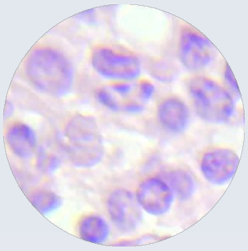
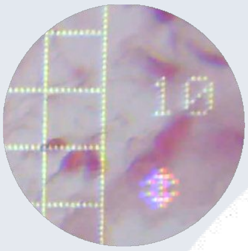
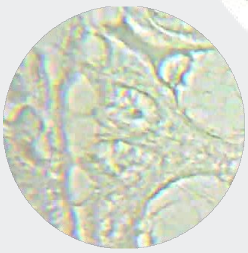
PUMA 3D Printing Guide

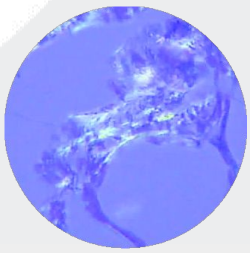
Document created: 26.02.2021, Last edited: 28.06.2025

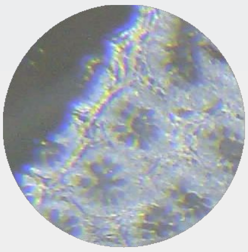
PUMA: The Open Source (GPL v3.0) 3D printed microscope system designed for direct eye observations and ultra-portability with advanced options for digital imaging, measurements and computer control.











Contents

Legal Information

License

Limitations of Use

The PUMA microscope and its associated systems do not have any certifications or regulatory approvals in any country for use in clinical diagnostics or treatment (human or veterinary).

The PUMA microscope and its associated systems are released to be used for research and educational purposes only.

Disclaimer

All PUMA project information, including without limitation any CAD file (or 3-dimensional (3D) model or mesh file in any other format) and all documentation, advice and instruction (whether provided in video form, audible form, written form or otherwise) is provided ‘as is’ in good faith and is intended to be helpful but comes with no warranty whatsoever.

Anyone attempting to build or use a PUMA microscope or other PUMA-related material, accessory, module or derivative is hereby advised that there will be risk involved in 3D printing, post-print processing, assembly and usage of the resulting structures. This risk includes, without limitation, the risk of personal damage and loss of resources.

Dr Paul J. Tadrous, TadPath and OptArc cannot accept any liability for any such loss or damages that may occur. All those who attempt to build or use any aspect of the PUMA project or derivatives thereof do so at their own risk.

Health and Safety Advice

Burns and Fire

There is a risk of fire and of burns when working with 3D printers, soldering irons and molten solder. Wear appropriate personal protective equipment such as gloves and eye and face protection. Ensure all electrical components are of the appropriate voltage and current tolerances. Do not leave electrical components powered for longer than they are required for use. Do not leave 3D printers unattended when they are powered up.

Toxic Fumes

Some filaments used in 3D printing can release toxic fumes when heated (such as during the 3D printing process). Working with solder can also release toxic fumes (especially if leaded solder is used). Ensure adequate ventilation at all times during 3D printing and soldering.

Lacerations

Cleaning and assembling 3D prints and other components of PUMA systems sometimes involves the use of sharp instruments – take appropriate precautions when handling sharp blades. Working with optics – especially thin plates of glass such as beamsplitter mirrors, microscope slides and coverslips and display screen panels can result in flying shards and sharp edges. Wear appropriate personal protective equipment such as gloves and face and eye protection.

Injury to Eyesight

Physical injuries to the eyes may occur from shards and specs of glass and airborne particles of molten or hot solder. Bright lights are used to illuminate the PUMA microscope. These should be used with caution. Do not stare directly into the illumination LED bulb (with or without its collector lenses in place), and only use a brightness setting that is appropriate for comfortable viewing when using the complete microscope. If using a mirror to provide illumination always use a reflection from a diffuse scene such as an open blue or cloudy sky. NEVER allow specular reflections of the sun to enter the field of view of the mirror or permanent eyesight loss may result. If using a bulb that emits UV light, always ensure an appropriate and effective UV blocking filter is used to shield your eyes from the UV light. If a laser is used for illumination then you should never look at the image through the lenses of the scope (you should use a camera for making observations).

Protecting the Vulnerable

The PUMA microscope and its accessories are not toys. Do not allow children, vulnerable adults or pets to come into contact with any PUMA product without appropriate supervision and safeguards.

Introduction

PUMA is a 3D printed high quality microscope system. The name PUMA stands for ***P**ortable, **U**pgradeable, **M**odular and **A**ffordable* – key features of this system.

This document provides practical advice for those who want to print their own parts for the building of PUMA-related modules and microscopes.

It also serves as a visual ‘index of parts’ for all the 3D printed parts in the PUMA project and shows which FreeCAD file contains which parts. Within the FreeCAD file those models have the same name as the printable model file but without the printable file extension (like ‘.stl’ or ‘.3mf’) and also without the two letter prefix before the first underscore. For example, the printable file ‘AR_Cc_locknut.stl’ is a mesh generated from the model called ‘Cc_locknut’ in the FreeCAD file called ‘AR_Projector.FCStd’.

The information in this file only relates to 3D printed parts. To build a PUMA microscope additional components will be needed such as nuts and bolts and optics elements. None of these additional components are addressed here. See the assembly / usage tutorials, videos and other ‘how to build’ documentation for that information.

At the beginning of each section some general printing advice (like slicer settings profile) is given if the models for that section are to be printed with a profile other than the default (to be discussed later). Futher advice is given for each model separately. For most models this advice consists solely in an illustration showing the preferred orientation of the model on the printer build plate. In some cases additional advice and illustrations are given, particularly where they relate to support structures.

This document makes no attempt at explaining what each part does or how to use or assemble them. For that kind of information you would need to see the assembly / usage tutorials and other documentation.

The Cura screenshot illustrations in this document show the models at various zooms and with some angular perspective variations from model to model in order to emphasise different aspects. However the grid and ‘Ender’ logo shown on the build plate should make it clear how the model is to be orientated and indicate the scale.

Each chapter begins with a table of resources showing the print time and length of 1.75 mm diameter PLA filament used to print each model file as estimated by Cura v.4.8.0 using the recommended print settings described in that chapter for each model.

Cover Illustration

Centre

A PUMA microscope in the following configuration: Full Kohler illuminator, motorised Z-stage, mechanical XY Vernier caliper slide holder, advanced filter block, augmented reality projector, binocular head, PUMA control console. It is fitted with a Zeiss Plan 2.5x objective and two high eye point wide field 10x oculars of 20 mm field of view. Many alternative configurations are possible due to PUMA's modular design.

From Top Going Clockwise

These microscope images (all taken with a PUMA microscope in various configurations) are highly cropped and compressed and do not show the full field of view. See the gallery of images on the PUMA websites for full quality and full field images. Magnifications given below are of the objective only:

Bright field Kohler illumination: H&E chronic inflammation, x100 oil immersion.

Fluorescence microscopy: Fluorescein stained *Soncus* bud showing pollen grains and other cellular structures x40.

Fluorescence microscopy: Fluorescein stained *Ilex* (holly) leaf showing chloroplasts, vascular structures and other cellular structures x40.

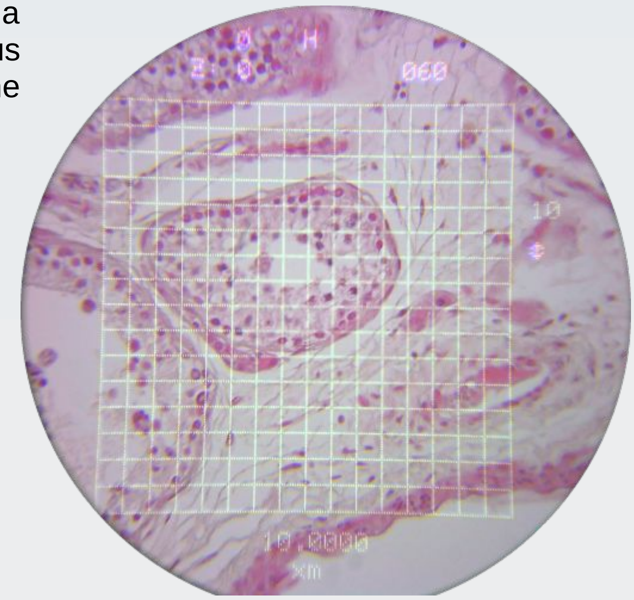
Crossed polarisation microscopy: Amyloid stained with Congo red x40.

Dark field / Dark ground microscopy: Unstained section of colonic tissue x10.

Schlieren phase contrast using a spatial light modulator in the illuminated aperture plane of the condenser: Unstained section of colonic mucosa, x100 oil immersion.

Crossed polarisation microscopy: Striated muscle of tongue stained with H&E x40.

AR HUD Overlay. The figure shows a cropped area from a small part of the field of a x10 view of an H&E section (of testis) with the augmented reality (AR) projector projecting a heads up display (HUD) of a grid and some microscope status information onto the live optical image. The full field image is shown here:



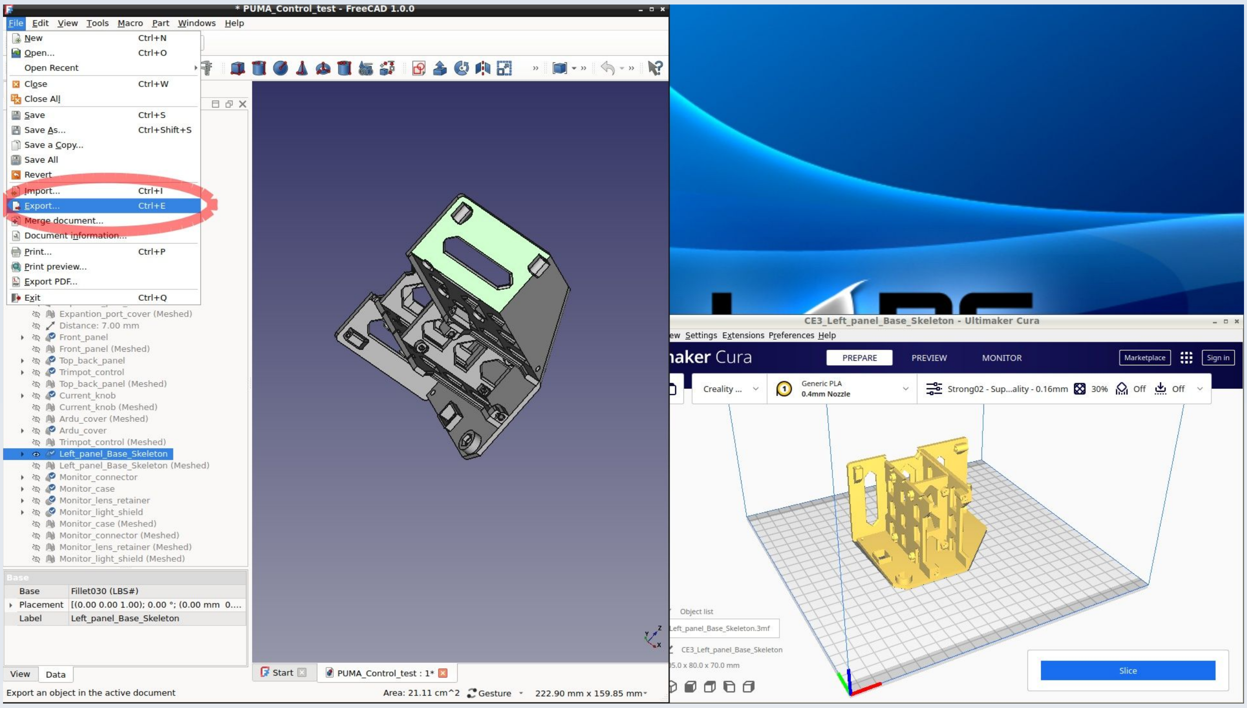
Generating Files for 3D Printing from the FreeCAD Source Files

In previous editions of this document I used mainly STL mesh files for 3D printing. I have since moved away from favouring STL in favour of 3mf files as I found that STL files could sometimes be excessively large (in terms of megabytes) and might not load properly (or take excessively long to load) in the slicer program that I use (Cura) as well as other slicers. Furthermore, STL file generation with FreeCAD requires an intermediate processing step on the models (to turn them into meshes) but FreeCAD models can be saved directly as 3mf files without any processing. This latter distinction became especially importance since some bugs have crept into later models of FreeCAD which do not allow the reading of older FreeCAD files properly once they are imported into the new FreeCAD version and ‘recalculated’ for processing. This means that, until such bugs are fixed, some of the older models cannot be edited in FreeCAD (such as to make them into meshes) but they can be read and directly saved as 3mf files. For all those reasons I tend to use 3mf files for printing rather than stl files. However, I will show you how to save models in both formats so you can choose (the latest FreeCAD files in the PUMA project – such as those for the CNC stage – are made in the modern (post v.1.0) FreeCAD so may be edited and saved as STL if desired).

Generating .3mf files from the models

Due to issues with FreeCAD v.1.0 onwards, take the following steps to avoid printing faulty models if using many of the older PUMA models. These steps will also work with the newer PUMA FreeCAD models:

Load the FreeCAD file but do NOT 'recompute' the model as suggested by FreeCAD (and make sure your FreeCAD does not autmatically re-compute models on loading). Instead just select the model and export it as a .3mf file by selecting File -> Export (see the figure).

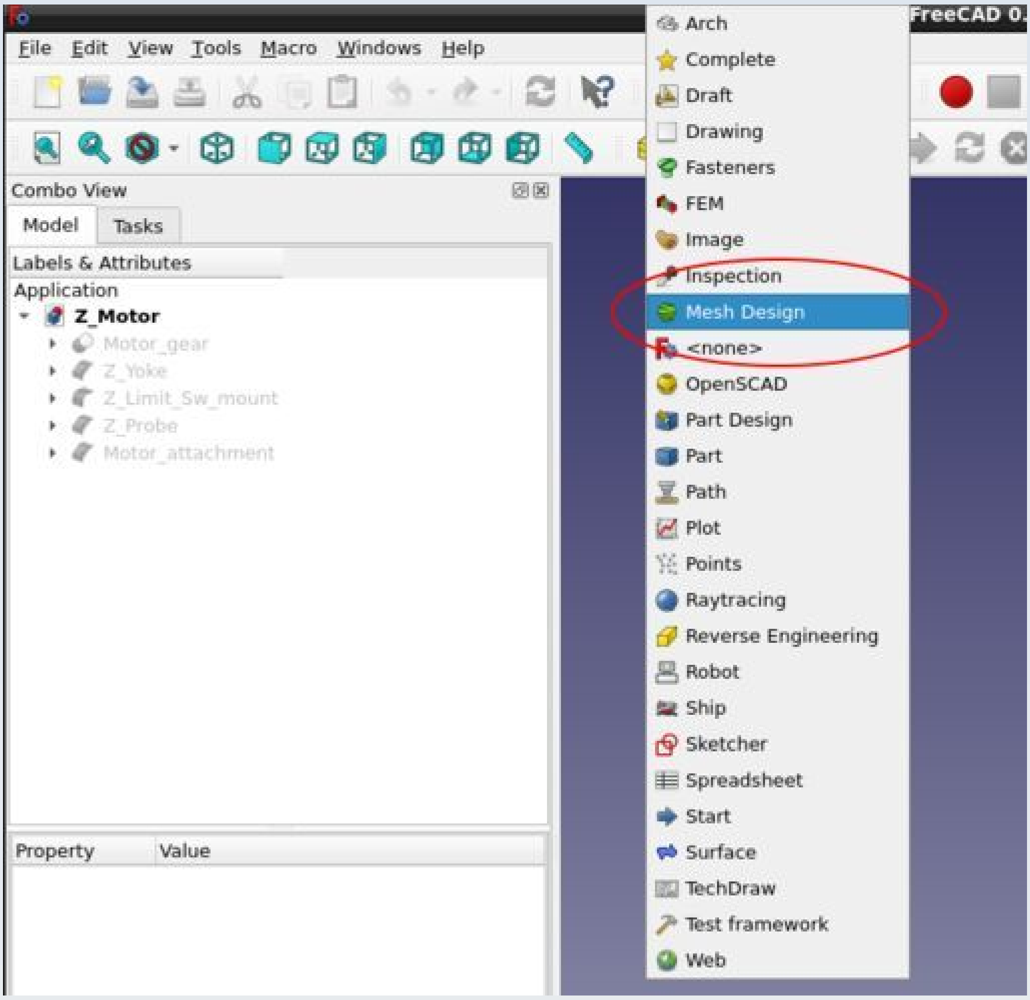


Generating STL files from the models

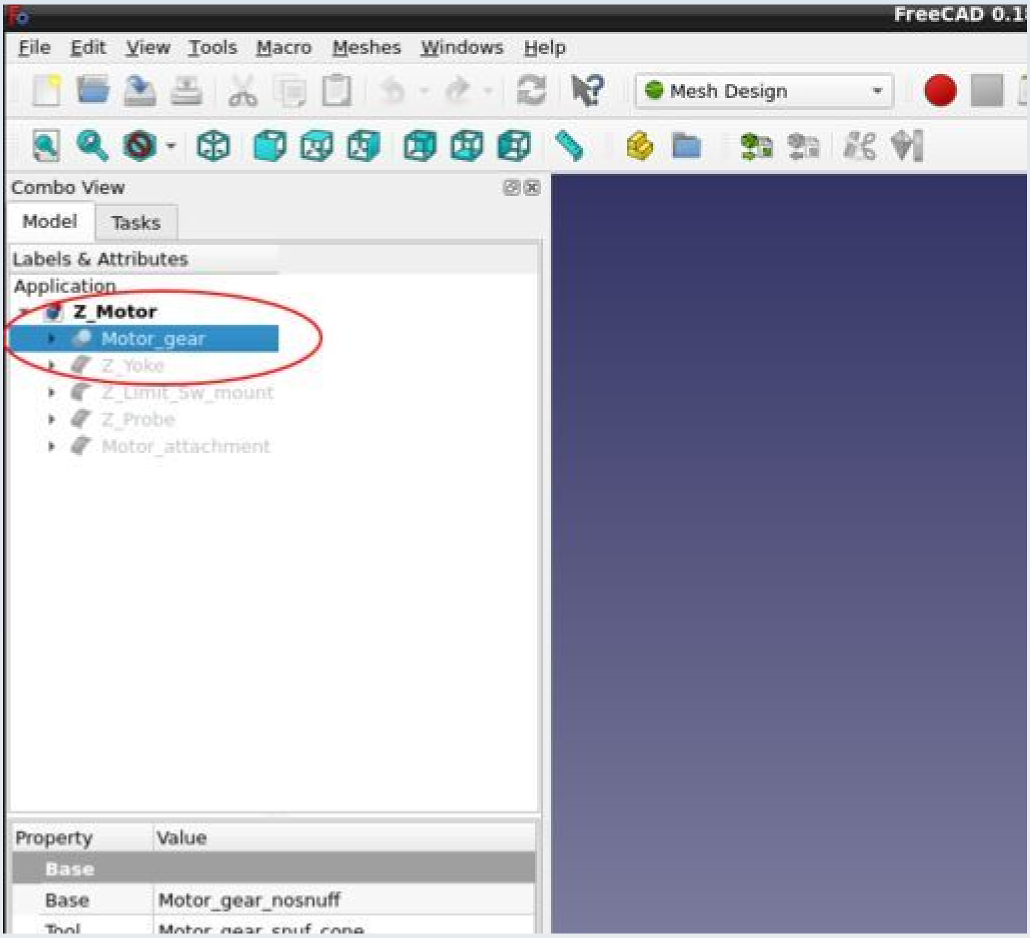
If you prefer or need to generate STL files instead of 3mf files, you can do so by means of the following steps. However, these will require you to have fully computed models so you may find this option is not available for the older PUMA models (prior to 2025) due to modern FreeCAD incompatibilities when loading older FreeCAD files. In some cases the files may undergo the ‘recompute’ process without crashing but, in that case, some aspects of the models may be altered making them ‘wrong’. This is why the 3mf file route discussed above is preferred.

1. Load the CAD file into FreeCAD (I used v. 0.18 to illustrate these steps but a later or the latest version may be reuqired to correctly view and edit the latest models). For the following illustrated examples I have loaded the ‘Z_Motor.FCStd’ file from the PUMA project.

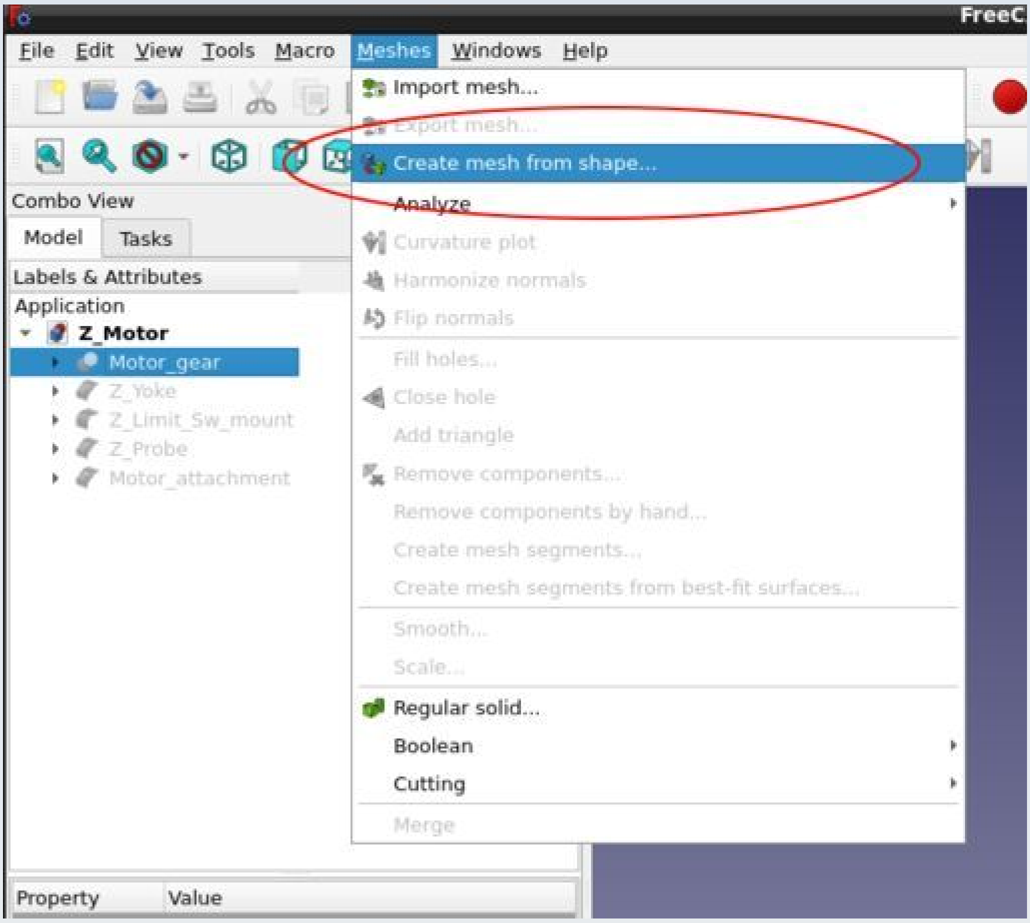
2. Select the 'Mesh Design' Workbench from the drop down selection list on the top button bar of FreeCAD.


FreeCAD 0.
File Edit View Tools Macro Windows Help
Combo View
Model Tasks
Labels & Attributes
Application
Z_Motor
Motor_gear
Z_Yoke
Z_Limit_Sw_mount
Z_Probe
Motor_attachment
Property Value
Arch
Complete
Draft
Drawing
Fasteners
FEM
Image
Inspection
Mesh Design
<none>
OpenSCAD
Part Design
Part
Path
Plot
Points
Raytracing
Reverse Engineering
Robot
Ship
Sketcher
Spreadsheet
Start
Surface
TechDraw
Test framework
Web

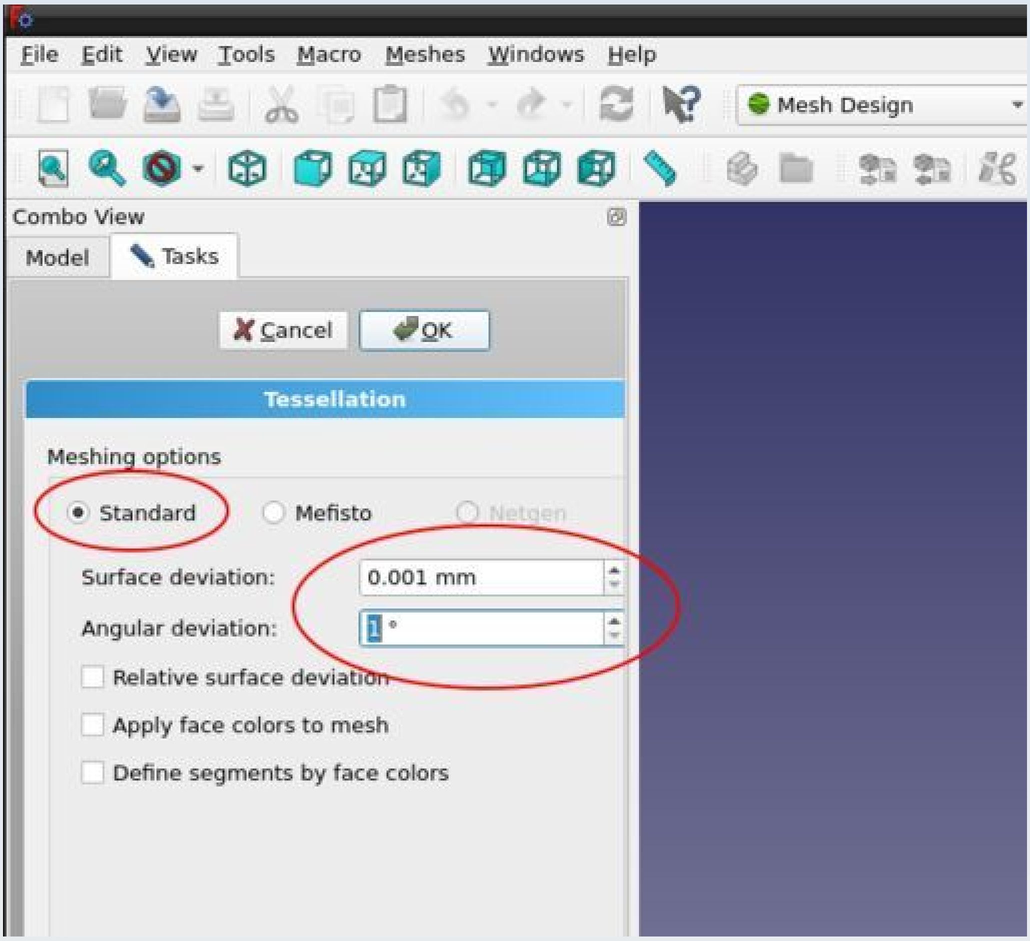
3. Left-click on the model you want to create a mesh for so as to select it.



