Sage 2-cup single wall basket
 - 24mm

- IMS 18-22g basket
 - 26mm

Note: For the very best fit, measure the internal depth of your basket. The above are based on specifications and have not all been tested. Please let me know if these recommendations need adjustments!

Stand Options

Print the corresponding stand, either Lug or NoLug, depending on the base you choose.

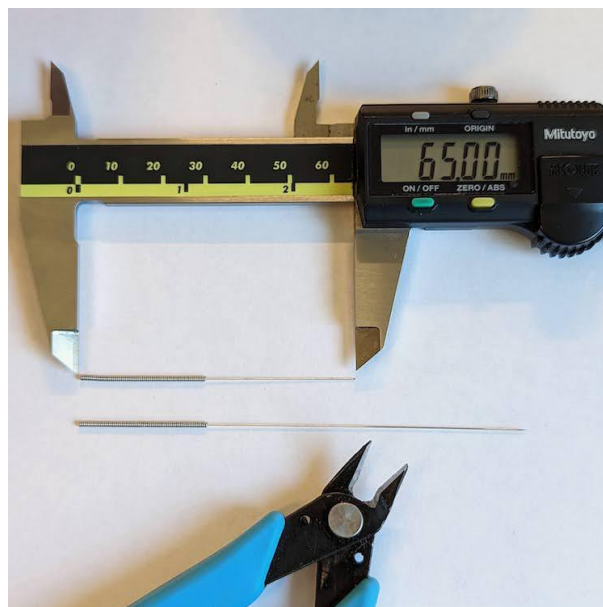
Cut the needles to size.

The designed needle depth for the various base files assumes the needle length to be cut exactly. If anything, favor slightly short.

The needles are likely harder than the cutting edges of most cheap flush cutters, so be prepared to dedicate them to the cause. I used a very inexpensive one from a multi-pack I got off of Amazon. Even better, use a proper, hardened cable cutter.

Be very careful to safely dispose of the cut ends of these needles!

First, cut 5 of your 10 needles to a total length of 65mm (35mm needle + 30mm handle):



Cut the remaining 5 needles to a total length of 55mm (25mm needle + 30mm handle):



To secure the needles in their places in the gears, give them a little bend, like in the above photo. This way they won't rattle around, but can still be removed if they ever need to be replaced.

[Optional] “Tap” the gears' screw-holes

This step is optional, particularly if your screw holes are quite tight. To make our lives a bit easier later, “tap” the holes with one of your M3 screws. Carefully screw them into each of the gears' holes, stopping when you feel the resistance noticeably increase (you've hit the bottom) and then remove the screw. Repeat for each of the 4 larger gears. You will need to hold the gears carefully to keep them from rotating while you do this. Be careful you do not get pinched!



Attach your base

[Optionally, press in the magnets if you went with the Magnet version.]
Screw on your chosen base. You can change bases at any time, but be very careful when doing so when the needles are installed!



Insert the needles!

Be careful during this step - the trimmed needles are still thin and sharp!
Place the assembly onto its stand at this point to keep the tips in a safe place. Gently insert each needle until it sits flush with the top of the gear. Do not force them! Give them a little jiggle if they are not quite lining up with the hole in the bottom.

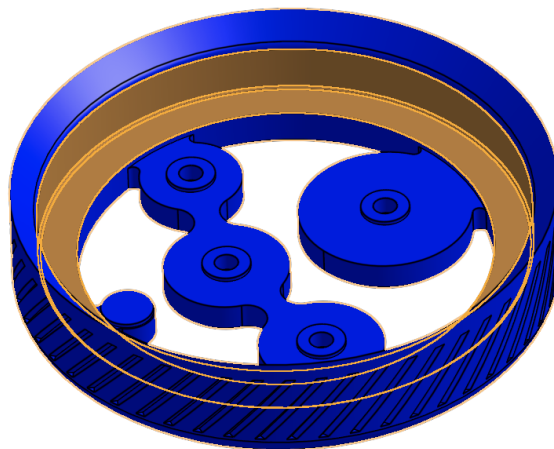


See below for the needle pattern with respect to the different needle lengths:



Lubricate the Spin Ring (V2rc1 version only)

For the smoothest operation, the V2rc1 mechanism benefits highly from some lubrication. I recommend rubbing some paraffin wax (such as from a tealight candle) on the inner surfaces of the Spin Ring.



Attach the spin ring and handle

Gently screw in 4 of the M3 screws to attach the spin ring. Fully tighten until they stop (the mechanism should be locked). Then back out 1 turn, which will align the gears vertically to the outer ring gear.



Then, do the same for the handle, but only back out $\sim 1/4$ turn:



Distribute some coffee!

And that is it! If you chose the NoMagnet NoLug base or the Magnet NoLug base but your basket isn't very magnetic, you will need to hold Umikot down while turning the mechanism. Gently give it several rotations - typically no more than 8 turns are necessary.

The distribution must be done with the basket in a level position - otherwise, the grounds will tend towards whichever direction the basket is tilted.

Finally, remove Umikot, give the portafilter a tap to settle the grounds, tamp, pull, and enjoy your espresso!