4. Go to 'Meshes' -> 'Create mesh from shape ...' to bring up the Tessellation dialogue box.



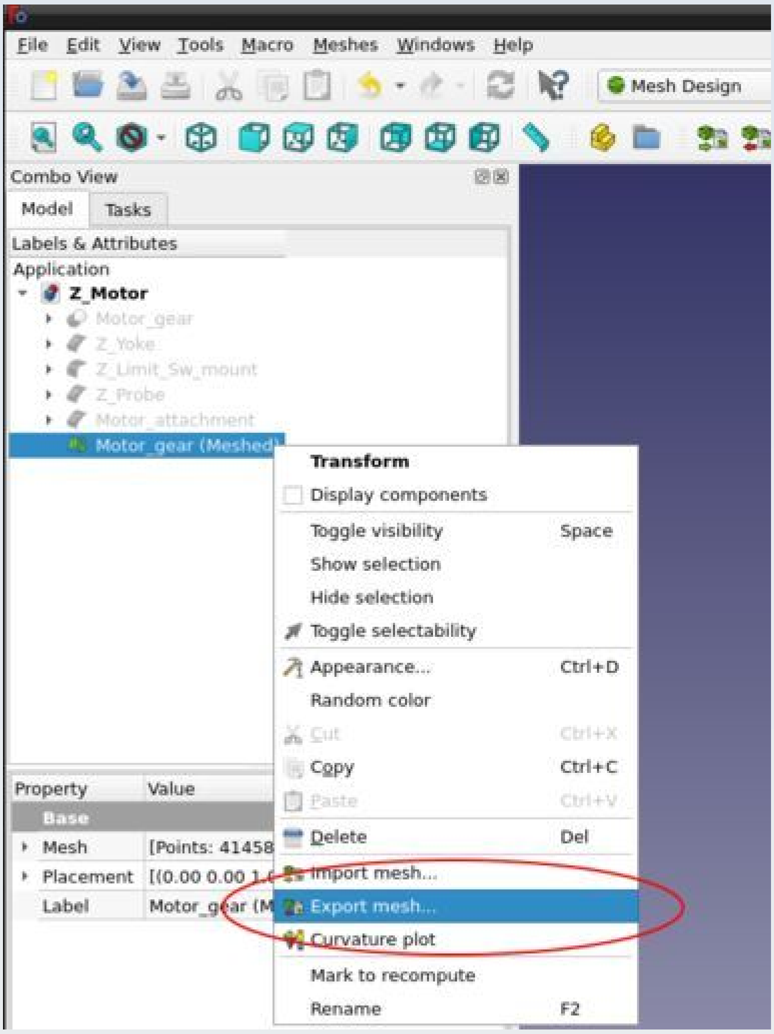
5. Select the 'Standard' meshing option set the 'surface deviation' to 0.001 mm and the 'Angular deviation' to 1 degree.



6. Click OK - it may take a while to complete.

These mesh settings may be overly fine for many of the models in that you could probably get away with coarser settings and lower resolution meshes for some models. However I have not experimented to see how low I can go before the models cease to function or cease to fit properly.

7. When the mesh is generated, right click on the mesh in the 'Model' tab of the combo view and select 'Export Mesh ...' from the drop down menu to save the mesh as an STL file. You might need to rotate the mesh first before export to make it easier to site on the build plate in Cura in the manner required for printing (as will be shown in the illustrations in the rest of this document for each model). Although you can also performs most of those manipulations in Cura itself.



Printer and Slicer Software and Settings

This advice relates specifically to printing parts using a Creality Ender 3 printer with ordinary PLA 1.75 mm diameter filament and the Ultimaker Cura slicer software (v. 4.8.0 to v. 4.13.1).

If you use a different printer and / or slicer you would need to explore for yourself what are the most appropriate settings and profiles to use and may also need to modify other aspects of the advice given here.

Note the orientation of models on the print bed as shown in the figures. For some models is probably won't matter if you use a different orientation but for others is it crucial to functionality that you stick to the orientation shown. My advice therefore is to alwatys use the orientation shown in the figures unless you want to experiment and are happy to risk either failure or suboptimal functionality.

All models are printed with the PUMA custom Cura profile called 'Flats' unless otherwise specified (several other PUMA custom Cura profiles are used on occasion and these are available in the GitHub repository). No supports are used unless specified otherwise. None of the Cura in-built build plate adhesion options are used. Where necessary, custom adhesion structures – called 'adhesins' – are built into the model and these will need to be trimmed off when the model is complete as part of model post print clean up.

I have only ever printed the parts of this project using super high quality print settings and the highest resolution tessellation meshes. No doubt this is 'overkill' for many of the parts but I have not done the practical experimentation required to find out the lowest resolution meshes that will work with the lowest quality / fastest print settings.

I have only ever used standard PLA 1.75 mm filament for printing the parts of this project – although I have used PLA from different suppliers from Creality's own brand to much cheaper generic filament. With the highest quality branded filaments the prints seem a bit smoother but from a functionality point of view all filaments I have tried give acceptable results.

Supports

You don't need supports for screw thread holes up to M4 diameter that are printed horizontally but Cura will try to insert supports for these which is one of the reasons why support advice in some of the models below specifies to use the 'touching build plate only' option (not 'Everywhere').

When supports are enabled the default overhang angle should be set to 67 degrees.

For 'Tree' supports the default parameters to use are: 'branch distance' is 1 mm, 'branch diameter' is 2 mm, 'branch diameter angle' is 5 degrees and 'collision resolution' is 0.2 mm.

The 'branch angle' for Tree supports may be 40 or 50 degrees depending on the model so this information is provided for each model that required tree supports.

If supports are not stated to be required then ensure supports are off – even if it appears (or Cura suggests) that they might be needed. Sometimes this is emphasised for models where having supports enabled could cause the print to fail of adversely affect the function of the resulting print.

Some models require specific support blockers. These will be illustrated in the figures.

Mesh Errors

Very occasionally for some models Cura will report model errors in the STL mesh and highlight those areas in bright colours. These ‘errors’ are very small and the model slices and prints just fine even with them so they can be ignored. During development I have been able to identify and fix some of those mesh errors in FreeCAD but the very few remaining ones were not obvious – and practically they do not matter for printing with an Ender 3 printer.

Post Processing and Aftercare of Prints

I have noticed that PLA prints will shrink a little if exposed to excessive heat post printing and this may distort closely fitting parts and prevent them from functioning adequately. To avoid this, never keep your 3D printed parts on or very near to a radiator and never use a heater, hair dryer or radiator to dry off any parts that may have gotten wet. Leaving parts in a car in the sun may have a similar detrimental heat shrinkage effect.

Some parts, especially closely fitting parts like threads and push fit components may need scraping or light sanding to remove ‘nerds’, ‘zits’ or prominent seams or other imperfections prior to use. It is advised that you allow parts to cool down thoroughly after printing before any such actions (especially sanding) otherwise you may find that you have over-eroded the model and end up with a fit that is too loose. Some 3D printed threads may require ‘training’ if they seem overly tight. This means you screw and unscrew the thread repeatedly to wear it down a bit – this will usually wear down small prominences / defects in the print that lie in the thread channels. This may need to be done gradually (you may not be able to screw a part all the way in at first). After training the thread should fit snugly without being too tight or too loose.

Some parts require lubrication – such as the polariser wheel and Z-stage bearings. This will be elaborated on in the construction and usage tutorials.

Many thread holes for screws (mostly M2 and M3 sizes but sometimes also up to M6) in many of the parts are printed simply as holes that are slightly too small for the screw and you are expected to cut a thread into the hole by simply screwing the metal screw into the hole. Do this slowly at first concentration on getting the screw perpendicular to the hole and applying downward pressure. For such joints it is important never to over-tighten the screws in the finished product because you can easily destroy the plastic thread so produced. Also, you should avoid unscrewing and re-screwing in those holes because the thread will wear out eventually (although they can take quite a few repeats before wearing down to a detrimental degree).

AR Projector

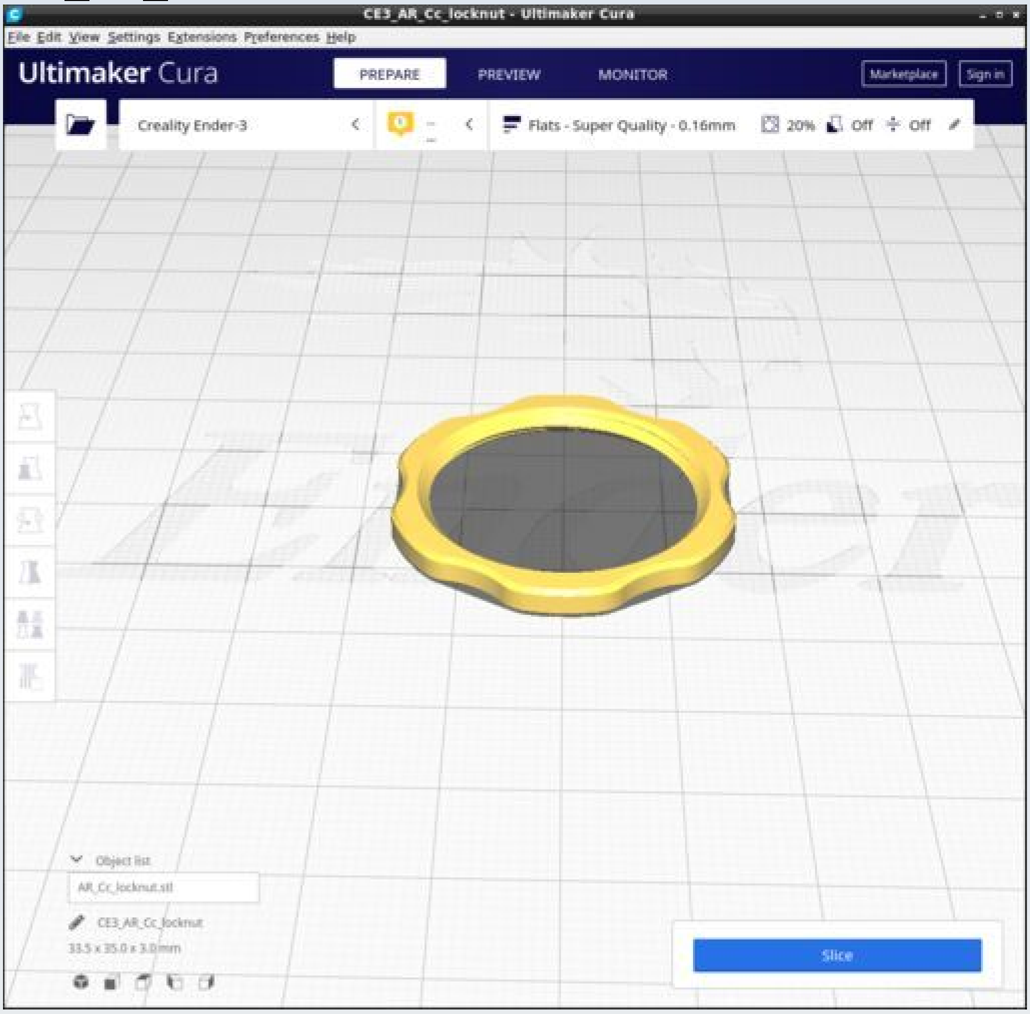
These are the parts for the augmented reality (AR) projector module which provides a heads-up-display (HUD) graphical user interface to the user. The CAD source models for these files are found in the file AR_Projector.FCStd.

Resources

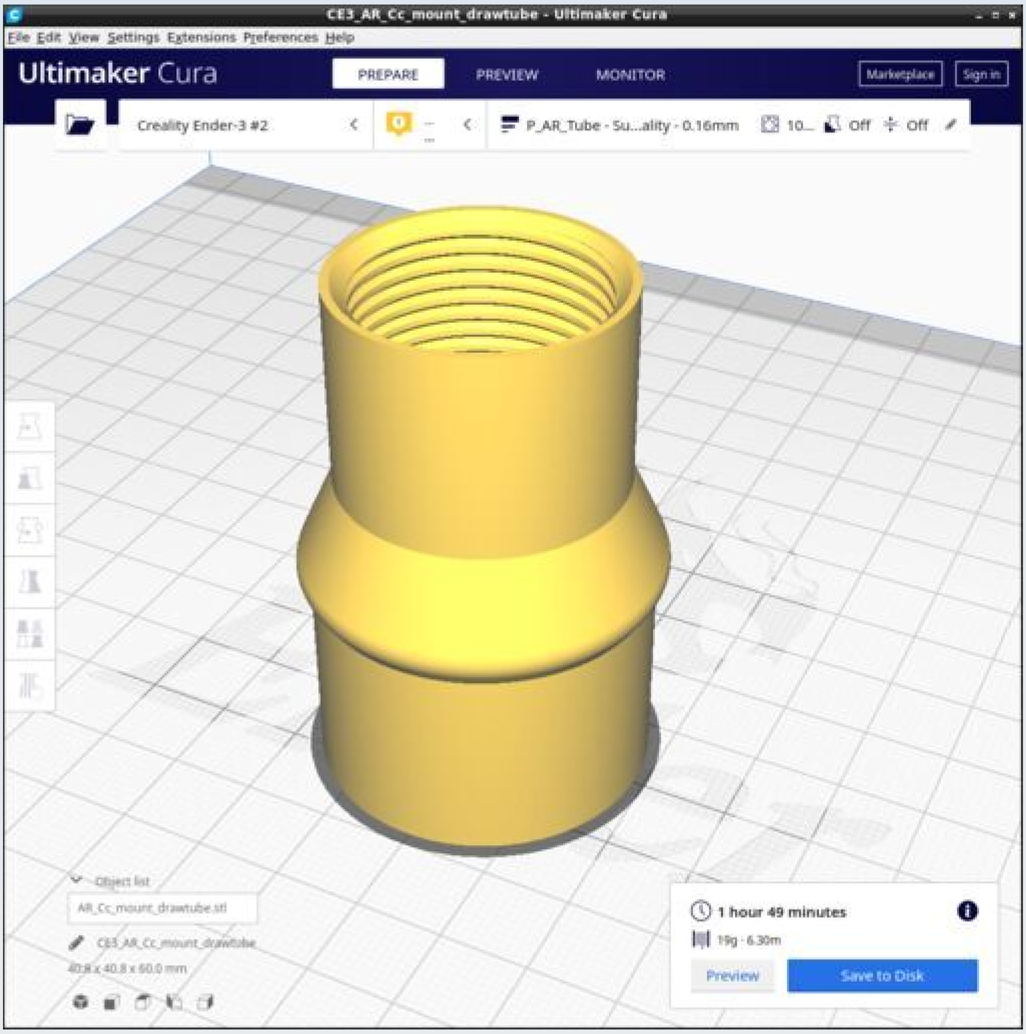
Cura calculates the following resources are required to print each model in this chapter:

AR_Projector	Time_Hr	Time_Min	PLA_Length(m)
AR_Cc_locknut	0	12	0.35
AR_Cc_mount_drawtube	1	49	6.3
AR_Cc_Retainer	0	7	0.28
AR_Cx_Cc_connector	0	28	1.16
AR_Cx_Collar	0	11	0.36
AR_Cx_Lens_holder	0	32	1.97
AR_Clip	0	45	1.41
AR_Light_block_filter	0	1	0.06
AR_Stay_thumbwheel	0	15	0.56
AR_TFT_DrawTube_F	2	59	5.33
AR_TFT_Drawtube_sheath	0	18	0.87
AR_TFT_LightShield	0	43	1.49
AR_TFT_Mount	1	1	2.3
AR_Slide_mount	0	59	1.91

AR_Cc_locknut

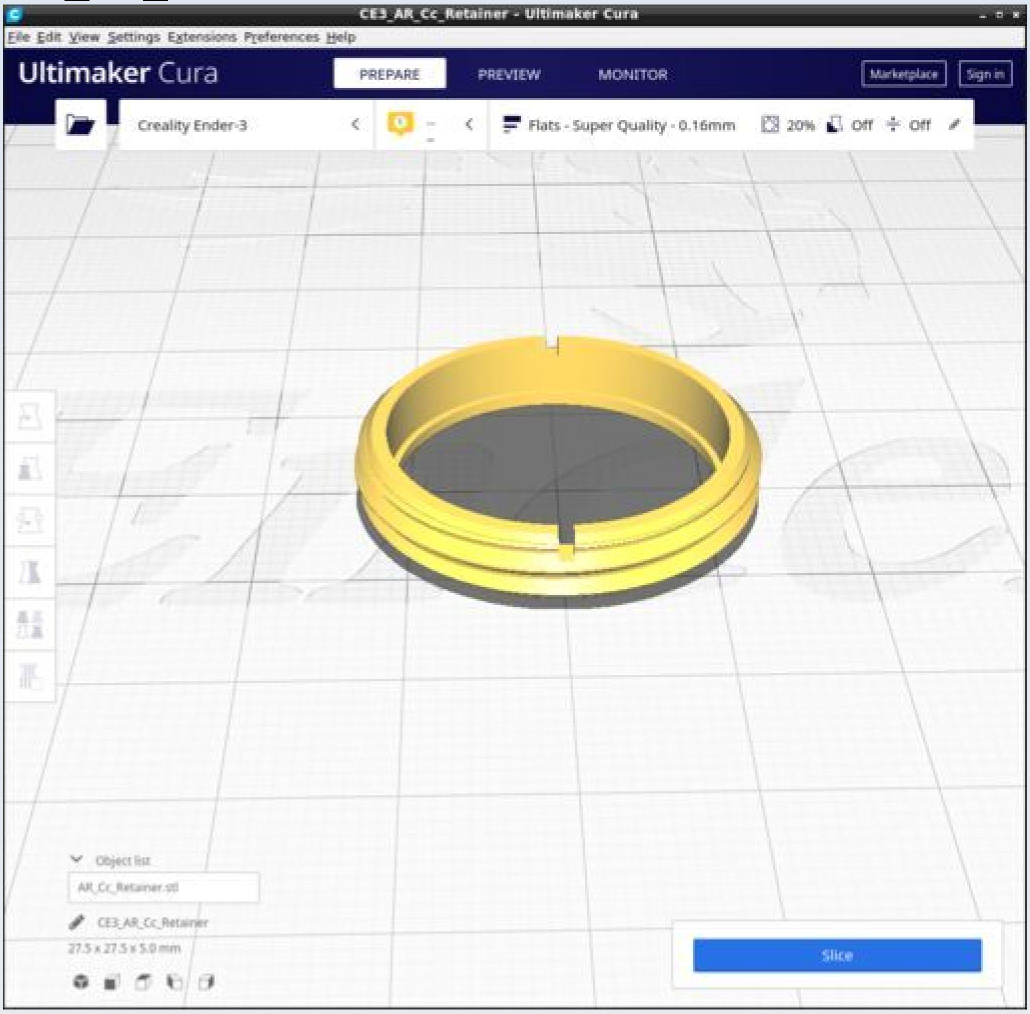


AR_Cc_mount_drawtube

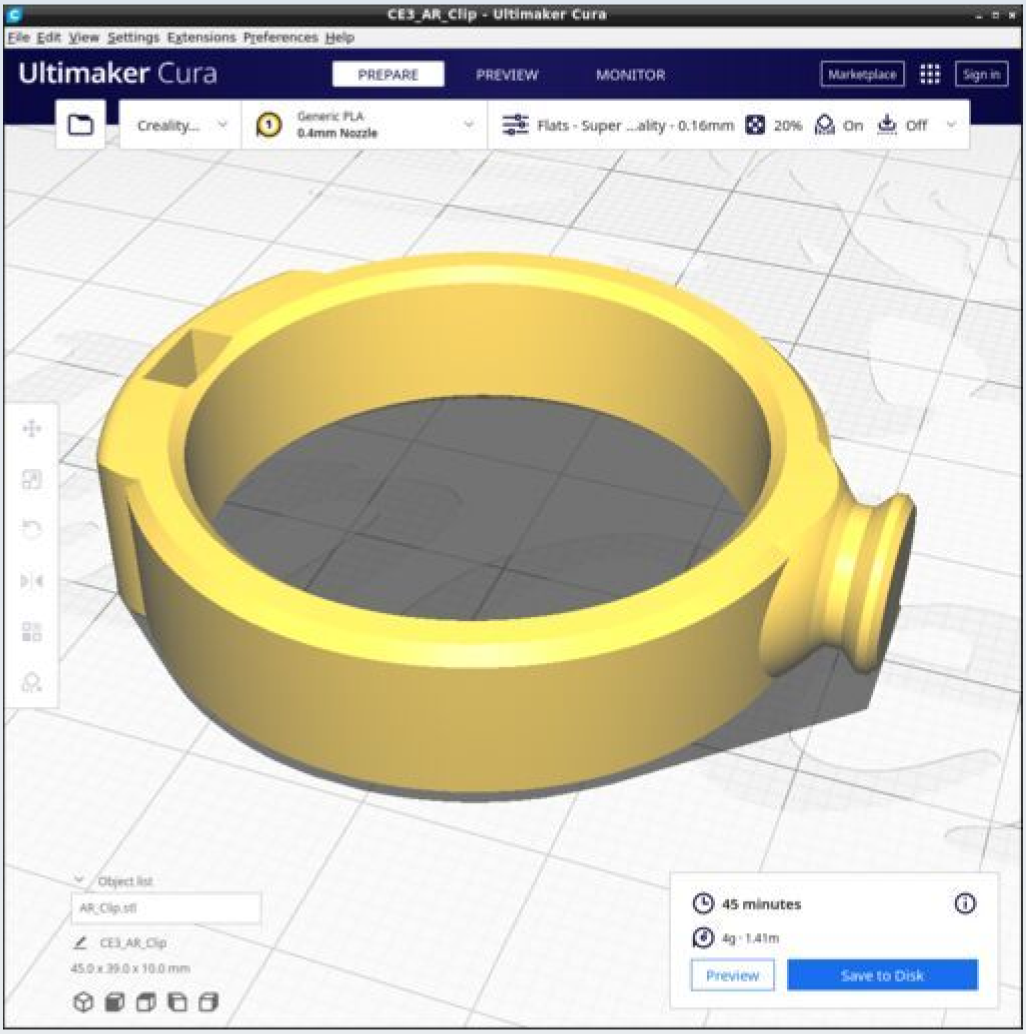


Print with PUMA custom Cura profile ‘P_AR_Tube’

AR_Cc_Retainer

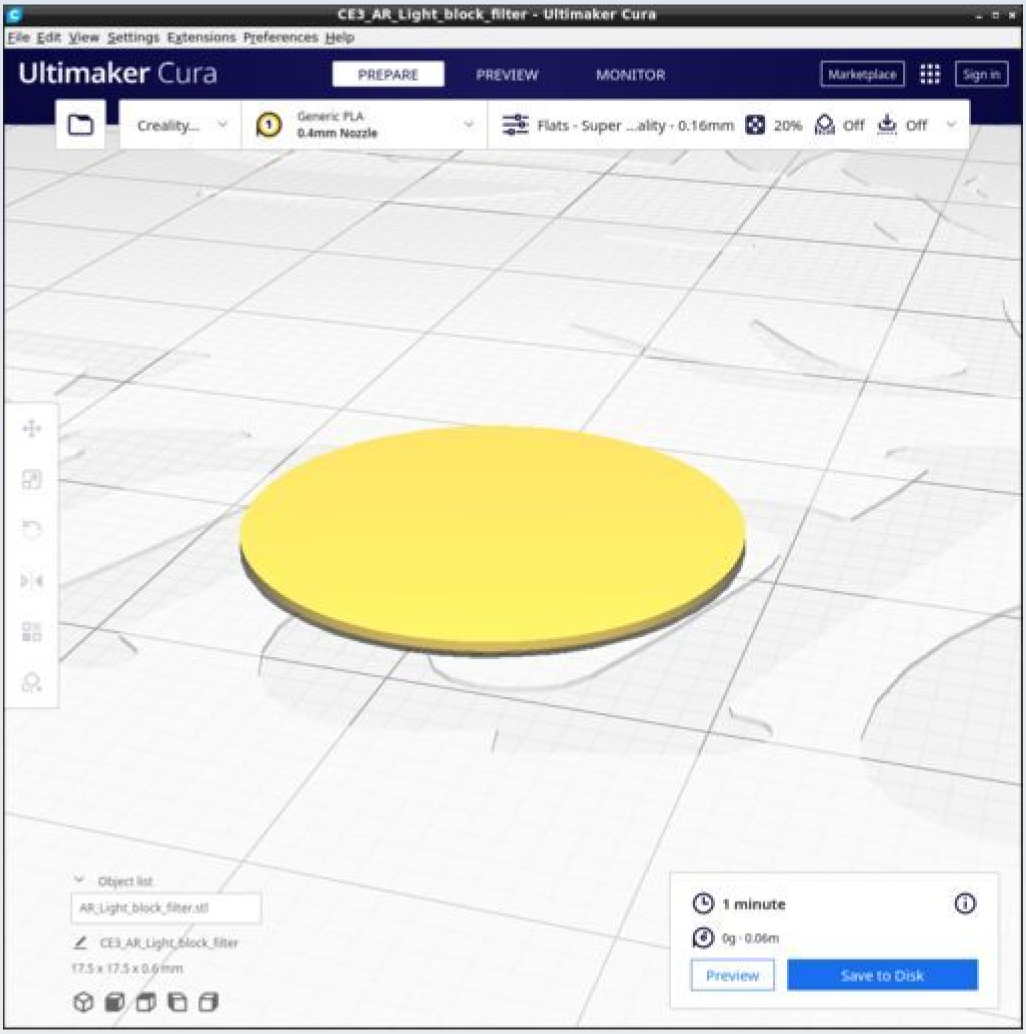


AR_Clip

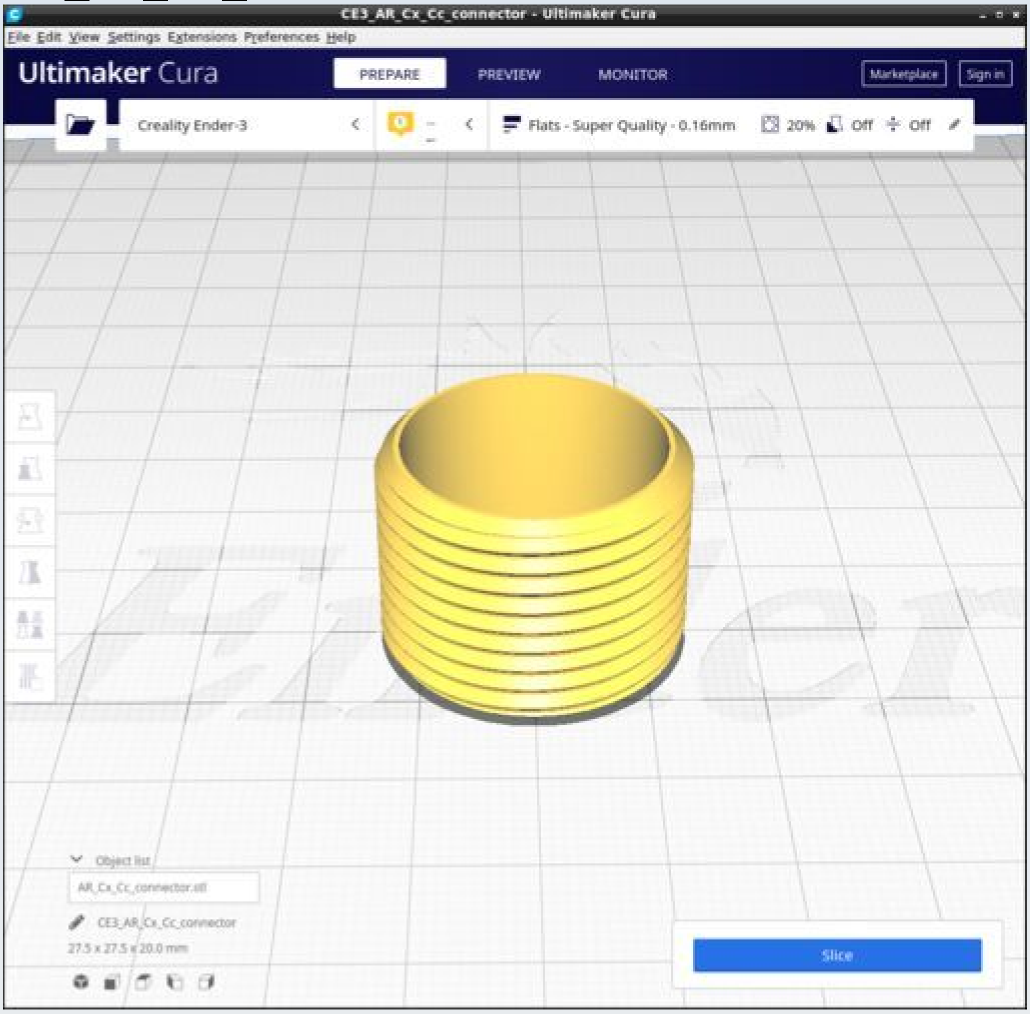


Use standard supports (not tree) with overhang of 67 degrees.

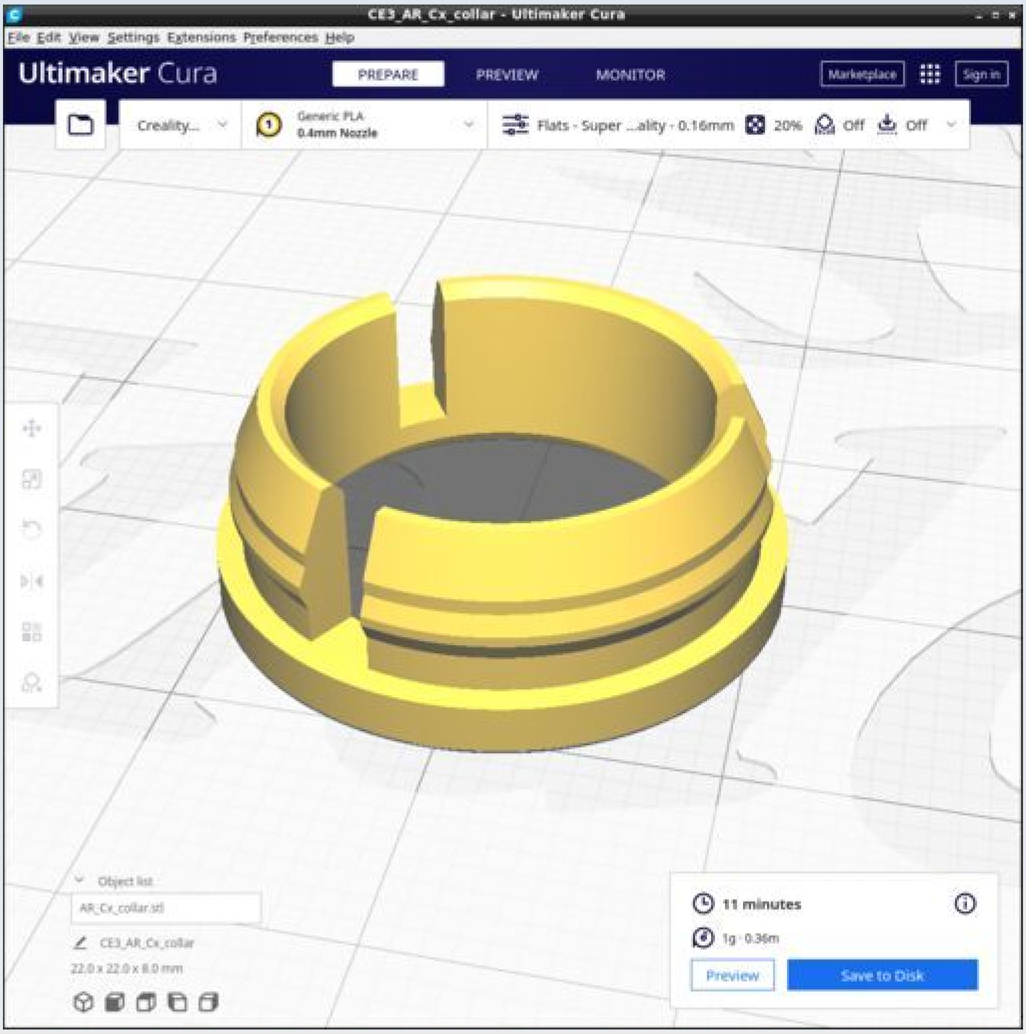
AR_Light_block_filter



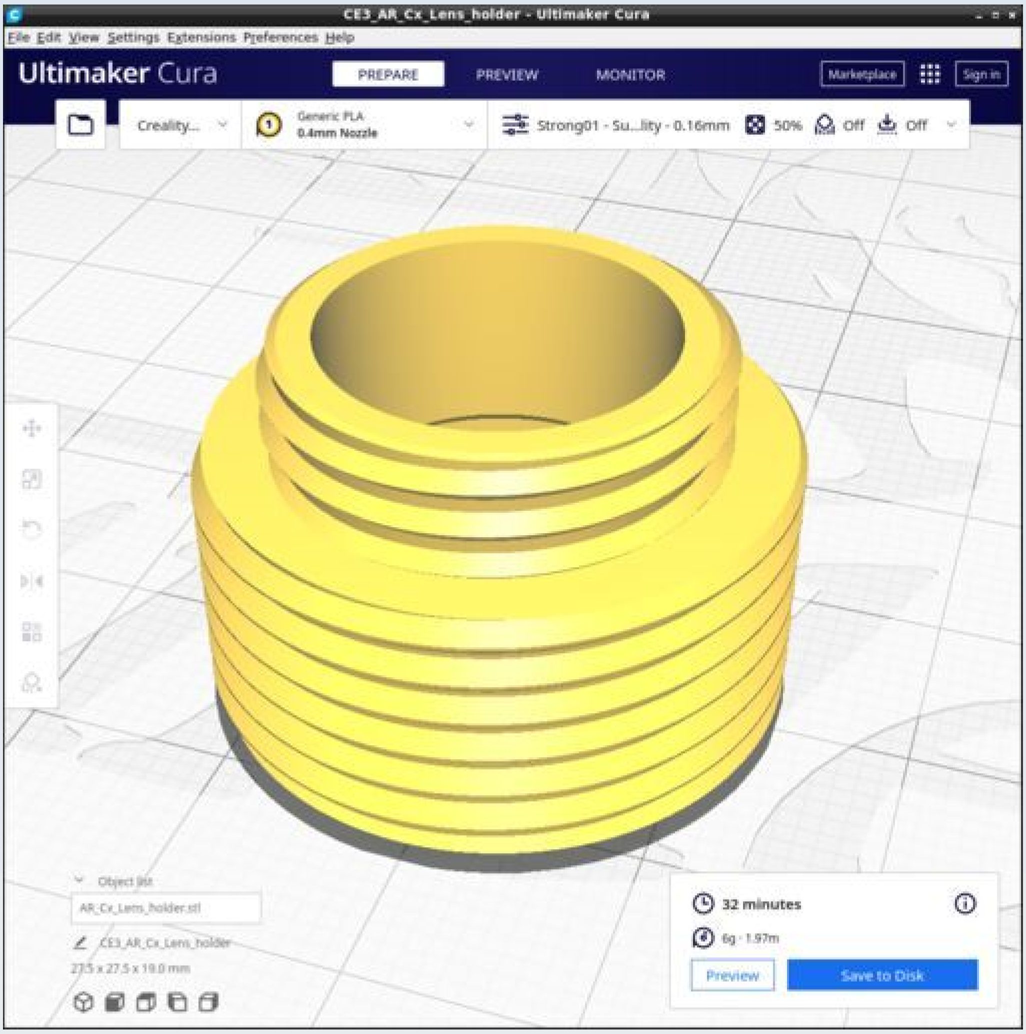
AR_Cx_Cc_connector



AR_Cx_Collar

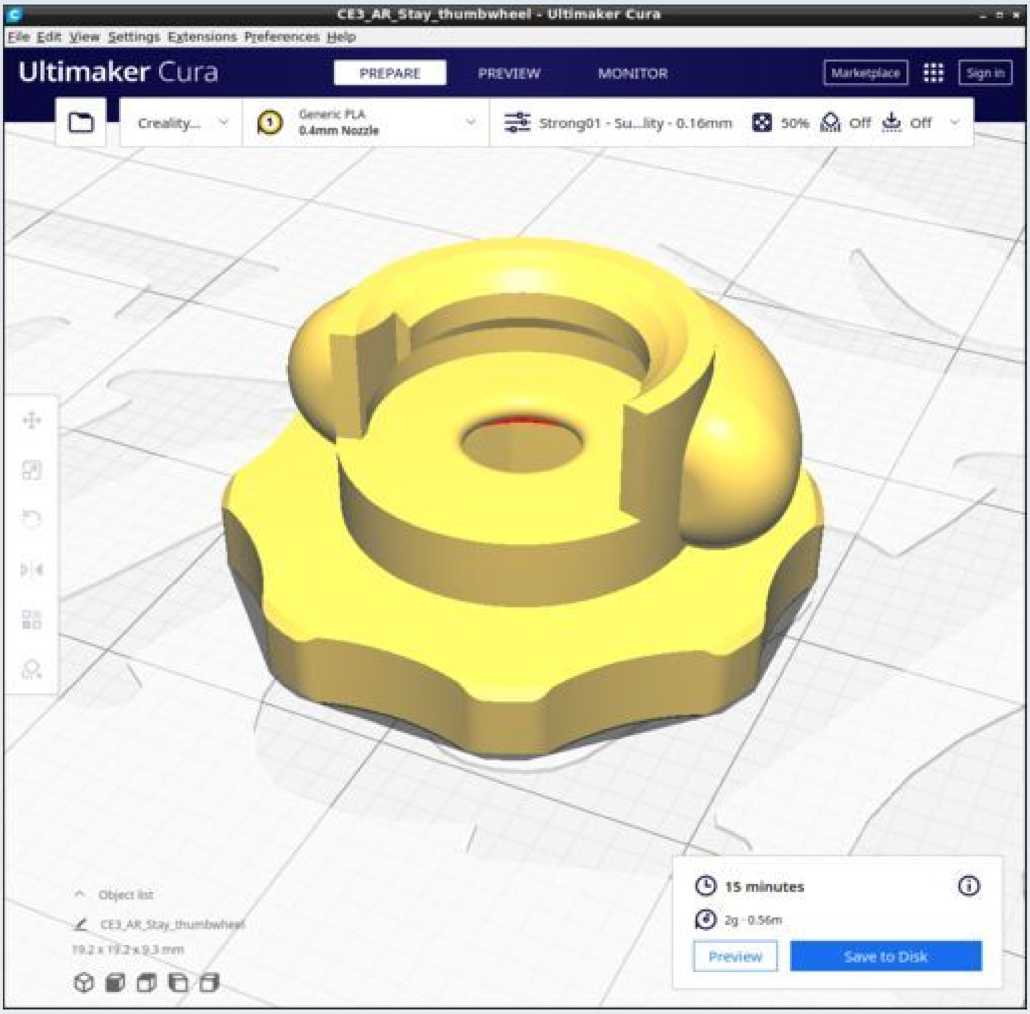

CE3_AR_Cx_collar - Ultimaker Cura
File Edit View Settings Extensions Preferences Help
Ultimaker Cura
PREPARE
PREVIEW
MONITOR
Marketplace
Sign in
Creality...
Generic PLA
0.4mm Nozzle
Flats - Super ...ality - 0.16mm
20%
Off
Off
Object list
AR_Cx_collar.stl
CE3_AR_Cx_collar
22.0 x 22.0 x 8.0 mm
11 minutes
1g · 0.36m
Preview
Save to Disk

AR_Cx_Lens_holder



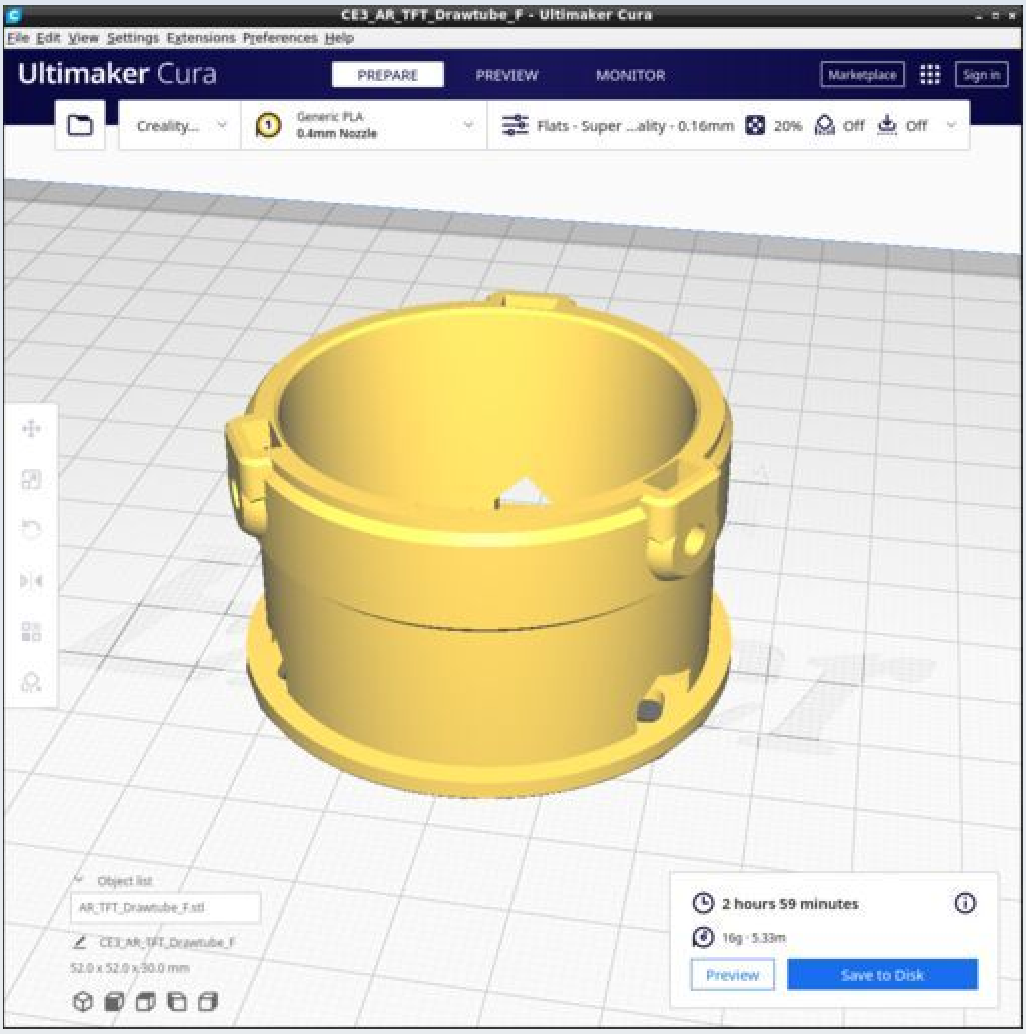
Print with PUMA custom Cura profile ‘Strong01’

AR_Stay_thumbwheel

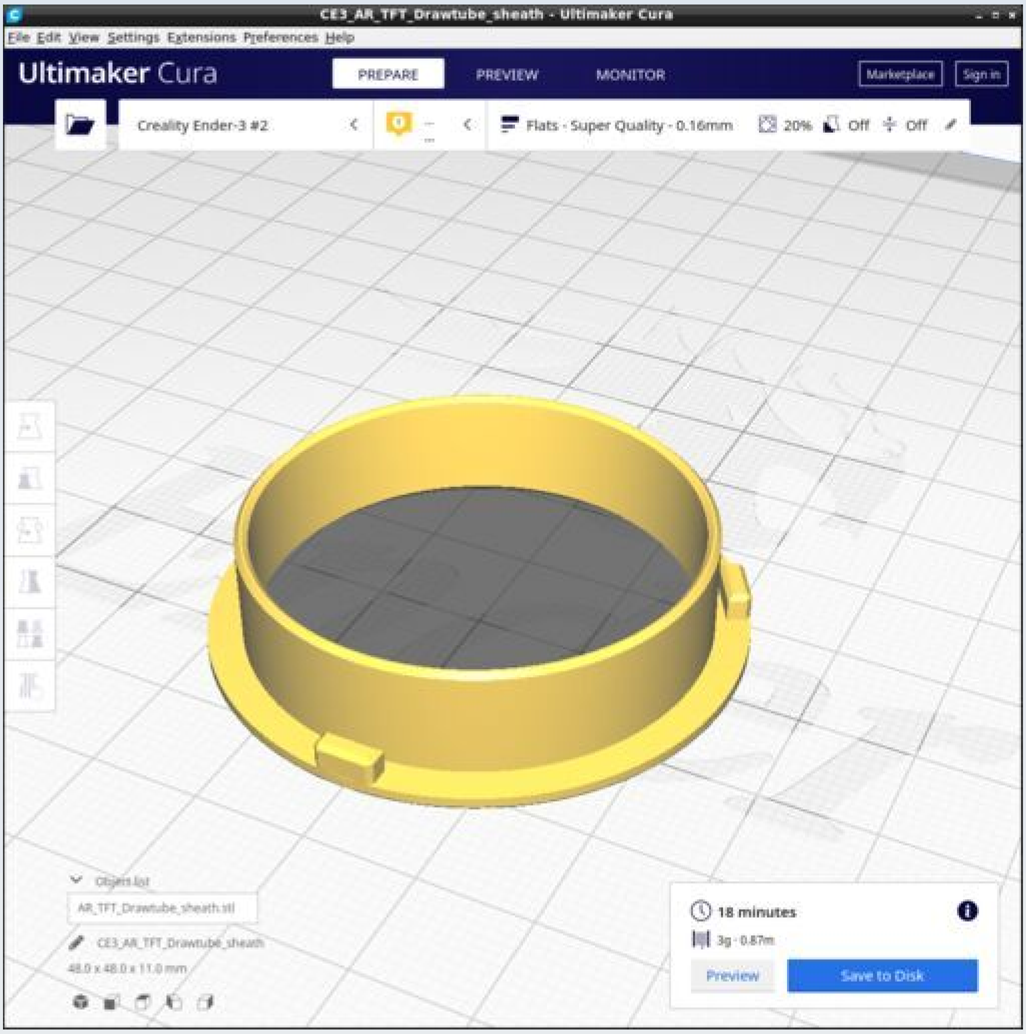


Use profile ‘Strong01’. No supports.