Disclaimer: not all filaments, nor the 3D-printing process, are certified food safe. Use of this tool is at your own discretion.

This remix is based on



Fully Parametric Planetary Herringbone Gear Bearing

by Henry

Model files



Umikot 58mm - Upper and Stand

22 files



umikot58-upper-mech-v2rc1.stl

☐ 05/07/2023 - Reduce lateral play and integrate spin grip



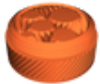
umikot58-spin-ring-v2rc1.stl

☐ 05/07/2023 - Reduce lateral play and integrate spin grip



umikot58-spin-ring-v2rc1-nohandle.stl

☐ 05/07/2023 - Reduce lateral play and integrate spin grip



umikot58-upper-mech-v17.stl

☐ 29/05/2023 - Improved mechanism smoothness



umikot58-spin-ring-v171.stl

☐ 01/06/2023 - Improved handle placement



umikot-handle-small.stl



umikot-handle-large.stl



umikot58-stand-lug.stl

☐ Use with "Lug" bases



umikot58-stand-nolug.stl

☐ Use with "NoLug" bases



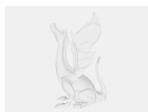
deprecated-umikot58-upper-mech-v16.stl

☐ 18/05/23 - 0.2mm gear tolerance



deprecated-umikot58-spin-ring-v17.stl

☐ 29/05/2023 - Improved mechanism smoothness, backwards compatible with V1.6 Upper Mech



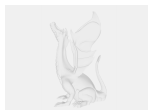
umikot58-upper-mech-v2rc1.step

☐ 05/07/2023 - Reduce lateral play and integrate spin grip



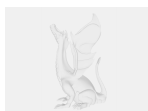
umikot58-spin-ring-v2rc1.step

☐ 05/07/2023 - Reduce lateral play and integrate spin grip



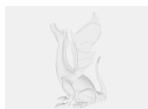
umikot58-spin-ring-v2rc1-nohandle.step

☐ 05/07/2023 - Reduce lateral play and integrate spin grip



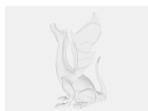
umikot58-upper-mech-v17.step

☐ 29/05/2023 - Improved mechanism smoothness, backwards compatible with V1.6 Upper Mech

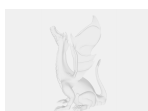


umikot58-spin-ring-v171.step

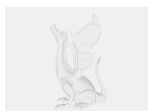
☐ 01/06/2023 - Improved handle placement