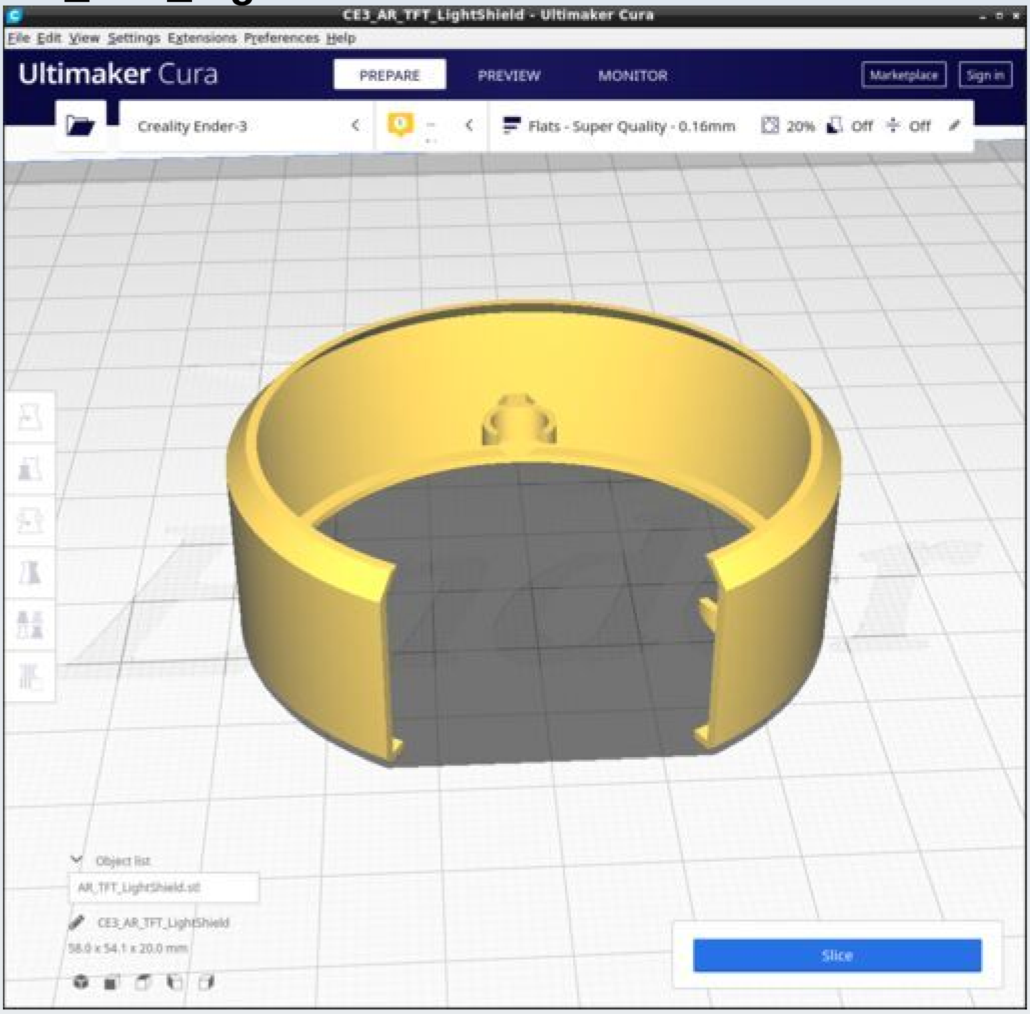
AR_TFT_DrawTube_F



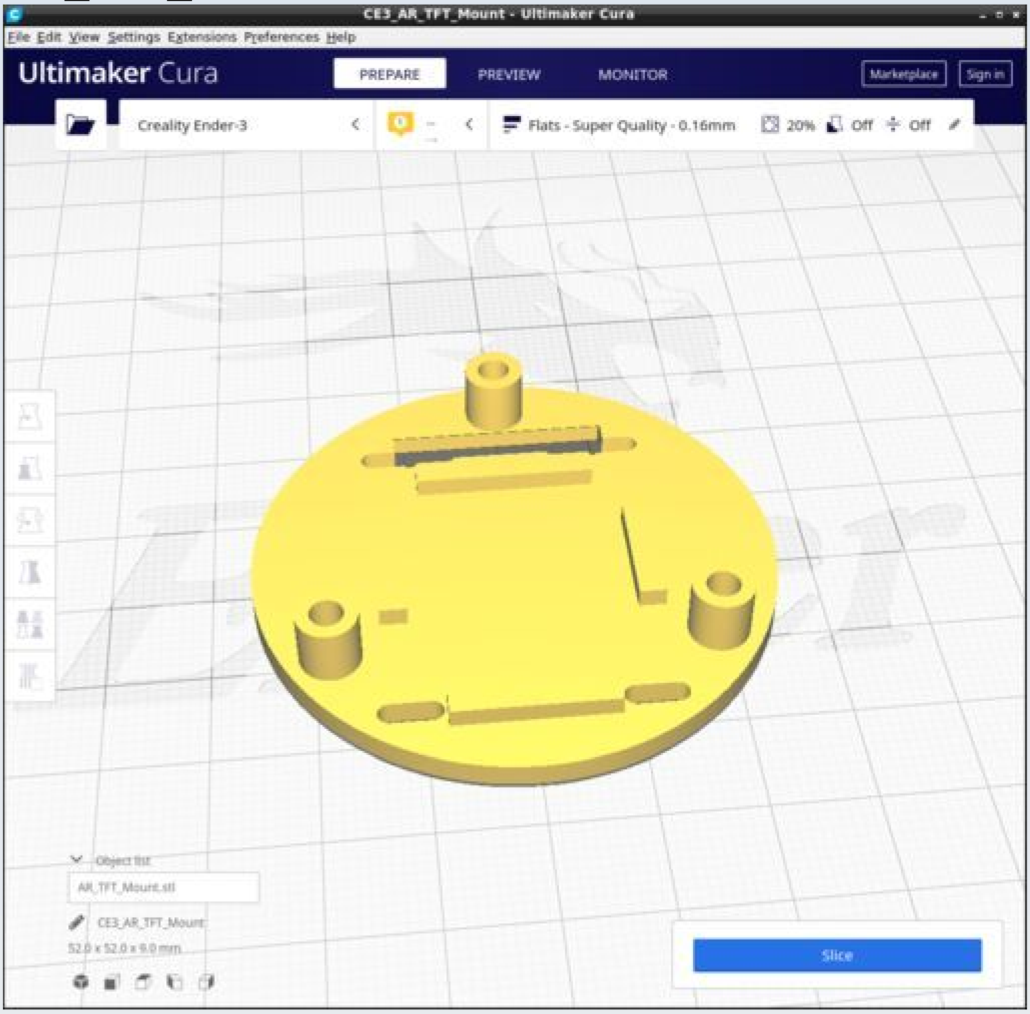
AR_TFT_Drawtube_sheath



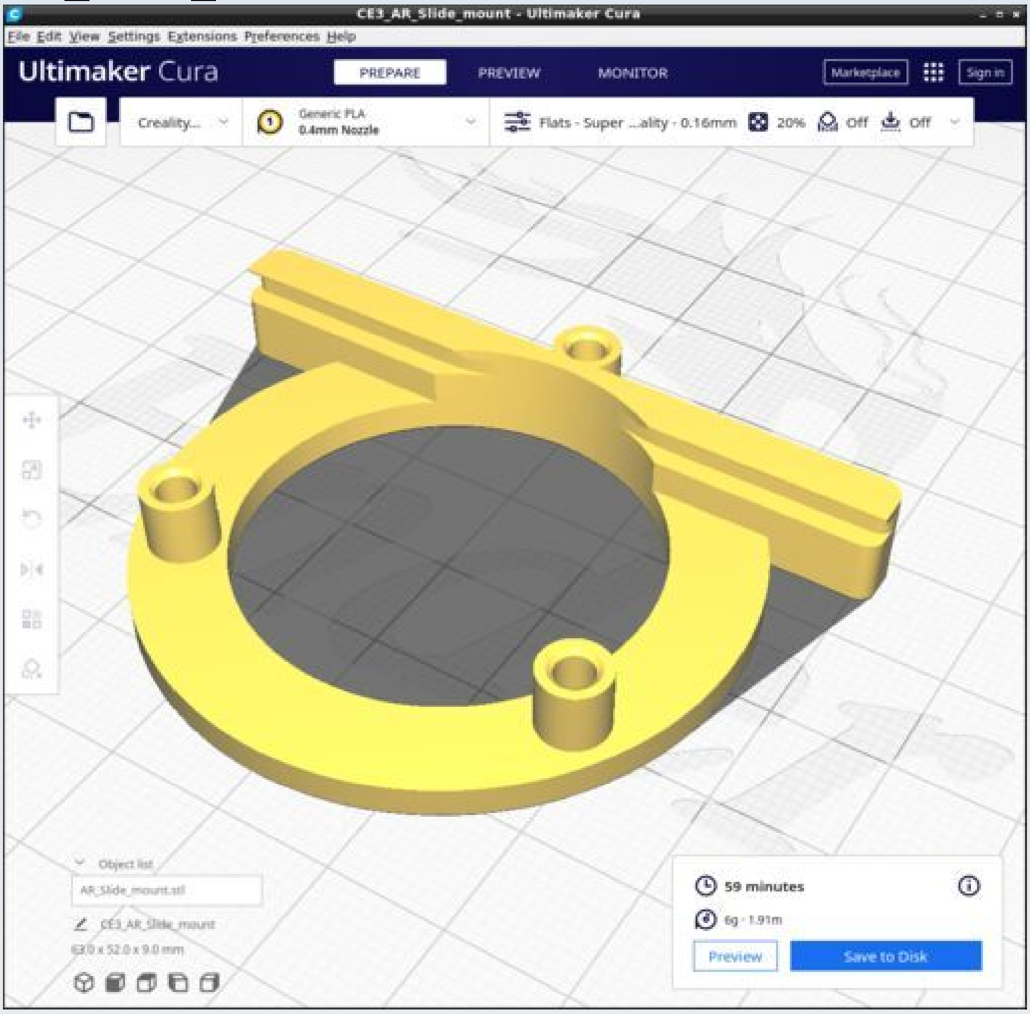
AR_TFT_LightShield



AR_TFT_Mount


CE3_AR_TFT_Mount - Ultimaker Cura
File Edit View Settings Extensions Preferences Help
Ultimaker Cura
PREPARE
PREVIEW
MONITOR
Marketplace
Sign in
Creality Ender-3
Flats - Super Quality - 0.16mm
20%
Off
Off
Object list
AR_TFT_Mount.stl
CE3_AR_TFT_Mount
52.0 x 52.0 x 9.0 mm
Slice

AR_Slide_mount



Binocular Head

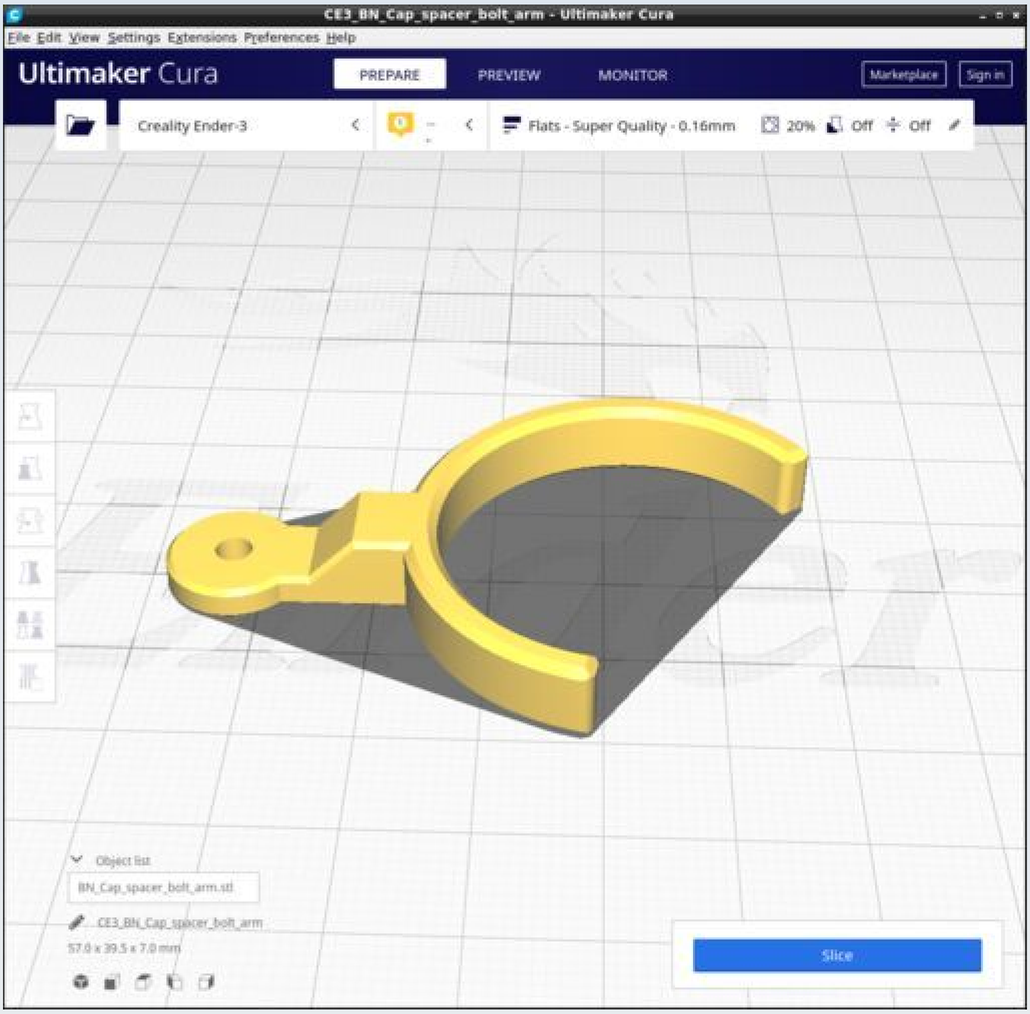
These are the 3D printed parts for the binocular head module. The CAD source models for these files are found in the file Binocular.FCStd.

Resources

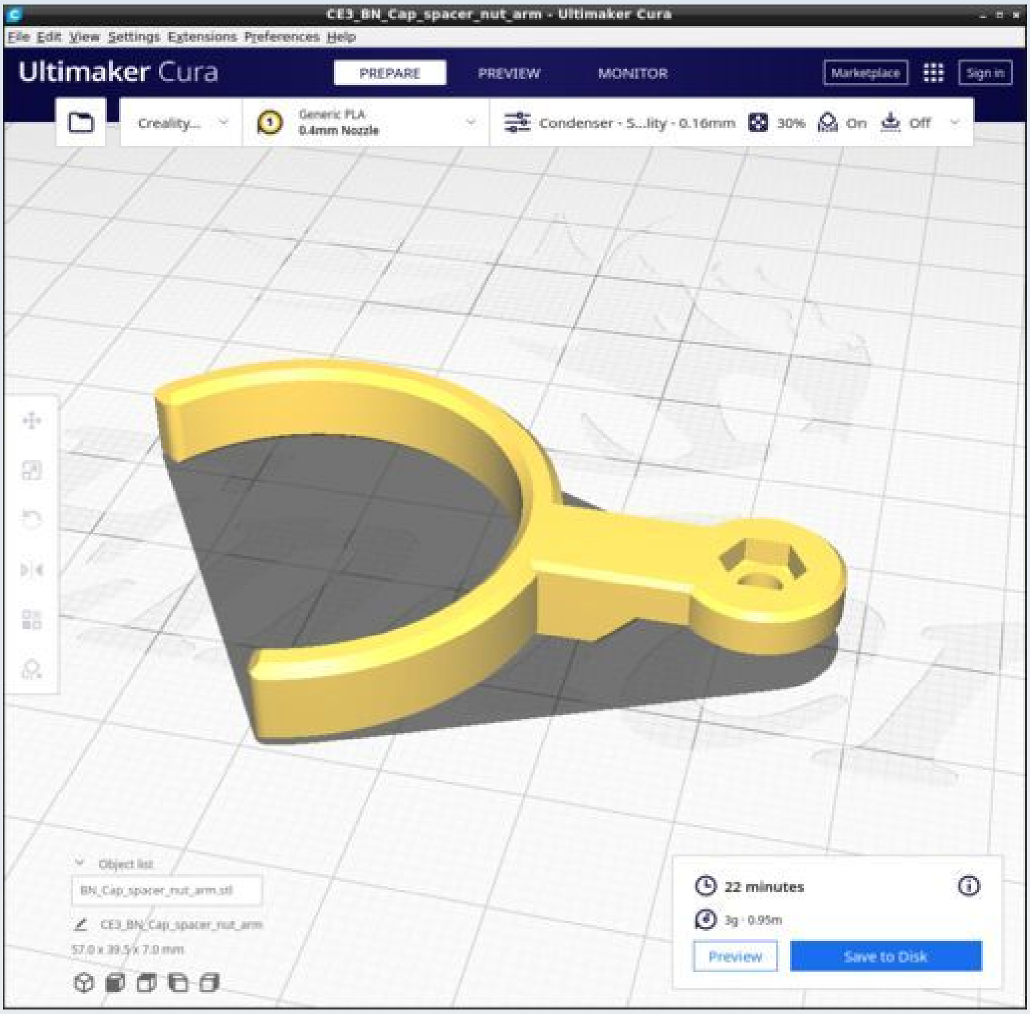
Cura calculates the following resources are required to print each model in this chapter:

Binocular_Head	Time_Hr	Time_Min	PLA_Length(m)
BN_Cap_spacer_bolt_arm	0	21	0.77
BN_Cap_spacer_nut_arm	0	22	0.95
BN_CM_BB_Cover	0	31	1.13
BN_CM_Tube_short_c_adhesin	0	41	1.69
BN_EM_Cover	0	21	0.87
BN_MB_Shim	0	5	0.08
BN_MBT_Cap	0	24	1
BN_MBT_Ring	0	21	0.64
BN_MB_Tube	1	50	3.68
BN_MB_Tube_spacer_2p5mm	0	12	0.28
BN_Mirror_mount_bottom	1	0	1.51
BN_Mirror_mount_top_ocular	1	31	2.84
BN_Ocular_spacer_ring_0p32	0	2	0.06
BN_Ocular_Base_thread_L	0	35	0.86
BN_Ocular_Base_thread_R	0	35	0.86
BN_Outlet_lower_spacer	0	0	0.02
BN_Outlet_upper	1	42	2.72
BN_Splitter_block	2	4	3.35
BN_Splitter_support	0	1	0.02

BN_Cap_spacer_bolt_arm

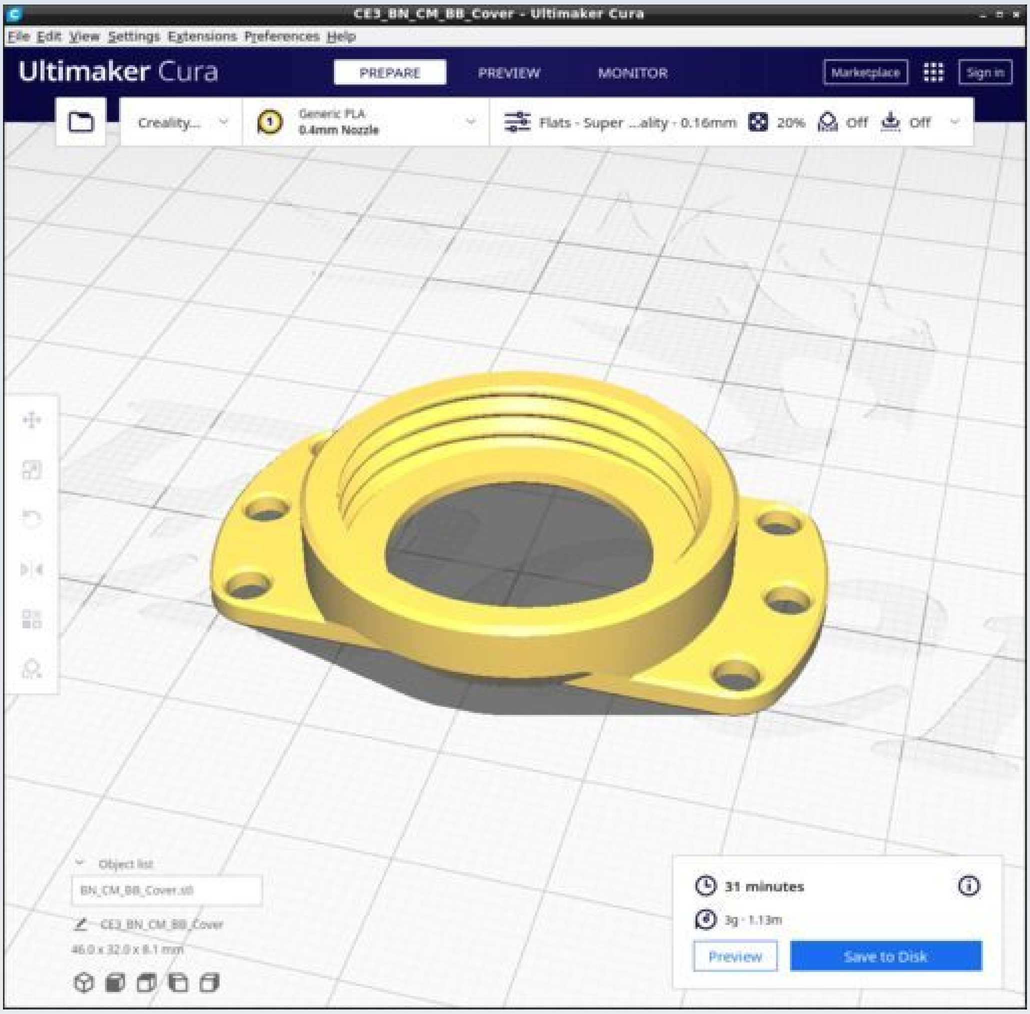


BN_Cap_spacer_nut_arm

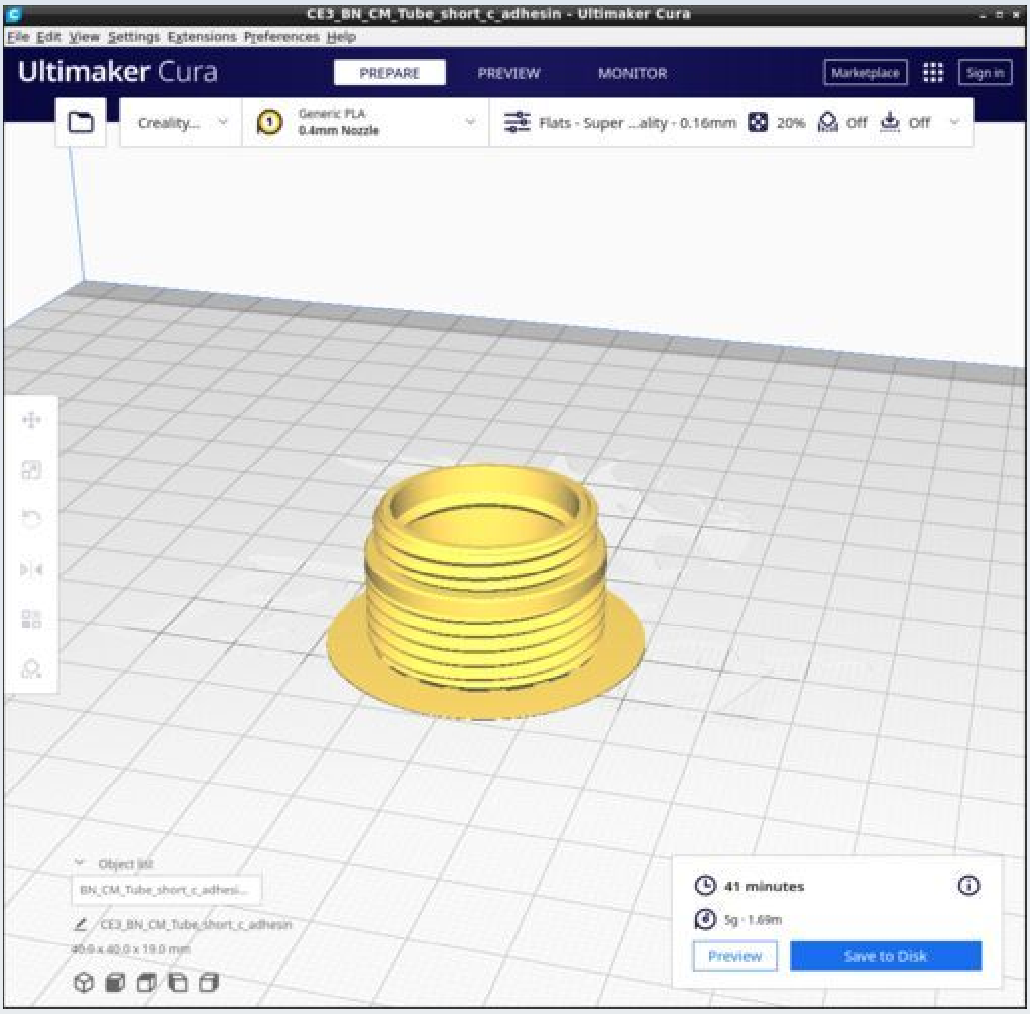


Use the Condenser profile (including its support settings).

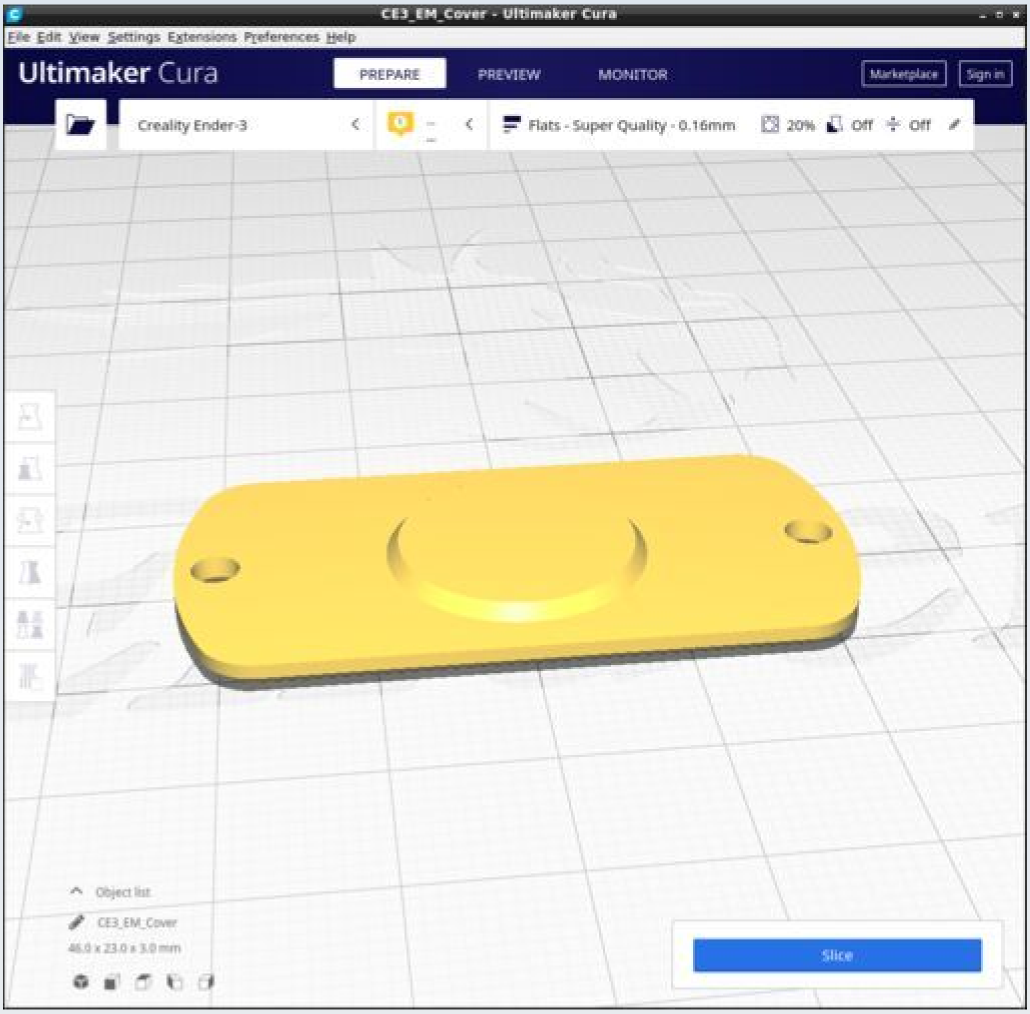
BN_CM_BB_Cover



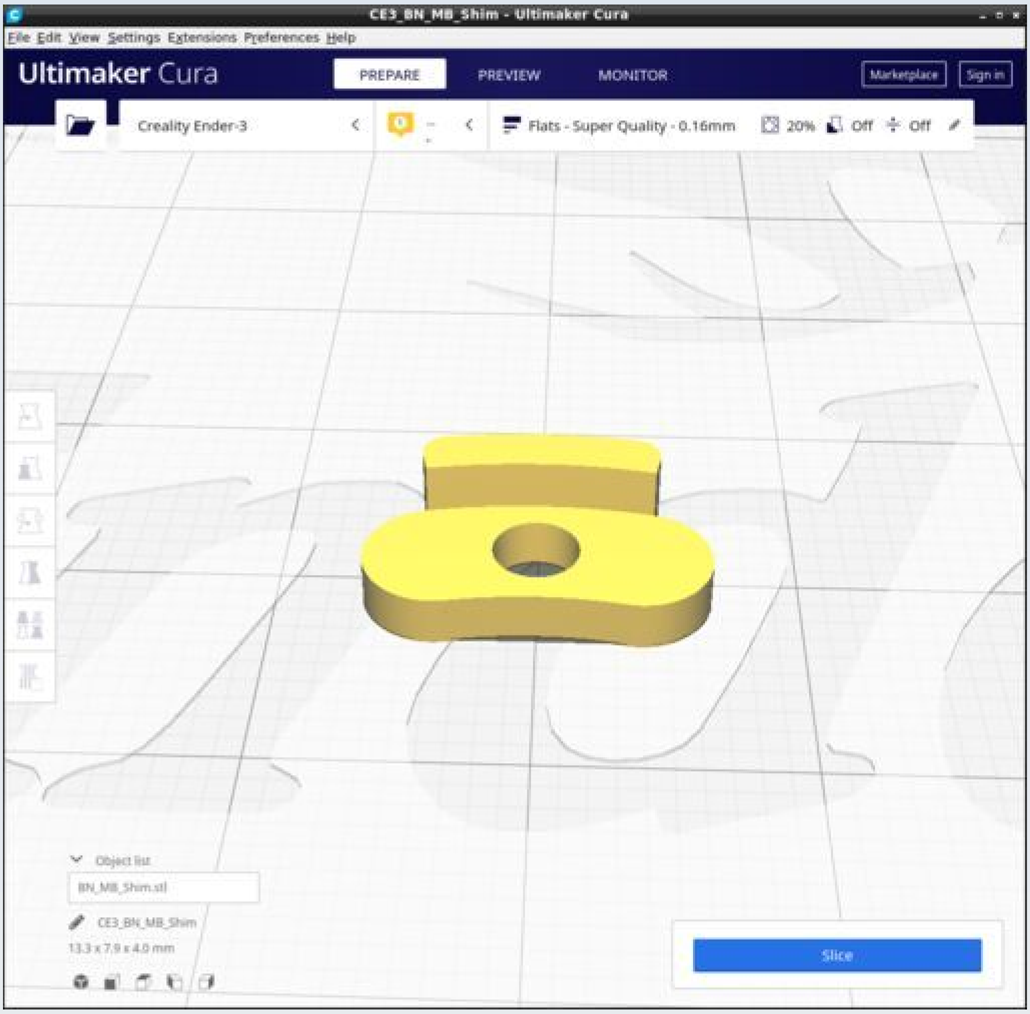
BN_CM_Tube_short_c_adhesin



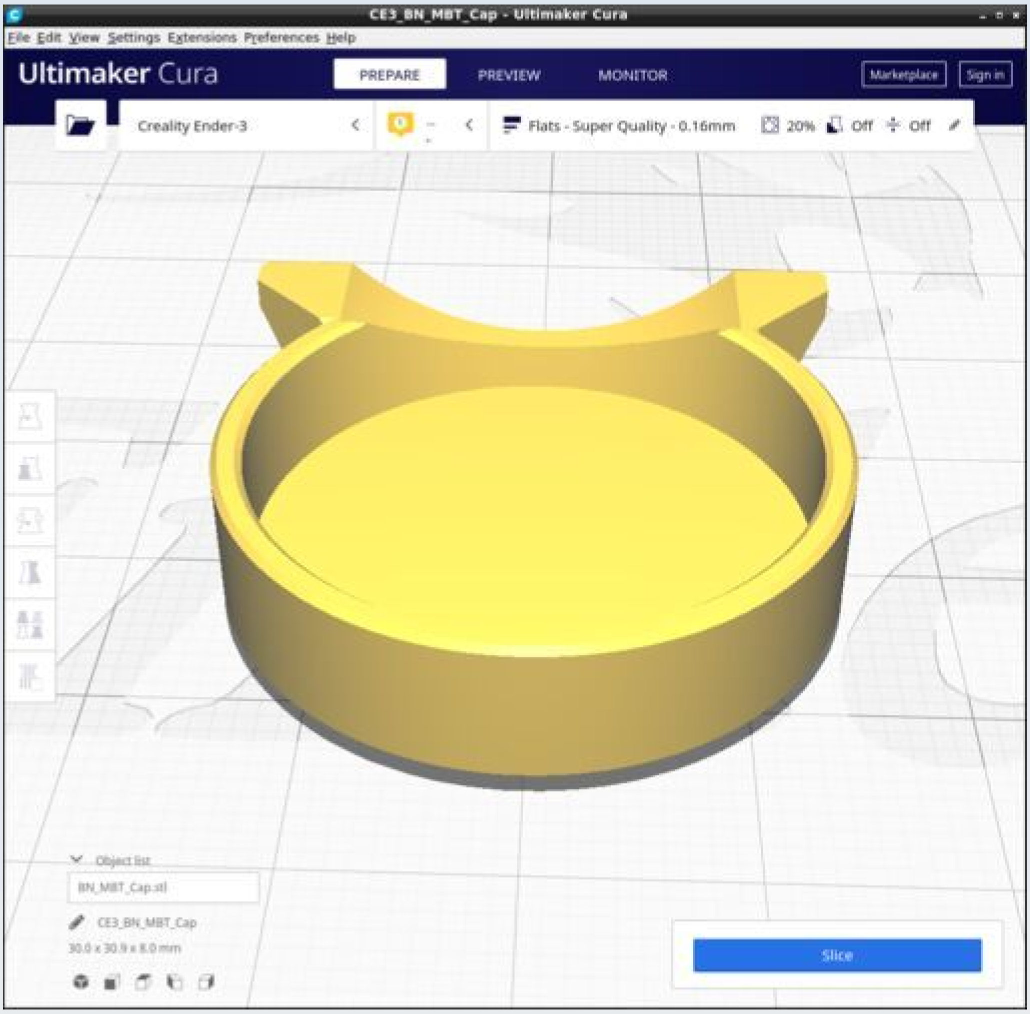
BN_EM_Cover


CE3_EM_Cover - Ultimaker Cura
File Edit View Settings Extensions Preferences Help
Ultimaker Cura
PREPARE
PREVIEW
MONITOR
Marketplace
Sign in
Creality Ender-3
Flats - Super Quality - 0.16mm
20%
Off
Off
Object list
CE3_EM_Cover
46.0 x 23.0 x 3.0 mm
Slice

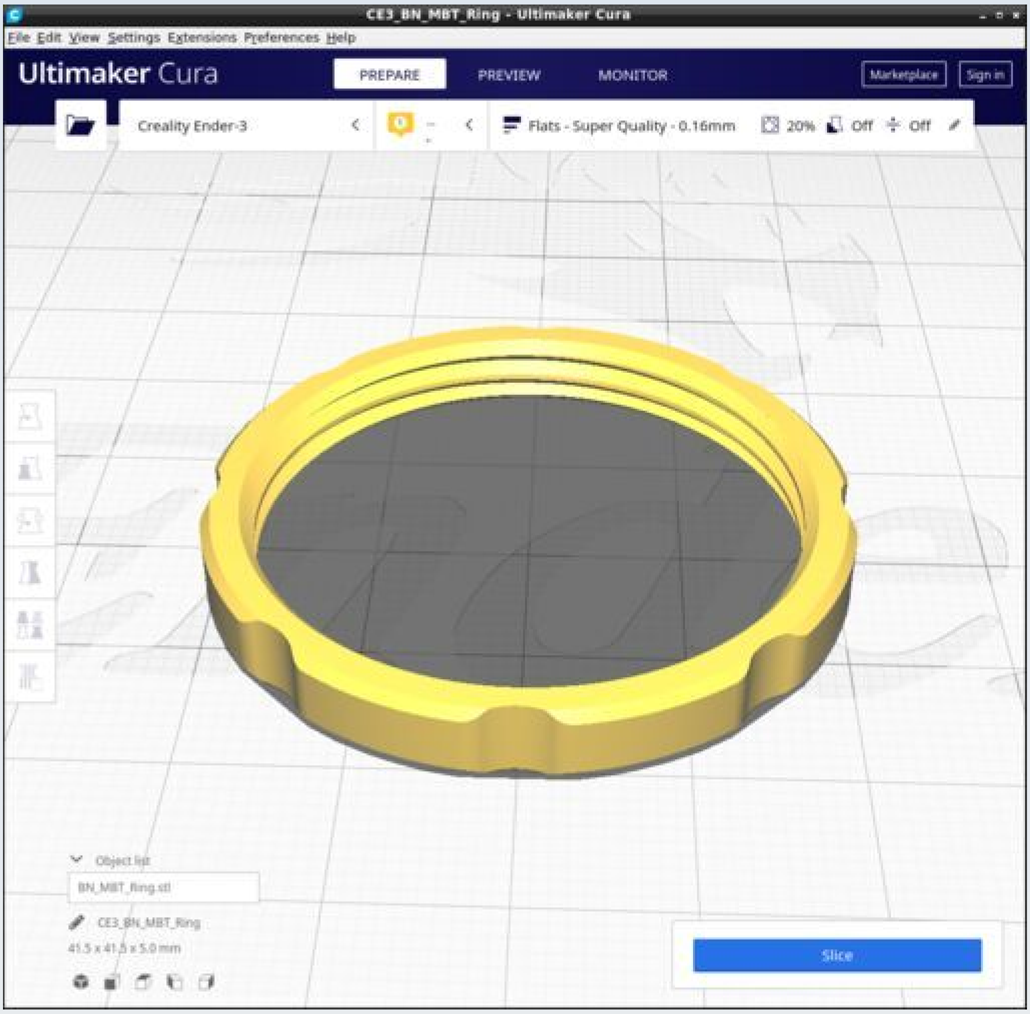
BN_MB_Shim


CE3_BN_MB_Shim - Ultimaker Cura
File Edit View Settings Extensions Preferences Help
Ultimaker Cura
PREPARE
PREVIEW
MONITOR
Marketplace
Sign in
Creality Ender-3
Flats - Super Quality - 0.16mm
20%
Off
Off
Object list
BN_MB_Shim.stl
CE3_BN_MB_Shim
13.3 x 7.9 x 4.0 mm
Slice

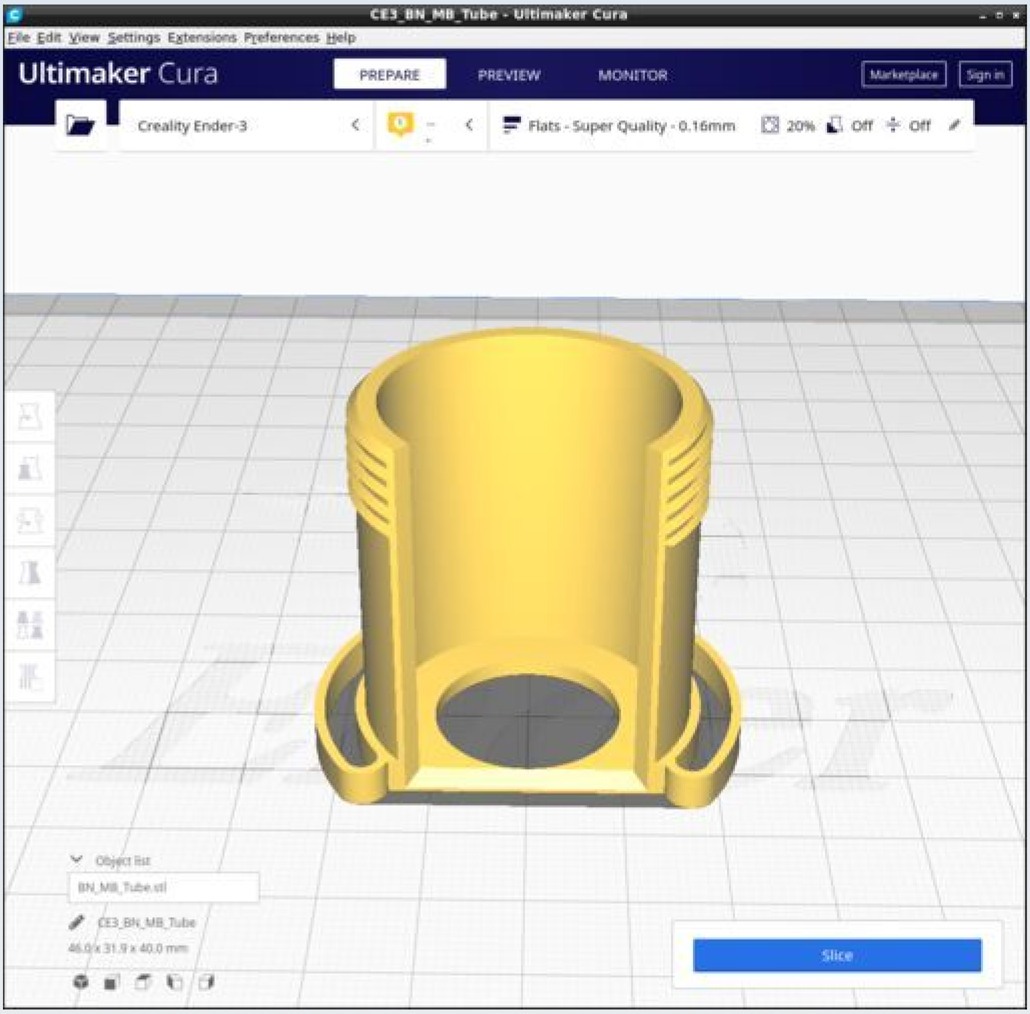
BN_MBT_Cap


CE3_BN_MBT_Cap - Ultimaker Cura
File Edit View Settings Extensions Preferences Help
Ultimaker Cura
PREPARE
PREVIEW
MONITOR
Marketplace
Sign in
Creality Ender-3
Flats - Super Quality - 0.16mm
20%
Off
Off
Object list
BN_MBT_Cap.stl
CE3_BN_MBT_Cap
30.0 x 30.9 x 8.0 mm
Slice

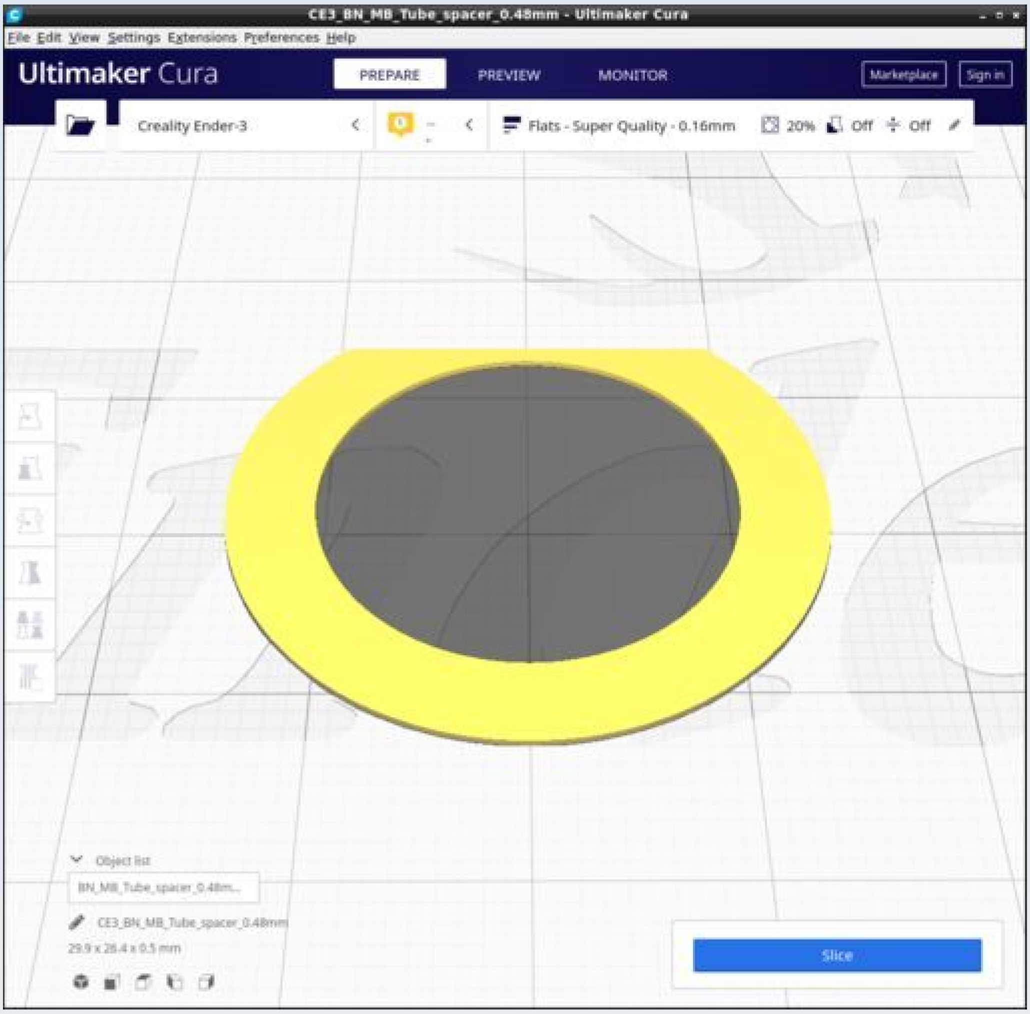
BN_MBT_Ring


CE3_BN_MBT_Ring - Ultimaker Cura
File Edit View Settings Extensions Preferences Help
Ultimaker Cura
PREPARE
PREVIEW
MONITOR
Marketplace
Sign in
Creality Ender-3
Flats - Super Quality - 0.16mm
20%
Off
Off
Object list
BN_MBT_Ring.stl
CE3_BN_MBT_Ring
41.5 x 41.5 x 5.0 mm
Slice

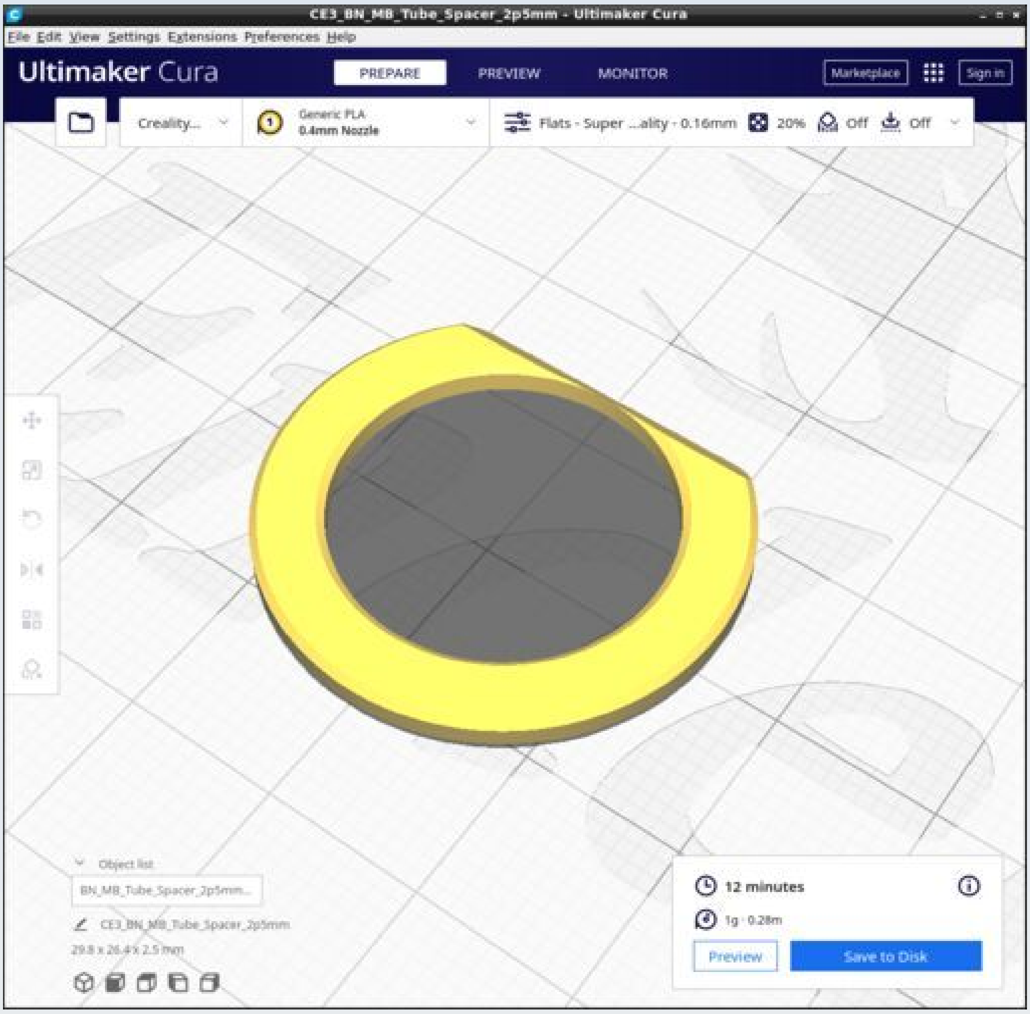
BN_MB_Tube


CE3_BN_MB_Tube - Ultimaker Cura
File Edit View Settings Extensions Preferences Help
Ultimaker Cura
PREPARE
PREVIEW
MONITOR
Marketplace
Sign in
Creality Ender-3
Flats - Super Quality - 0.16mm
20%
Off
Off
Object list
BN_MB_Tube.stl
CE3_BN_MB_Tube
46.0 x 31.9 x 40.0 mm
Slice