umikot-handle-small.step

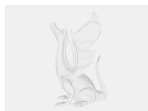


umikot-handle-large.step



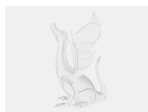
umikot58-stand-lug.step

☐ Use with "Lug" bases



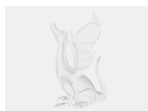
umikot58-stand-nolug.step

☐ Use with "NoLug" bases



deprecated-umikot58-upper-mech-v16.step

☐ 18/05/23 - 0.2mm gear tolerance



deprecated-umikot58-spin-ring-v17.step

☐ 29/05/2023 - Improved mechanism smoothness



Umikot 58mm - Base 21mm

8 files



umikot58-base-21mm-magnet-lug.stl



umikot58-base-21mm-magnet-nolug.stl



umikot58-base-21mm-nomagnet-lug.stl



umikot58-base-21mm-nomagnet-nolug.stl



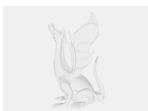
umikot58-base-21mm-magnet-lug.step



umikot58-base-21mm-magnet-nolug.step



umikot58-base-21mm-nomagnet-lug.step



umikot58-base-21mm-nomagnet-nolug.step



Umikot 58mm - Base 22mm

8 files



umikot58-base-22mm-magnet-lug.stl



umikot58-base-22mm-magnet-nolug.stl



umikot58-base-22mm-nomagnet-lug.stl



umikot58-base-22mm-nomagnet-nolug.stl



umikot58-base-22mm-magnet-lug.step



umikot58-base-22mm-magnet-nolug.step



umikot58-base-22mm-nomagnet-lug.step



umikot58-base-22mm-nomagnet-nolug.step



Umikot 58mm - Base 23mm

8 files



umikot58-base-23mm-magnet-lug.stl



umikot58-base-23mm-magnet-nolug.stl



umikot58-base-23mm-nomagnet-lug.stl



umikot58-base-23mm-nomagnet-nolug.stl



umikot58-base-23mm-magnet-lug.step



umikot58-base-23mm-magnet-nolug.step



umikot58-base-23mm-nomagnet-lug.step



umikot58-base-23mm-nomagnet-nolug.step



Umikot 58mm - Base 24mm

8 files



umikot58-base-24mm-magnet-lug.stl



umikot58-base-24mm-magnet-nolug.stl



umikot58-base-24mm-nomagnet-lug.stl



umikot58-base-24mm-nomagnet-nolug.stl



umikot58-base-24mm-magnet-lug.step



umikot58-base-24mm-magnet-nolug.step



umikot58-base-24mm-nomagnet-lug.step



umikot58-base-24mm-nomagnet-nolug.step



Umikot 58mm - Base 25mm

8 files



umikot58-base-25mm-magnet-lug.stl



umikot58-base-25mm-magnet-nolug.stl



umikot58-base-25mm-nomagnet-lug.stl



umikot58-base-25mm-nomagnet-nolug.stl



umikot58-base-25mm-magnet-lug.step



umikot58-base-25mm-magnet-nolug.step



umikot58-base-25mm-nomagnet-lug.step



umikot58-base-25mm-nomagnet-nolug.step



Umikot 58mm - Base 26mm

8 files



umikot58-base-26mm-magnet-lug.stl



umikot58-base-26mm-magnet-nolug.stl



umikot58-base-26mm-nomagnet-lug.stl



umikot58-base-26mm-nomagnet-nolug.stl



umikot58-base-26mm-magnet-lug.step



umikot58-base-26mm-magnet-nolug.step



umikot58-base-26mm-nomagnet-lug.step



umikot58-base-26mm-nomagnet-nolug.step



Umikot 58mm - Base 27mm

8 files



umikot58-base-27mm-magnet-lug.stl



umikot58-base-27mm-magnet-nolug.stl



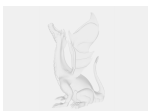
umikot58-base-27mm-nomagnet-lug.stl



umikot58-base-27mm-nomagnet-nolug.stl



umikot58-base-27mm-magnet-lug.step



umikot58-base-27mm-magnet-nolug.step



umikot58-base-27mm-nomagnet-lug.step



umikot58-base-27mm-nomagnet-nolug.step



Umikot 58mm - Base 30mm

4 files



umikot58-base-30mm-nomagnet-lug.stl

☐ >28mm not compatible with 5x3mm nor 5x2mm magnets



umikot58-base-30mm-nomagnet-nolug.stl

☐ >28mm not compatible with 5x3mm nor 5x2mm magnets



umikot58-base-30mm-nomagnet-lug.step

☐ >28mm not compatible with 5x3mm nor 5x2mm magnets



umikot58-base-30mm-nomagnet-nolug.step

☐ >28mm not compatible with 5x3mm nor 5x2mm magnets



Umikot 54mm - Upper and Stand

16 files



umikot54-upper-mech-v17.stl

☐ 29/05/2023 - Improved mechanism smoothness



deprecated-umikot54-upper-mech-v16.stl

☐ 18/05/23 - 0.2mm gear tolerance



umikot54-spin-ring-v171.stl

📅 01/06/2023 - Improved handle placement



umikot54-spin-ring-v17.stl

📅 29/05/2023 - Improved mechanism smoothness, backwards compatible with V1.6 Upper Mech



umikot-handle-small.stl



umikot-handle-large.stl



umikot54-stand-lug.stl



umikot54-stand-nolug.stl



umikot54-upper-mech-v17.step

📅 29/05/2023 - Improved mechanism smoothness



deprecated-umikot54-upper-mech-v16.step

📅 18/05/23 - 0.2mm gear tolerance



umikot54-spin-ring-v171.step

📅 01/06/2023 - Improved handle placement



umikot54-spin-ring-v17.step

📅 29/05/2023 - Improved mechanism smoothness, backwards compatible with V1.6 Upper Mech



umikot-handle-small.step



umikot-handle-large.step



umikot54-stand-lug.step



umikot54-stand-nolug.step



Umikot 54mm - Base 24mm

8 files



umikot54-base-24mm-magnet-nolug.stl

☐ 20/05/2023 - 16x magnets, slightly looser magnet fit



umikot54-base-24mm-magnet-lug.stl

☐ 20/05/2023 - 16x magnets, slightly looser magnet fit



umikot54-base-24mm-nomagnet-lug.stl

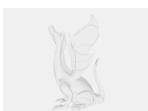


umikot54-base-24mm-nomagnet-nolug.stl



umikot54-base-24mm-magnet-lug.step

☐ 20/05/2023 - 16x magnets, slightly looser magnet fit



umikot54-base-24mm-magnet-nolug.step

☐ 20/05/2023 - 16x magnets, slightly looser magnet fit



umikot54-base-24mm-nomagnet-lug.step



umikot54-base-24mm-nomagnet-nolug.step



Umikot 54mm - Base 26mm

8 files



umikot54-base-26mm-magnet-lug.stl

20/05/2023 - 16x magnets, slightly looser magnet fit



umikot54-base-26mm-magnet-nolug.stl

20/05/2023 - 16x magnets, slightly looser magnet fit



umikot54-base-26mm-nomagnet-nolug.stl



umikot54-base-26mm-nomagnet-lug.stl



umikot54-base-26mm-magnet-lug.step

20/05/2023 - 16x magnets, slightly looser magnet fit

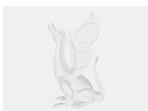


umikot54-base-26mm-magnet-nolug.step

20/05/2023 - 16x magnets, slightly looser magnet fit



umikot54-base-26mm-nomagnet-lug.step



umikot54-base-26mm-nomagnet-nolug.step

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