BN_MB_Tube_spacer_0p48mm

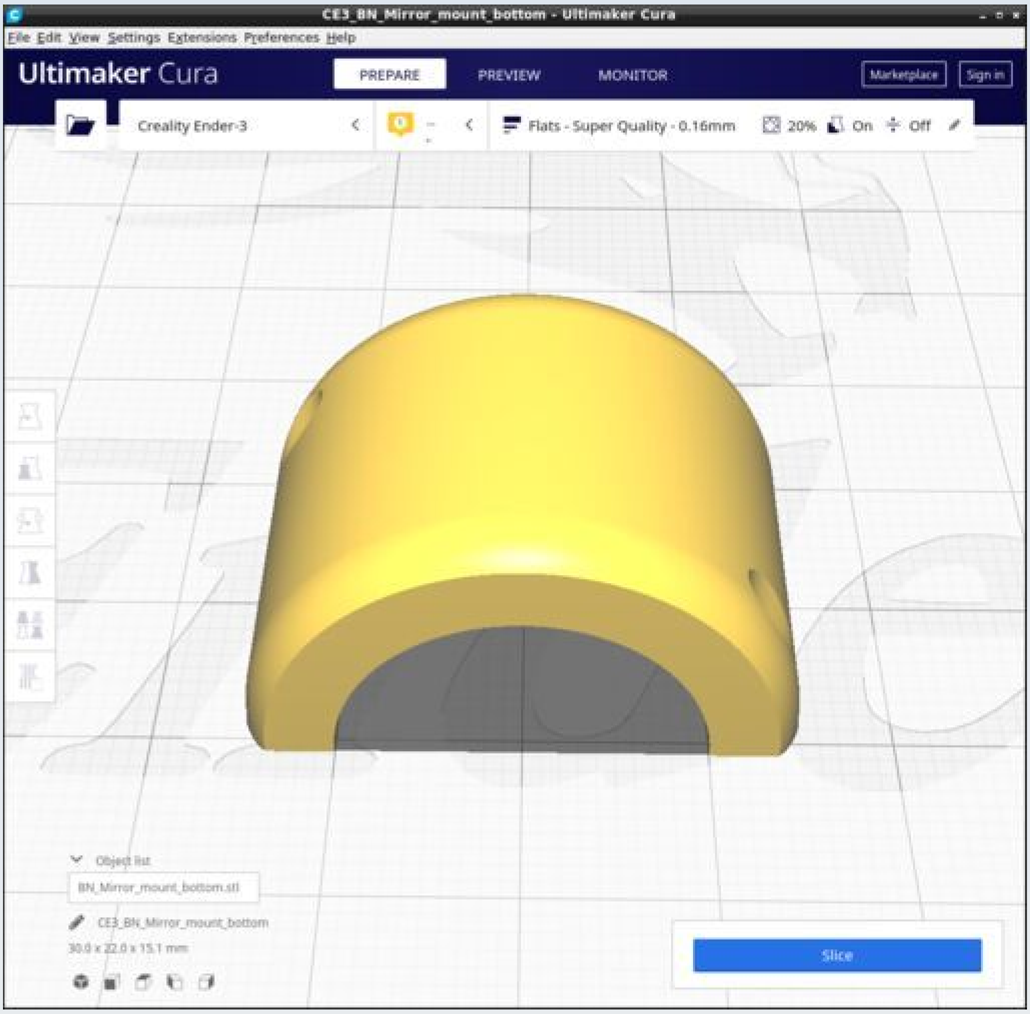


BN_MB_Tube_spacer_2p5mm



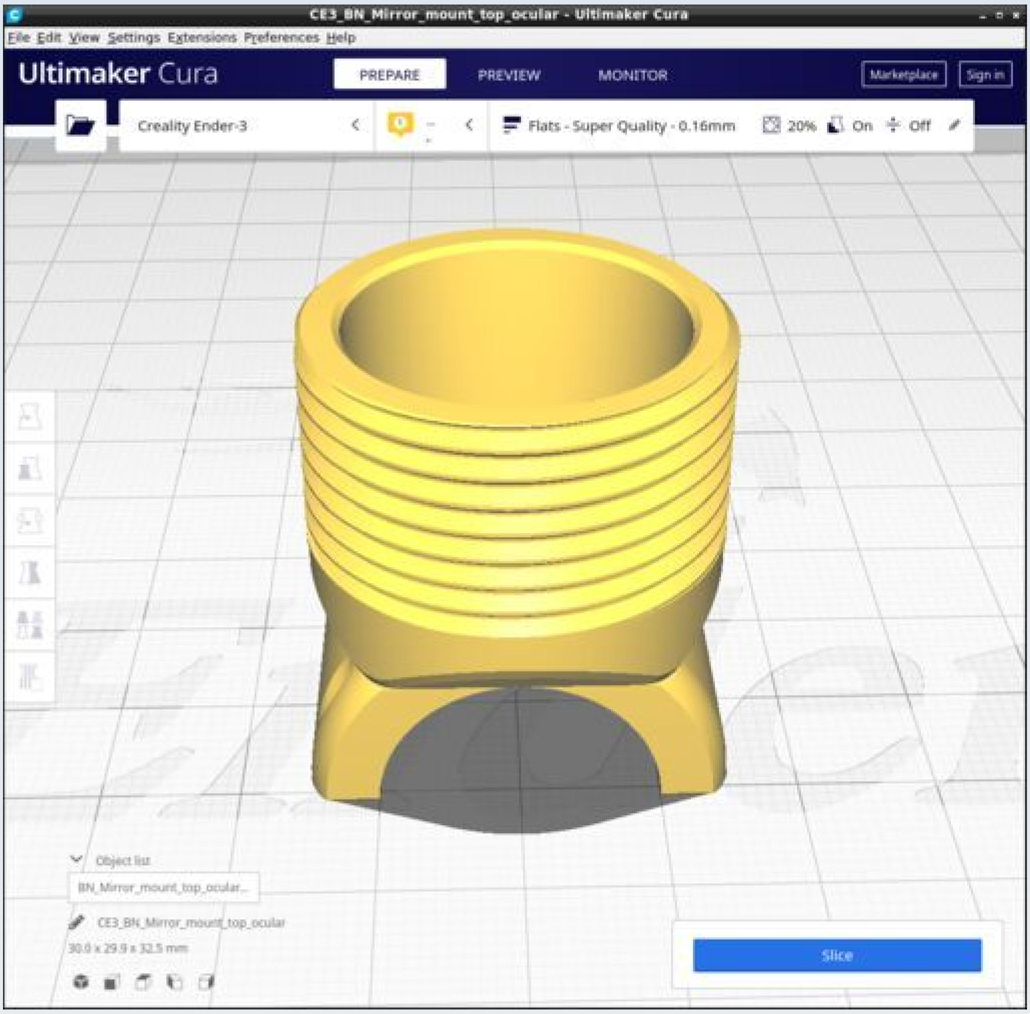
This is just one example from a range of MB_Tube_spacers of various thicknesses.

BN_Mirror_mount_bottom



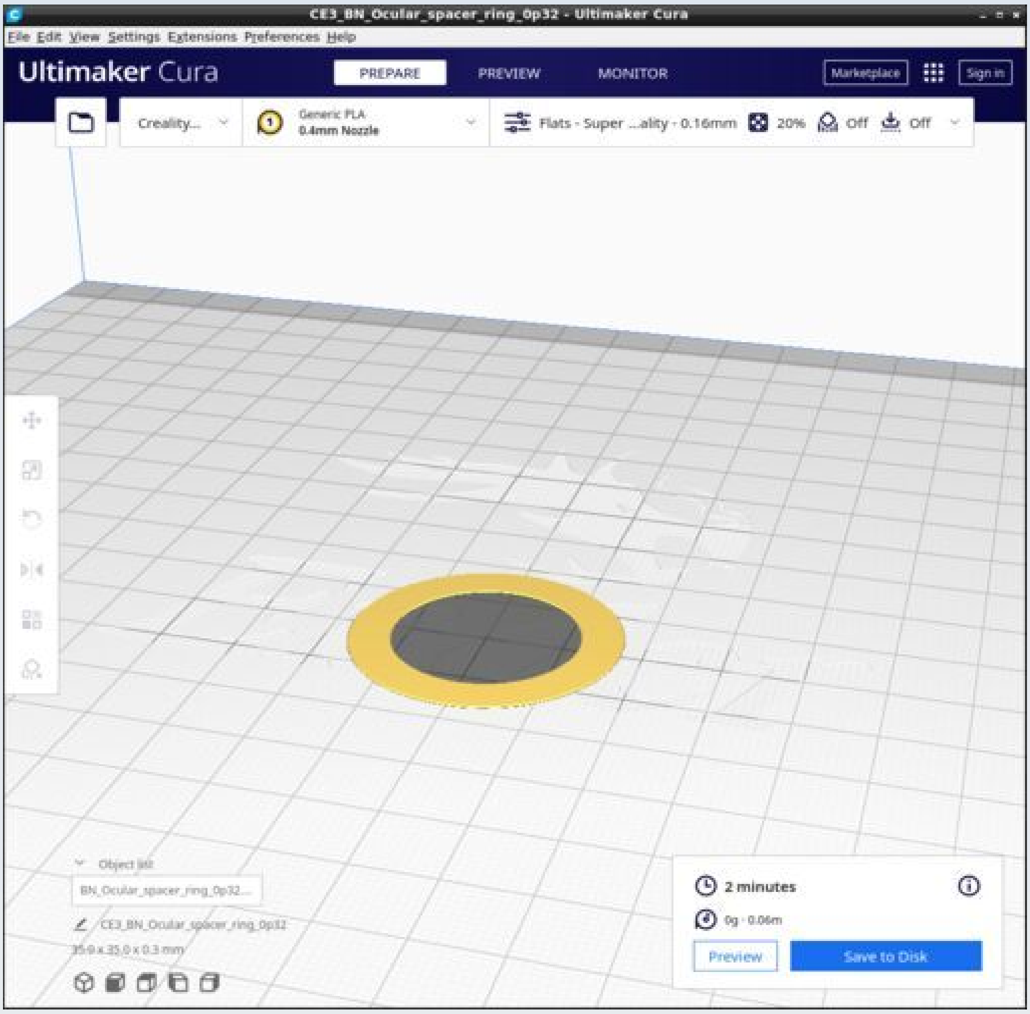
Select suports 'touching build plate only' (not 'Everywhere').

BN_Mirror_mount_top_ocular



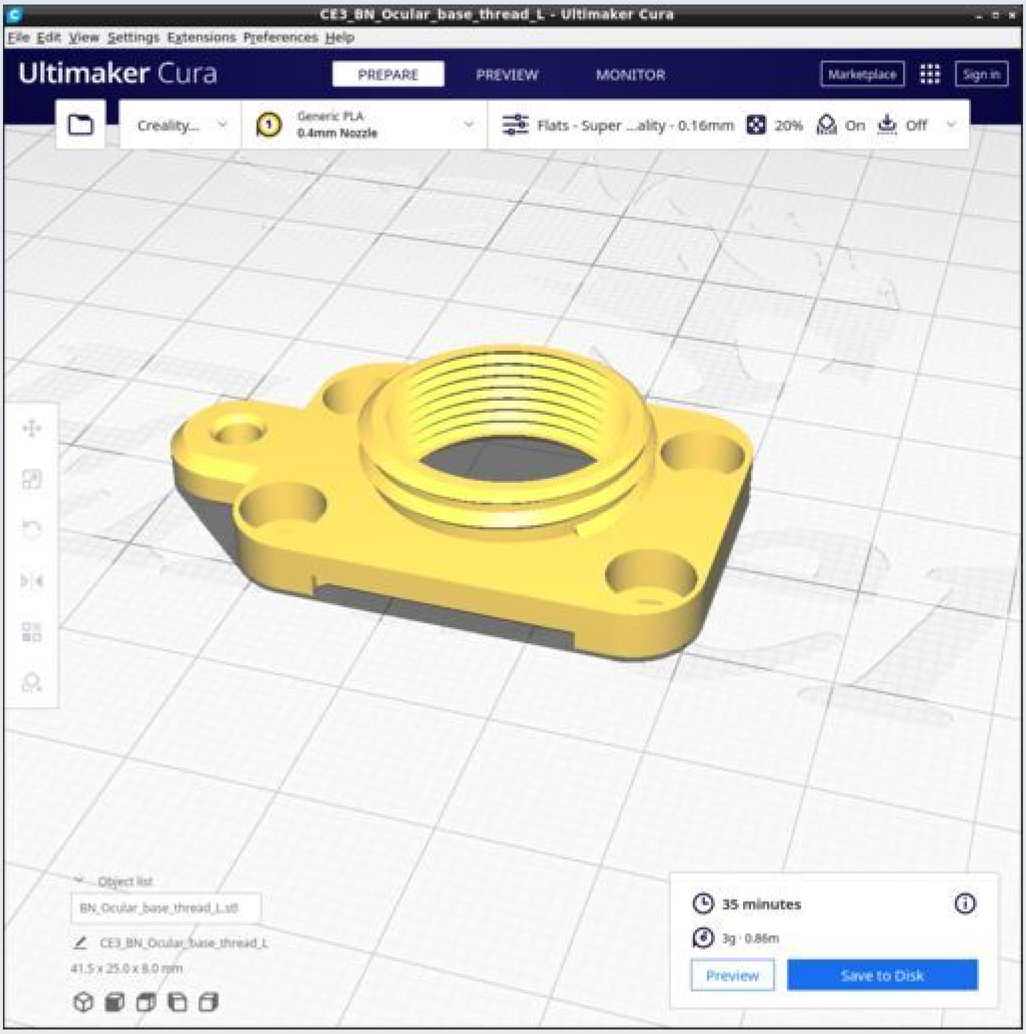
Select suports 'touching build plate only' (not 'Everywhere').

BN_Ocular_spacer_ring_0p32



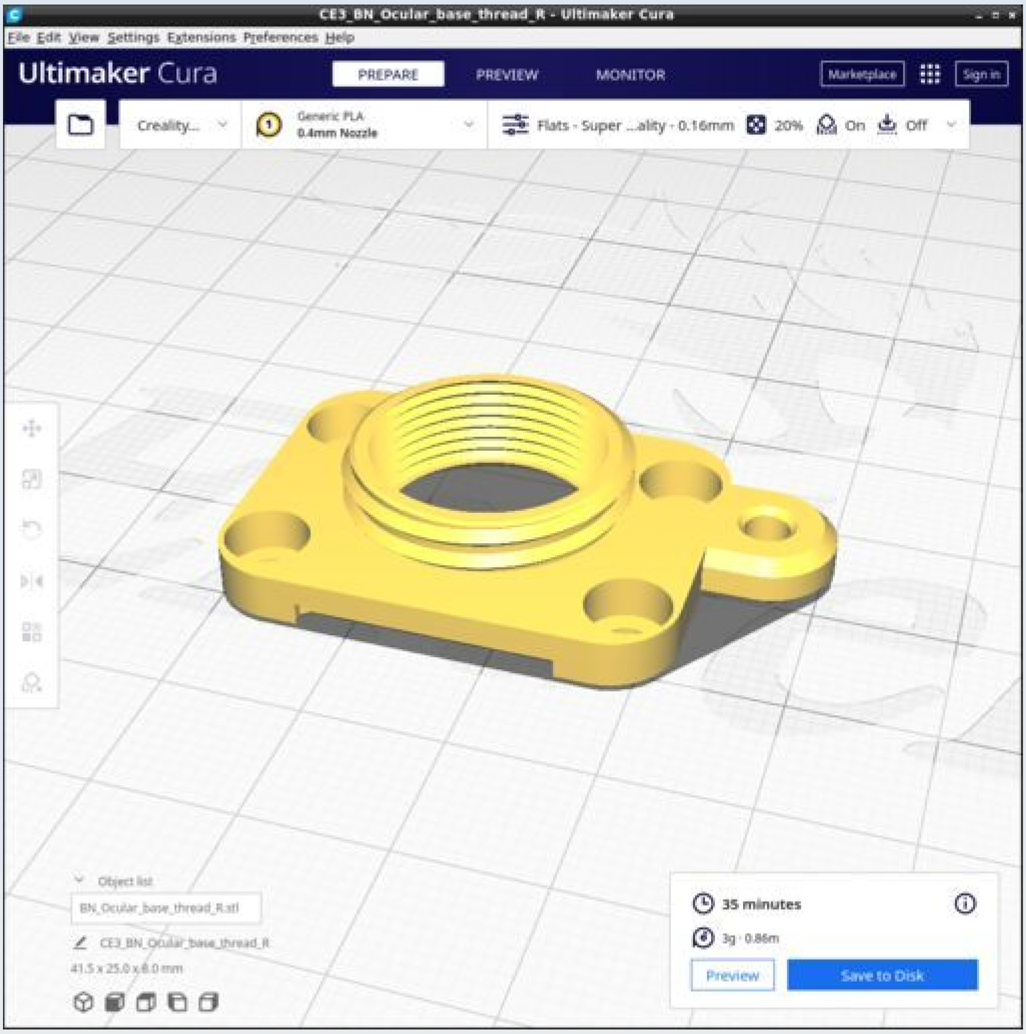
Use 'Top/bottom pattern'='Concentric' in the Top/Bottom' settings

BN_Ocular_Base_thread_L



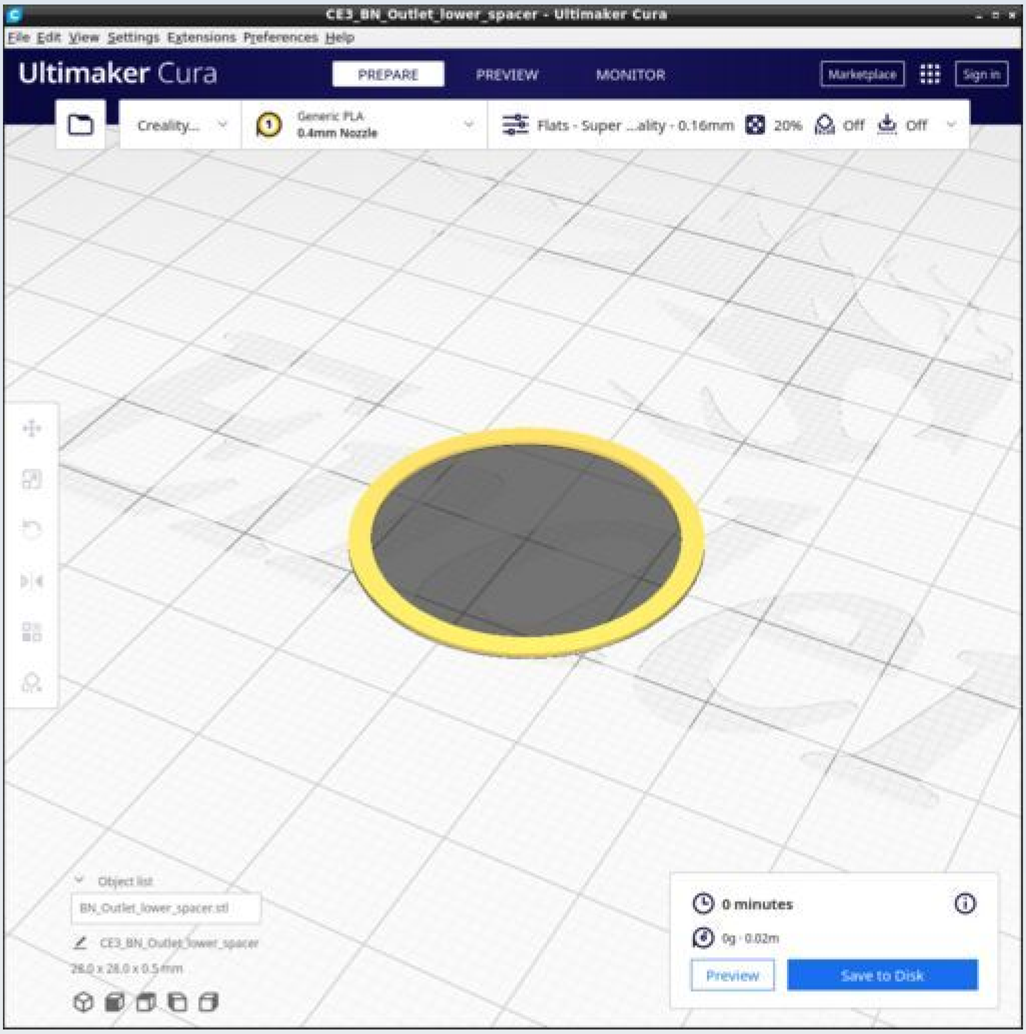
Select suports 'touching build plate only' (not 'Everywhere').

BN_Ocular_Base_thread_R

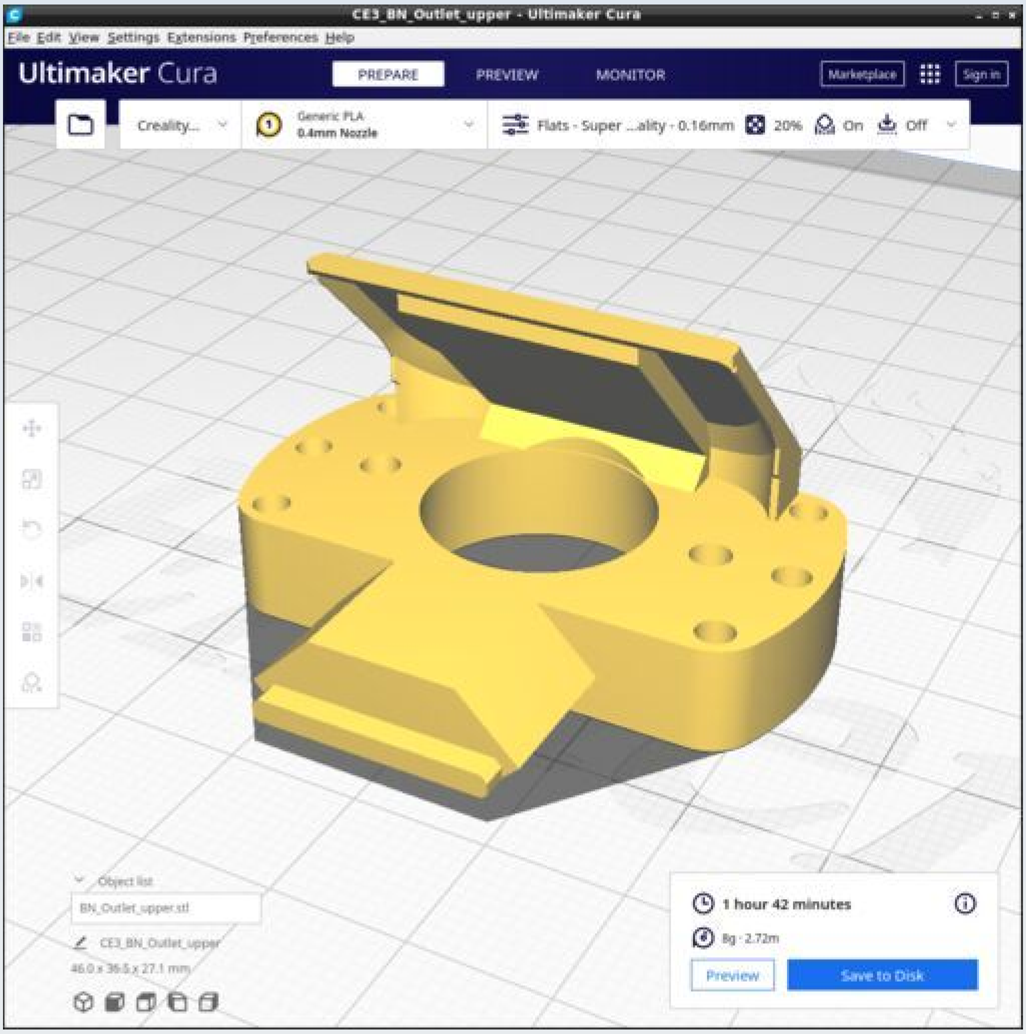


Select suports 'touching build plate only' (not 'Everywhere').

BN_Outlet_lower_spacer

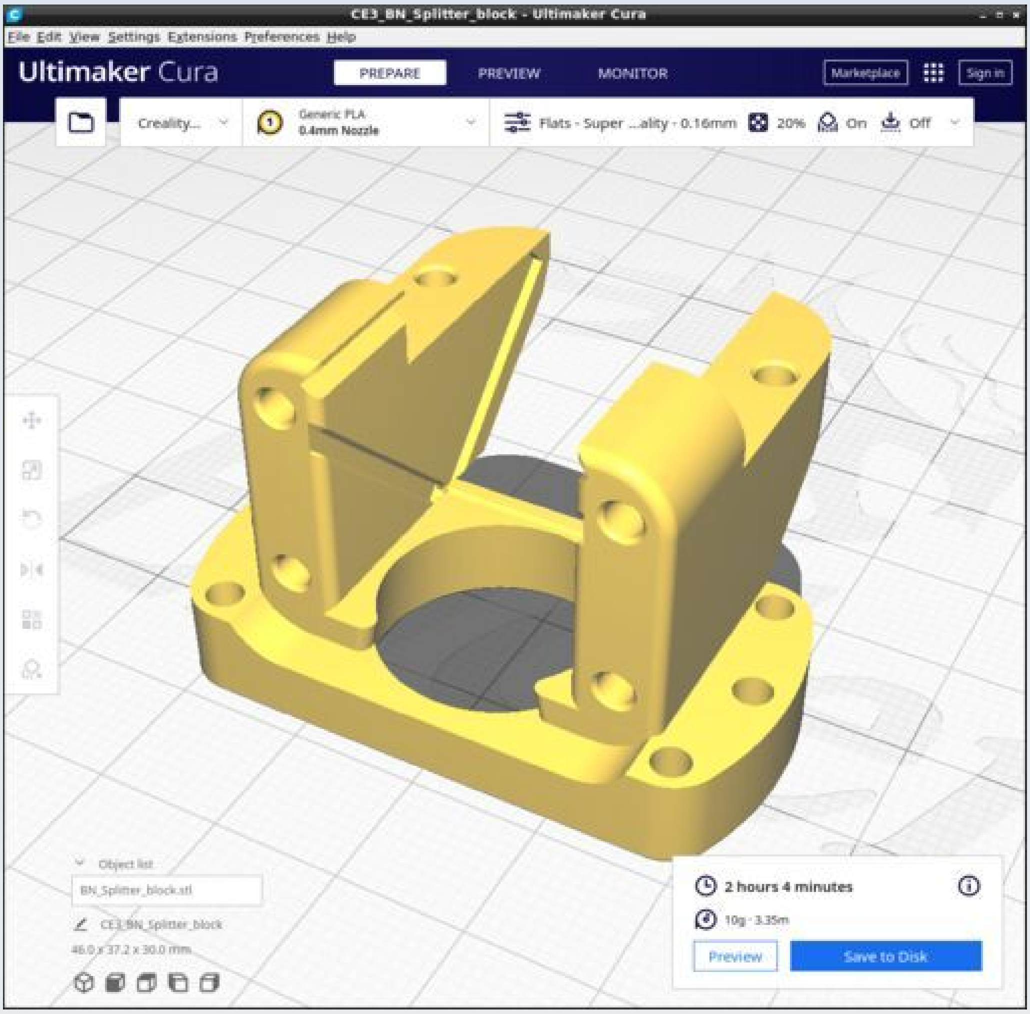


BN_Outlet_upper



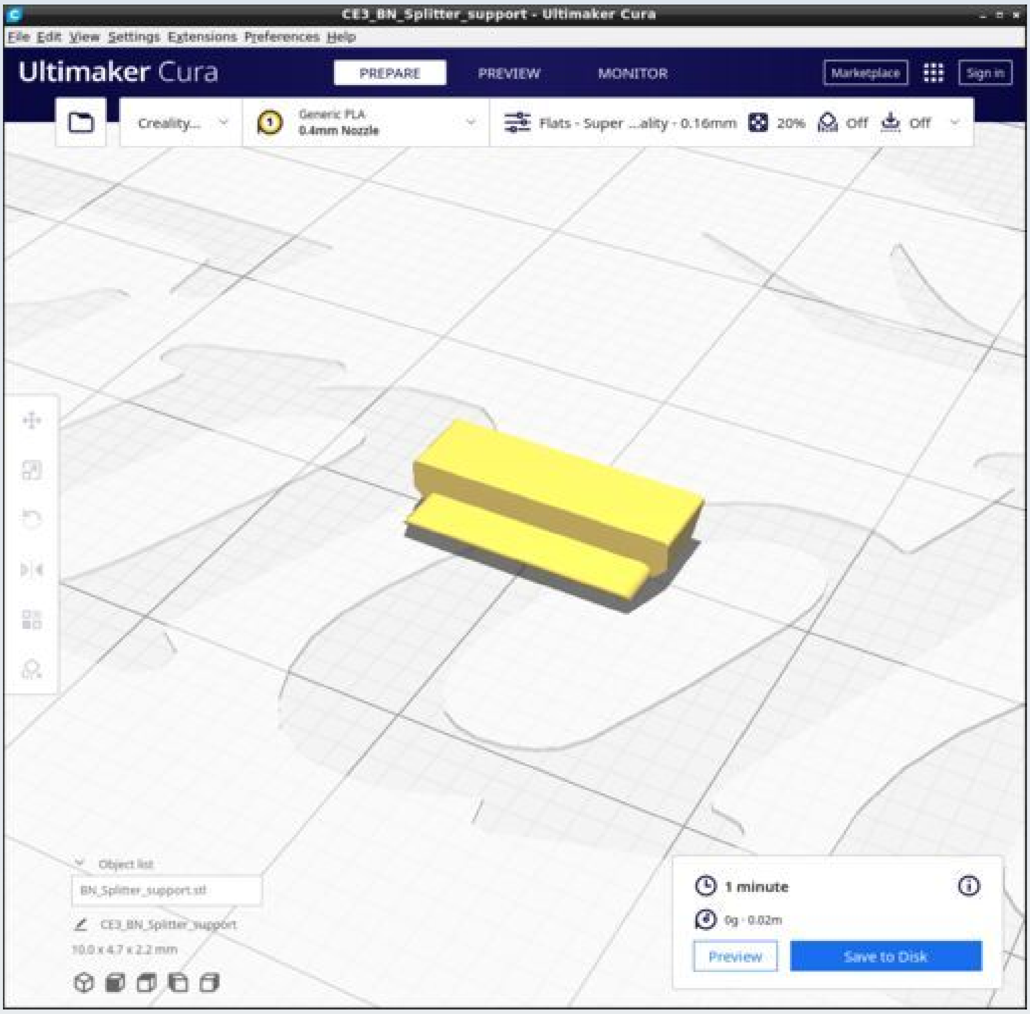
Use supports of 'Tree' type 'touching build plate only' (not 'Everywhere') and change the default for 'tree support branch distance' from 1.0 mm to 0.2 mm.

BN_Splitter_block



Select suports 'touching build plate only' (not 'Everywhere').

BN_Splitter_support



Dominus Illumination System

These are parts for the modular illumination system of the microscope.

The illumination system includes an extensive range of modules for various types of illumination and has many more models than other apsects of the PUMA microscopy system. If all placed in 1 file it would go over the 25 MB limit for files on GitHub so these models are split into 3 separate FreeCAD files: Dominus_part1.FCStd, Dominus_part2.FCStd and Dominus_part3.FCStd.

Also, because there are so many models, to make it easier for users to identify which file a particular model is in I have put the models into separate functionally related groups within each file and a list of where each model can be found is given below. Note that some modules require models from different functional groups and the instructional videos and other 'How To' documentation will make it clear what models are needed to build any particular illumination module.

Location of the models

File: Dominus_part1.FCStd

Group: LED_Housing

LED_Washer

LED_Cover

LED_Holder

Group: Mirror_illumination

Mirror_suspend_plain

Mirror_to_baseplate

Mirror_holder_plain

Cnd_mirror_holder_socket

Daylight_Kohler_adaptor

Group: IFD

IFD_Threadlock

IFD_Tray

Field_Stop_Round

Field_Stop_Rectangle

IFD_Filter_Crosshairs

IFD_Extension_c_adhesin

M3_Adjustment_ring_Kohler

Group: Lower_Collector

LC_Cap

LC_Receptacle

LC_Adjust_collar

LC_Collar_2

LC_Collar_7

LC_Spacer

Group: Tools

Tool_23

Tool_44

Group: Low_Power_Collimator

IFD_Adapter

IFD_Threadjoiner

Ferrule_46_c_adhesin

LPC_Single_23

LPC_Lensholder

LPC_Lens_retainer

LPC_Lenseless_23

Group: M3_Thumbscrews

M3_Thumbscrew_short_hex

Sub-group: M3_Thumbscrew_tall

M3_knob

File: Dominus_part2.FCStd

Group: IAD

IAD_SLM_Cover

IAD_SLM_Filter

IAD_AP_DF_Stop_oil_20

IAD_AP_Phase180_oil

IAD_Filter_tray_oil

IAD_AP_DF_Stop_2p5

IAD_AP_DF_Stop_11

IAD_AP_DF_Stop_10

IAD_AP_DF_Stop_12

IAD_AP_Phase180

IAD_Filter_Tray

IAD_Tray

IAD_Filter_template

IAD_AP_25mm_oil

Group: Upper_Collector

UC_Spacer

UC_Retention_Cap

Cnd_to_UC_long

Cnd_to_UC

Group: Intercollector_Mirror_block

Mirror_block_spacer

Proximal_collector_attachment

Collector_mirror_block

Group: Polariser_Condenser

Pol_to_baseplate

Pol_Receptacle

Pol_top_bottom

Pol_middle

Pol_Adjustment_ring

Uber_pol

Group: Epi_Illumination

Epi_Cnd_Aperture_10

Epi_Cnd_Aperture_04

Epi_Cnd_Aperture_13

Epi_condenser

Epi_condenser

Epi_attachment

M3_Adjustment_ring

Epi_black_body

Epi_pol

Group: Abbe_Condenser

Cnd_Adj_thumbwheel

Cnd_protector_cap

Cnd_Crosshair_Cap_c_adhesin

Cnd_gripper

Cnd_Flange_Spacer_0p48
Condenser_base
Condenser_23_30

File: Dominus_part3.FCStd

Group: HNA_Illuminator001

HNA_Illuminator
HNA_Diffuser
HNA_Flange_Spacer_0p48

Group: Plane_Wave_Generator

PWG_Pinhole_plain
PWG_Pinhole_mount
PWG_Tripod
PWG_CM_Aperture_12
PWG_Pinhole_mount_washer
PWG_Pinhole_presser_c_adhesin
PWG_Front_stop_12
PWG_Front_stop_16
PWG_WindowCap_c_adhesin
PWG_RMS_to_LC_c_adhesin
PWG_Pinhole_mount_well_c_adhesin

Group: Youngs_Slits

Youngs_slit
Youngs_frame

Resources

Cura calculates the following resources are required to print each model in this chapter:

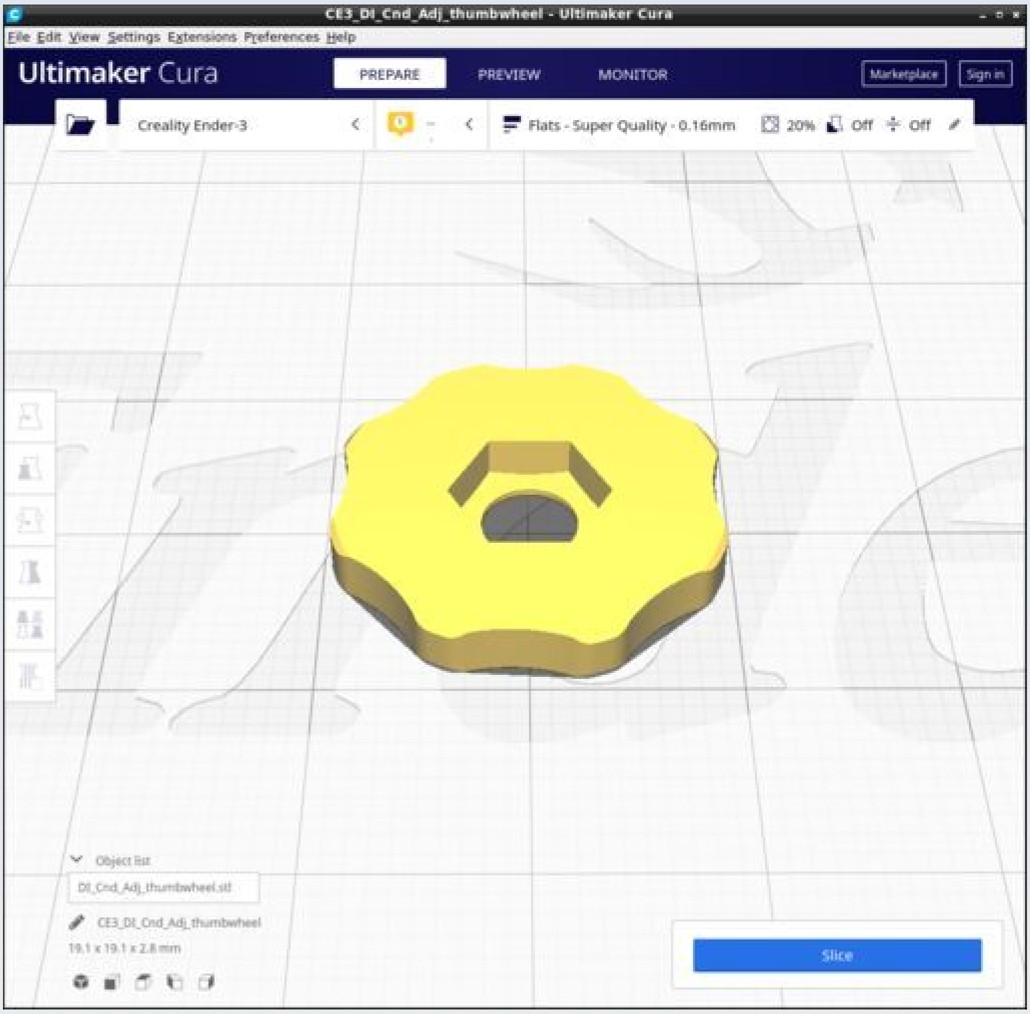
Dominus_Illuminator	Time_Hr	Time_Min	PLA_Length(m)
DI_Cnd_Adj_thumbwheel	0	8	0.26
DI_Cnd_Crosshair_Cap_c_adhesin	0	21	0.87
DI_Cnd_Flange_Spacer_0p48	0	5	0.19
DI_Cnd_gripper	1	30	3.69
DI_Cnd_Mirror_holder_socket	1	33	4.43

DI_Cnd_protector_cap	0	22	0.98
DI_Cnd_to_UC	0	47	2.89
DI_Cnd_to_UC_long	1	8	3.87
DI_Collector_mirror_block	5	9	12.51
DI_Condenser_23_30	2	31	5.94
DI_Condenser_base	0	46	1.38
DI_Daylight_Kohler_adaptor	1	17	3.25
DI_Epi_attachment	0	47	1.84
DI_Epi_black_body	1	33	4.14
DI_Epi_cap	0	13	0.58
DI_Epi_Cnd_Aperture_04	0	4	0.15
DI_Epi_Cnd_Aperture_10	0	3	0.1
DI_Epi_Cnd_Aperture_13	0	2	0.07
DI_Epi_condenser	2	30	6.23
DI_Epi_pol	0	58	2.02
DI_Ferrule_46_c_adhesin	1	16	4.08
DI_Field_Stop_Rectangle	0	3	0.12
DI_Field_Stop_Round	0	3	0.11
DI_HNA_Diffuser	0	24	0.93
DI_HNA_Flange_Spacer_0p48	0	4	0.14
DI_HNA_Illuminator	0	58	3.08
DI_IAD_AP_25mm_oil	0	1	0.05
DI_IAD_AP_DF_Stop_10	0	1	0.04
DI_IAD_AP_DF_Stop_11	0	1	0.04
DI_IAD_AP_DF_Stop_12	0	1	0.05
DI_IAD_AP_DF_Stop_2p5	0	1	0.03
DI_IAD_AP_DF_Stop_oil_20	0	2	0.08
DI_IAD_AP_Phase180_oil	0	2	0.08
DI_IAD_AP_Phase180	0	1	0.06
DI_IAD_Filter_Tray_oil	0	33	1.41
DI_IAD_Filter_Tray	0	37	1.64
DI_IAD_SLM_Cover	0	19	0.76
DI_IAD_SLM_Filter	0	29	0.93

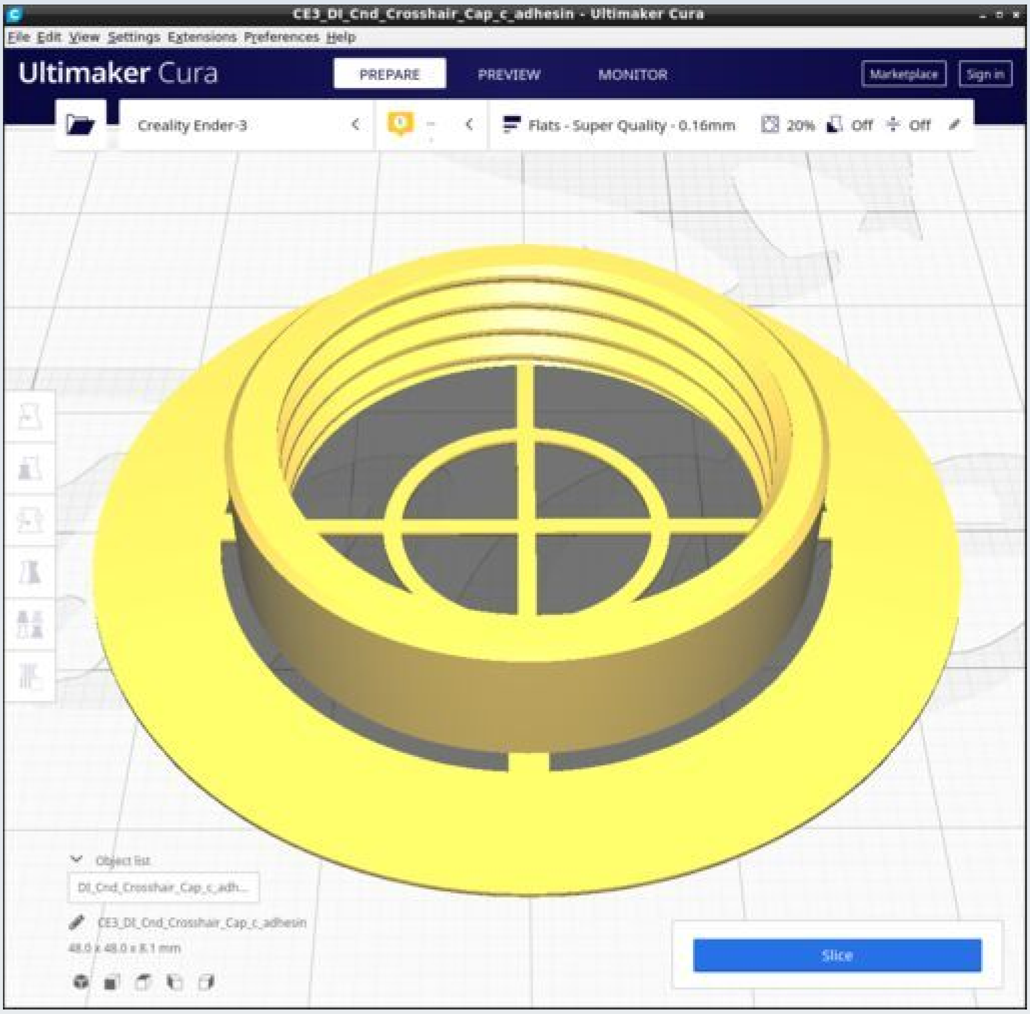
DI_IAD_Tray	0	27	0.72
DI_IFD_Adapter	1	5	2.88
DI_IFD_Extension_c_adhesin	2	10	7.28
DI_IFD_Filter_crosshairs	0	37	1.59
DI_IFD_Threadjoiner	0	50	1.8
DI_IFD_Threadlock	0	24	0.84
DI_IFD_Tray	2	2	4
DI_LC_Adjust_collar	0	20	0.88
DI_LC_Cap	0	21	1.02
DI_LC_Collar_2	0	2	0.07
DI_LC_Collar_7	0	7	0.22
DI_LC_Receptacle	0	21	0.77
DI_LC_Spacer	0	16	0.44
DI_LED_Cover	0	34	0.87
DI_LED_Holder	0	57	1.87
DI_LED_Washer	0	2	0.06
DI_LPC_Lensholder	0	16	0.54
DI_LPC_Lens_retainer	0	10	0.38
DI_LPC_Lenseless_23	0	31	1.08
DI_LPC_Single_23	0	22	0.81
DI_M3_Adjustment_ring	1	7	2.35
DI_M3_Adjustment_ring_Kohler	2	11	5.2
DI_M3_Thumbscrew_short_hex	0	8	0.14
DI_M3_Thumbscrew_tall	0	19	0.29
DI_Mirror_block_spacer	0	52	1.73
DI_Mirror_holder_plain	1	0	2.45
DI_Mirror_suspend_plain	1	34	3.18
DI_Mirror_to_baseplate	0	49	1.88
DI_Pol_Adjustment_ring	1	22	2.58
DI_Pol_middle	0	5	0.16
DI_Pol_Receptacle	0	46	1.28
DI_Pol_to_baseplate	2	19	4.88
DI_Pol_top_bottom	0	7	0.25

DI_Proximal_collector_attachment	0	38	1.32
DI_PWG_CM_Aperture_12	0	2	0.06
DI_PWG_Pinhole_plain	0	5	0.24
DI_PWG_Pinhole_mount	0	5	0.24
DI_PWG_Pinhole_mount_washer	0	5	0.15
DI_PWG_Front_stop_16	0	18	0.91
DI_PWG_Front_stop_12	0	20	1
DI_PWG_Pinhole_mount_well	0	41	1.43
DI_PWG_Pinhole_presser	0	25	1.17
DI_PWG_RMS_to_LC	0	29	1.35
DI_PWG_Tripod	0	58	2.14
DI_PWG_WindowCap	0	14	0.6
DI_Tool_23	0	24	1.14
DI_Tool_44	0	28	0.84
DI_UC_Retention_Cap	0	10	0.59
DI_UC_Spacer	0	1	0.05
DI_Uber_pol	0	12	0.19

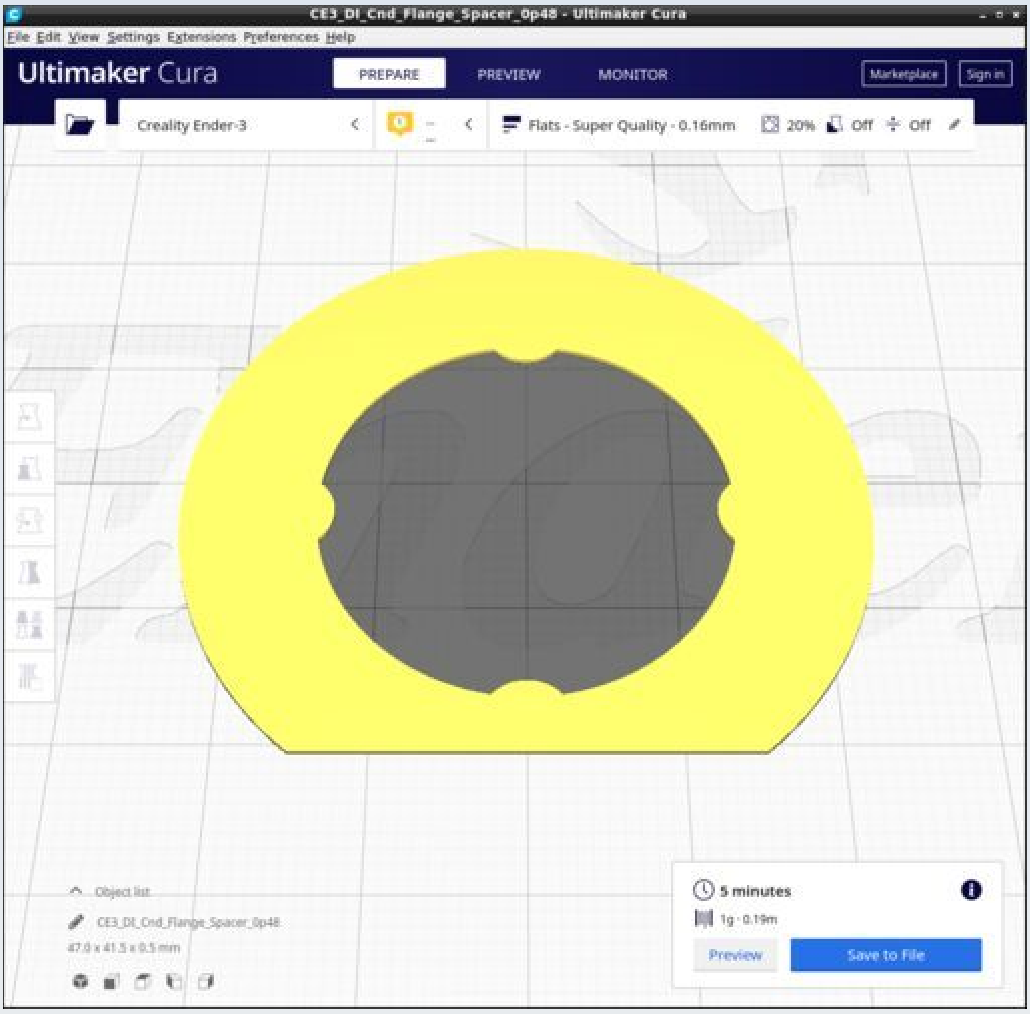
DI_Cnd_Adj_thumbwheel



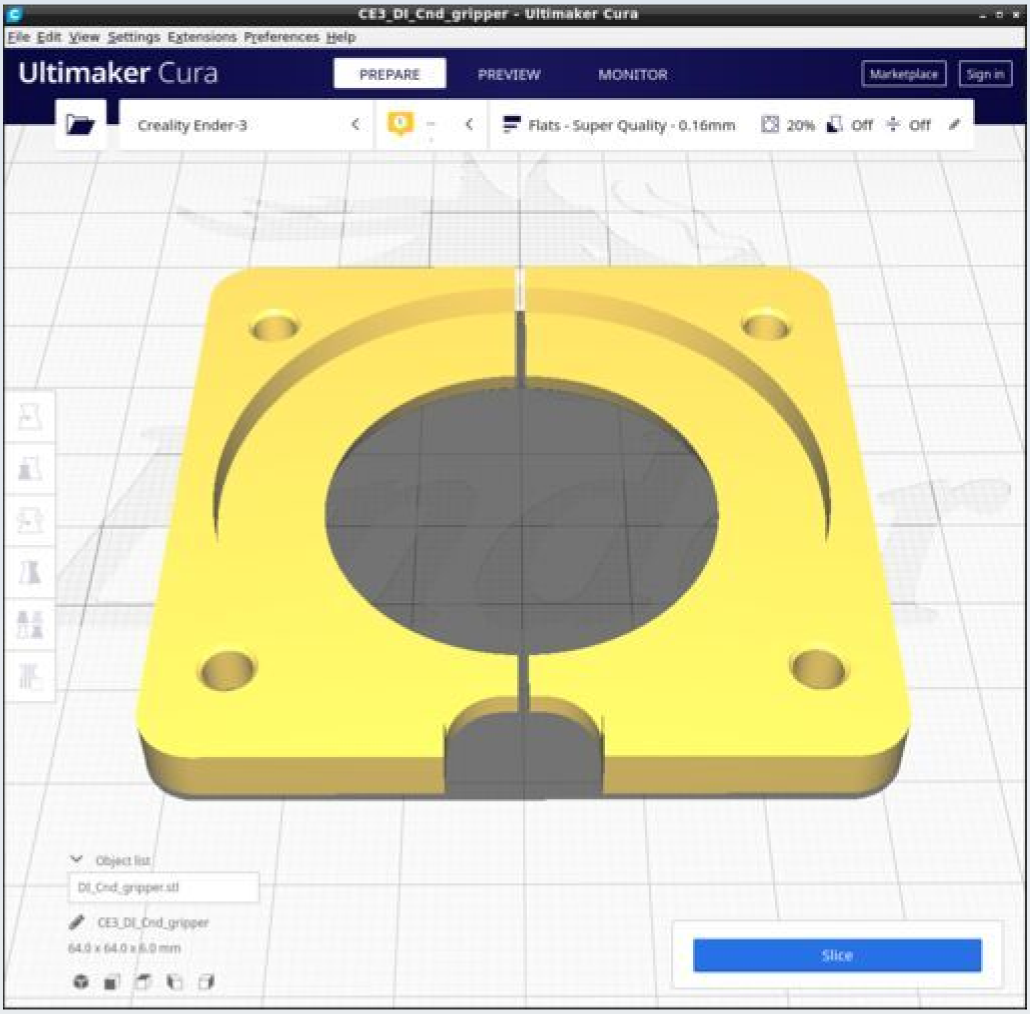
DI_Cnd_Crosshair_Cap_c_adhesin



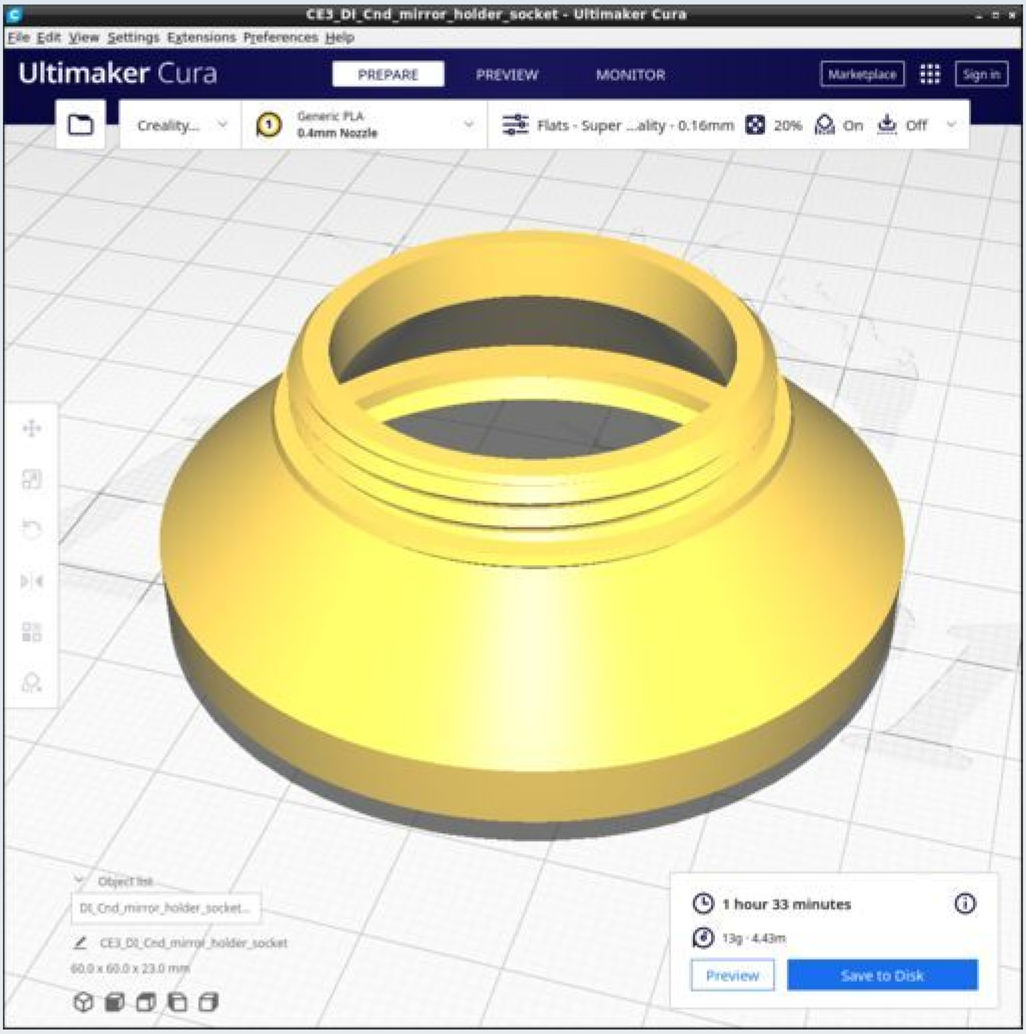
DI_Cnd_Flange_Spacer_0p48



DI_Cnd_gripper

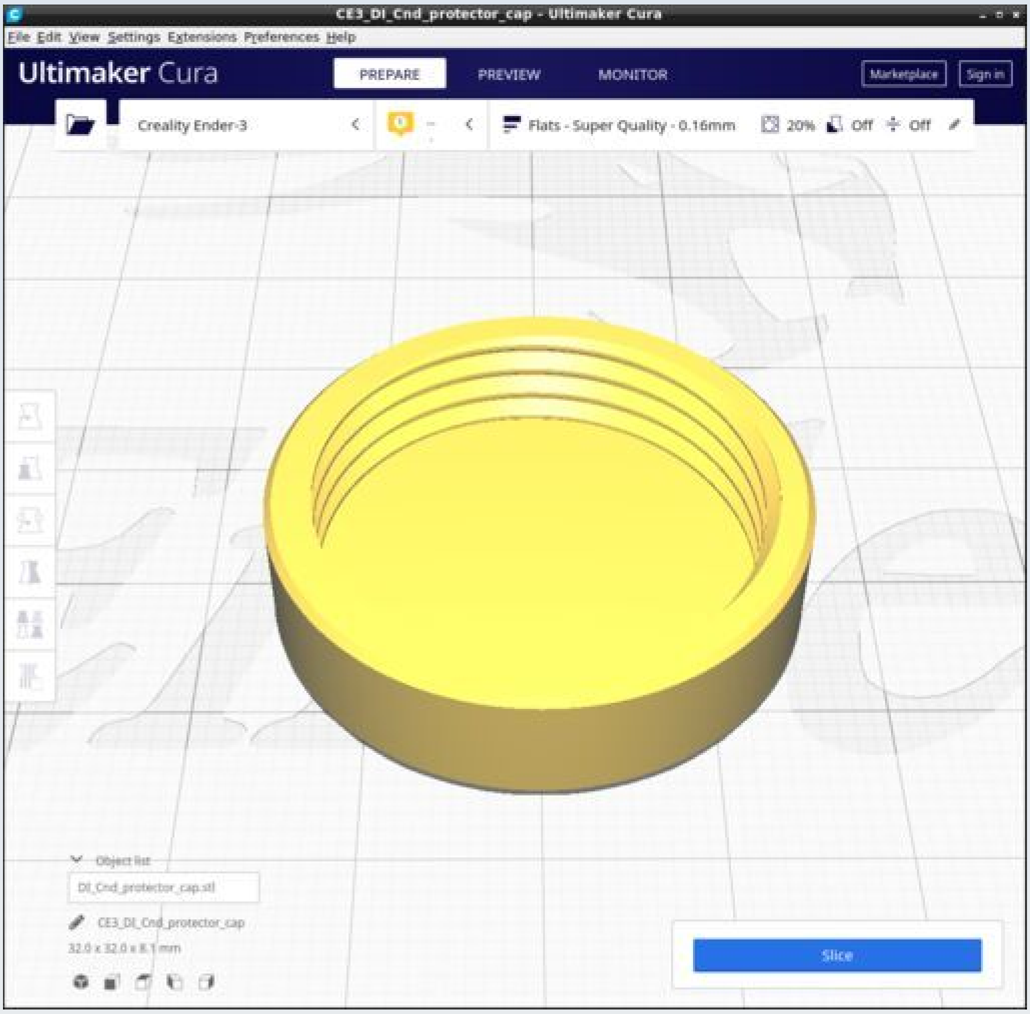


DI_Cnd_Mirror_holder_socket

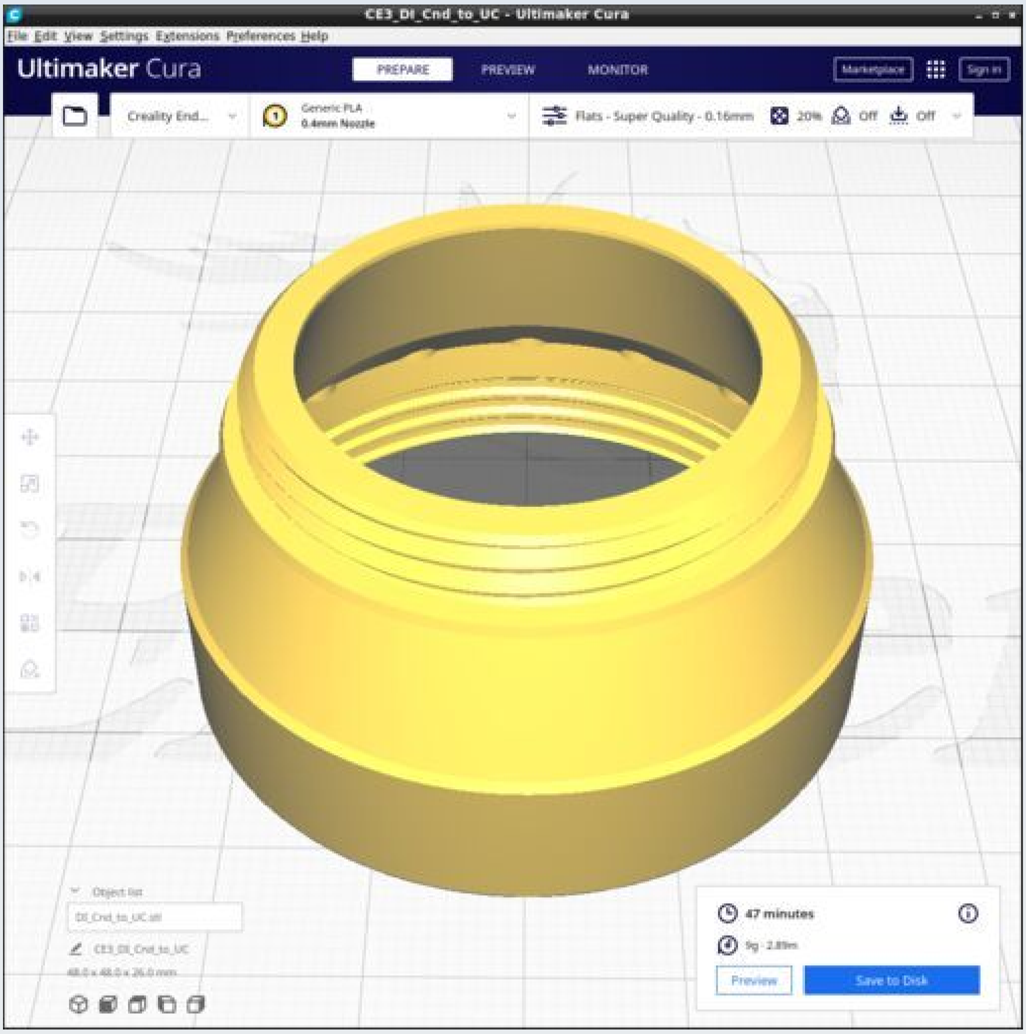


This uses tree support touching baseplate only with tree support branch angle 40 degrees and tree support branch distance 1 mm.

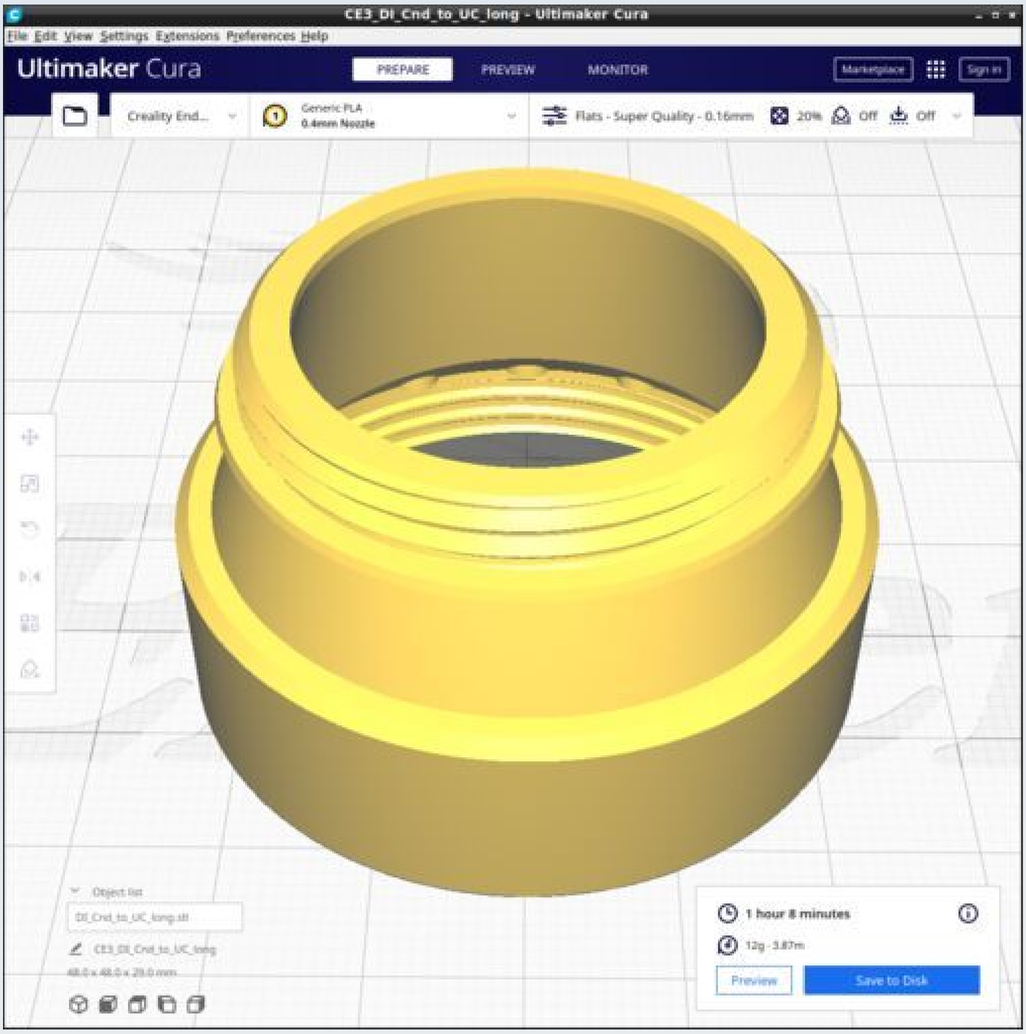
DI_Cnd_protector_cap



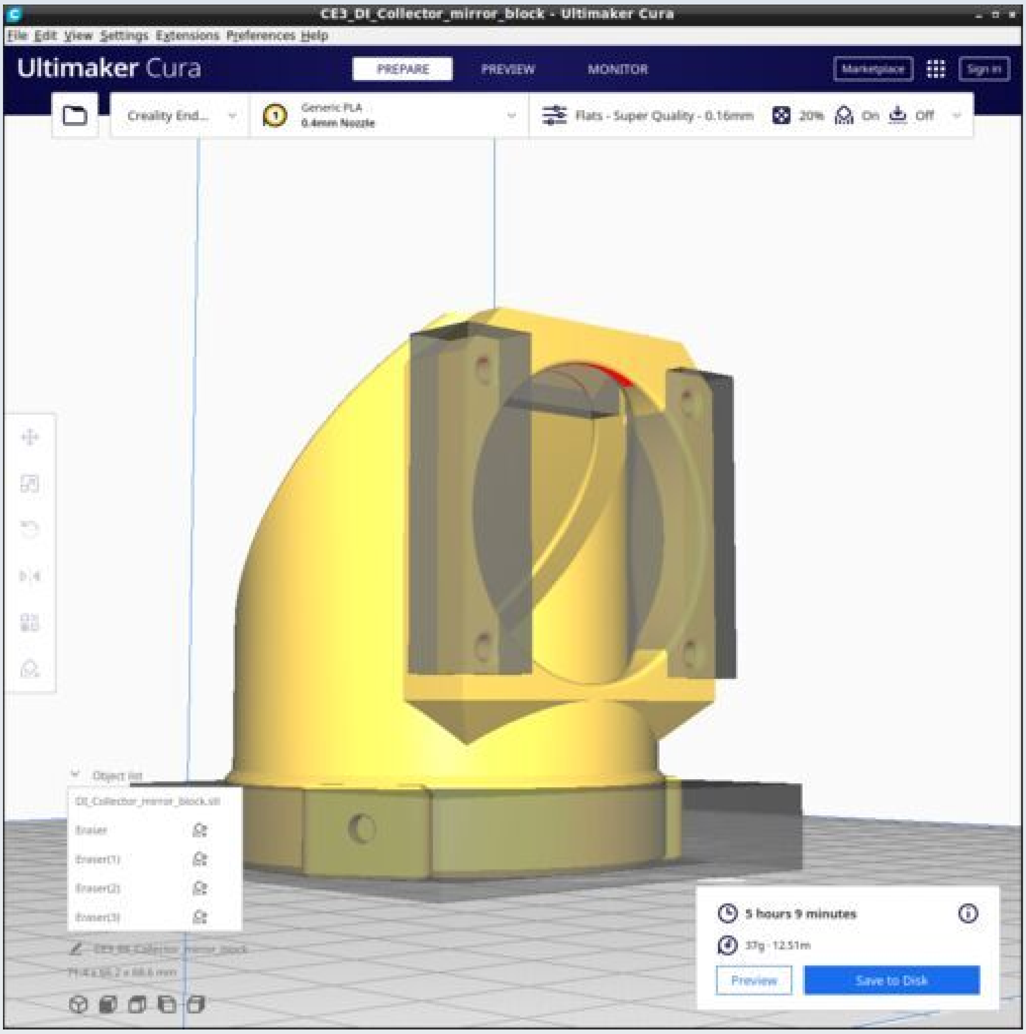
DI_Cnd_to_UC


CE3_DI_Cnd_to_UC - Ultimaker Cura
File Edit View Settings Extensions Preferences Help
Ultimaker Cura
PREPARE
PREVIEW
MONITOR
Marketplace
Sign in
Creality End...
Generic PLA
0.4mm Nozzle
Flats - Super Quality - 0.16mm
20%
Off
Off
Object list
47 minutes
Preview
Save to Disk

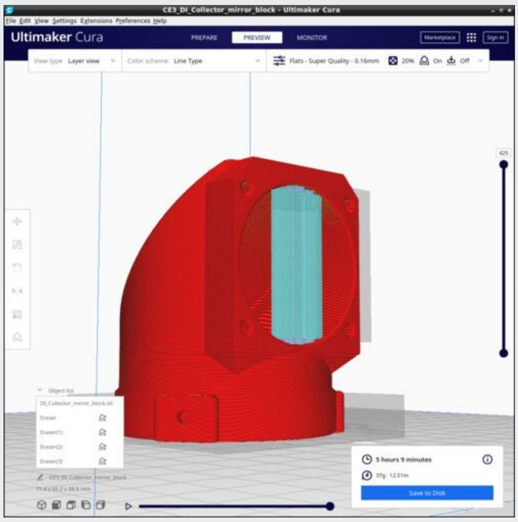
DI_Cnd_to_UC_long



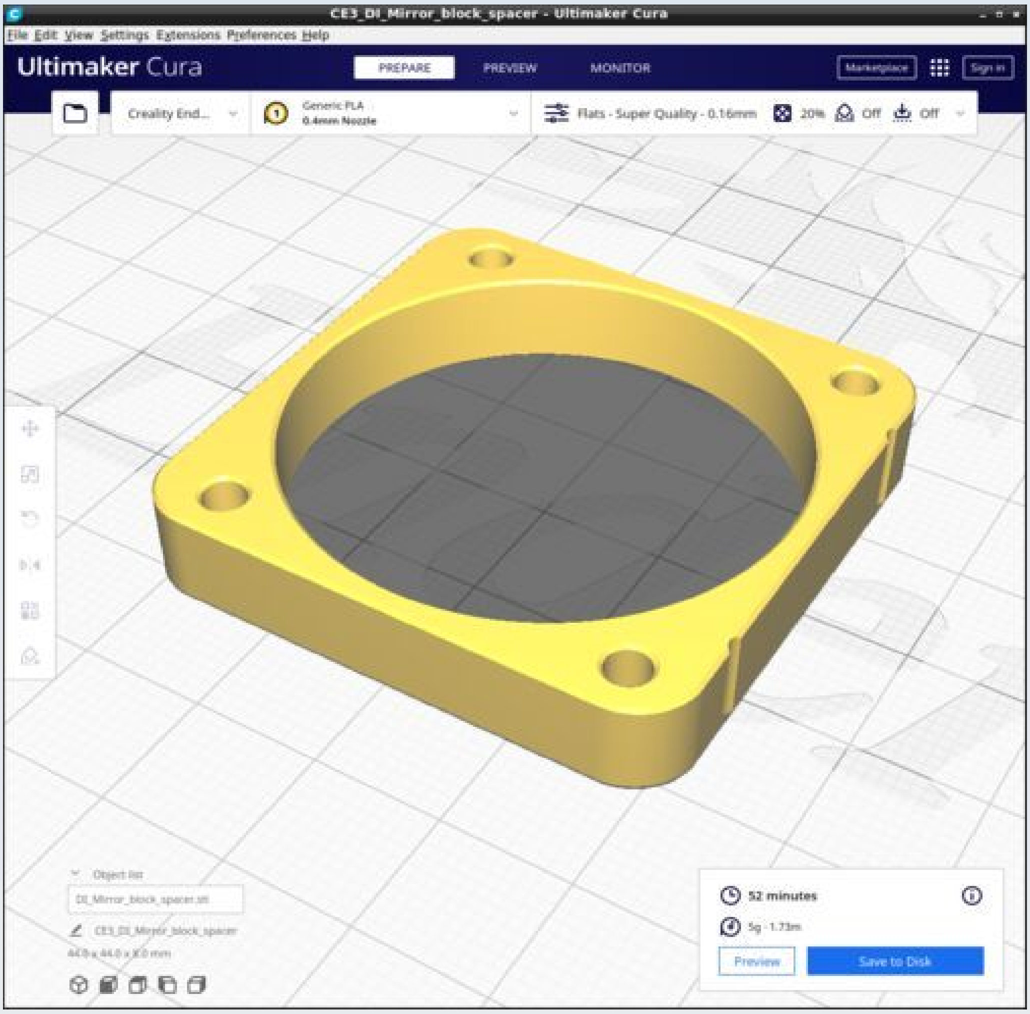
DI_Collector_mirror_block



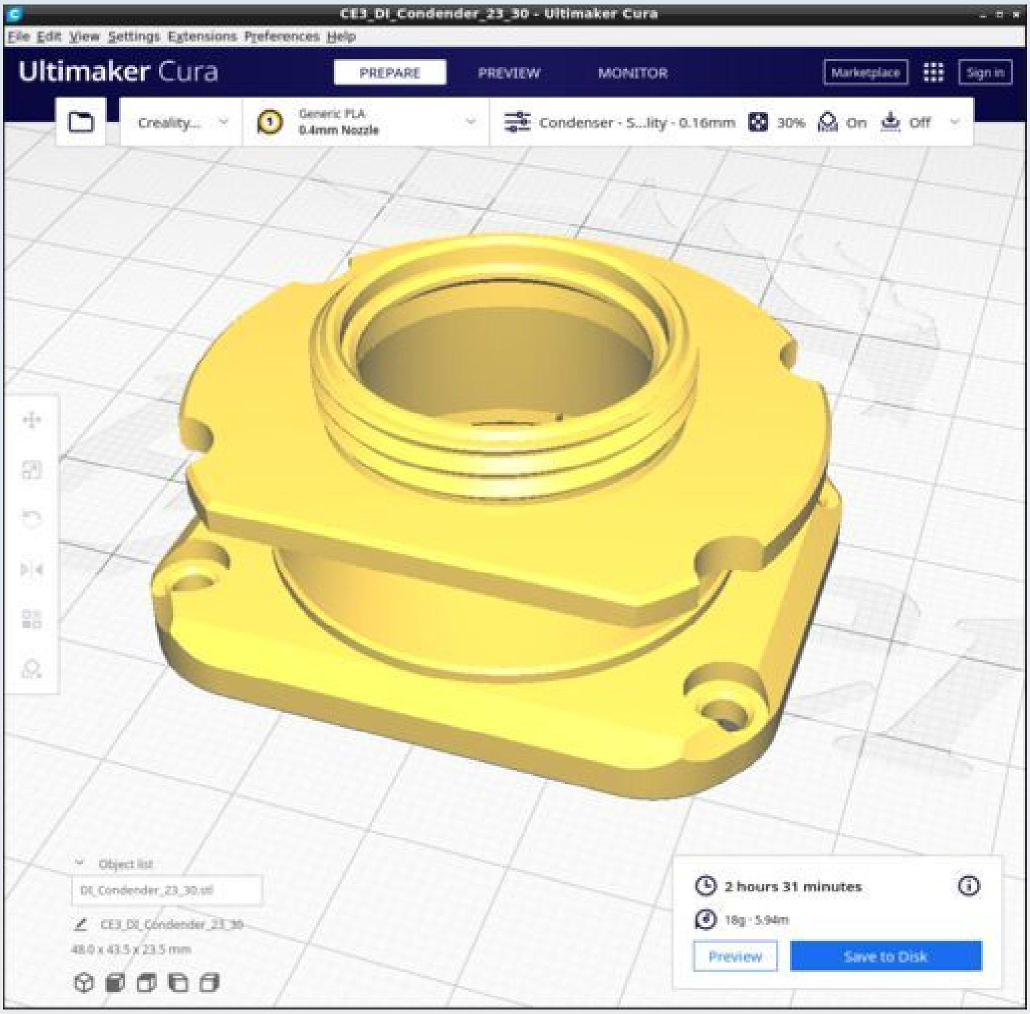
Supports on for 'Everywhere' and ensure 'Support overhang angle' is 67. Make support blockers for the M3 holes in the front flat part, the M3 adjustment ring holes and the part of the mirror indentation that overhangs - essentially everywhere except the big vertical aperture - that is what needs support.



DI_Mirror_block_spacer

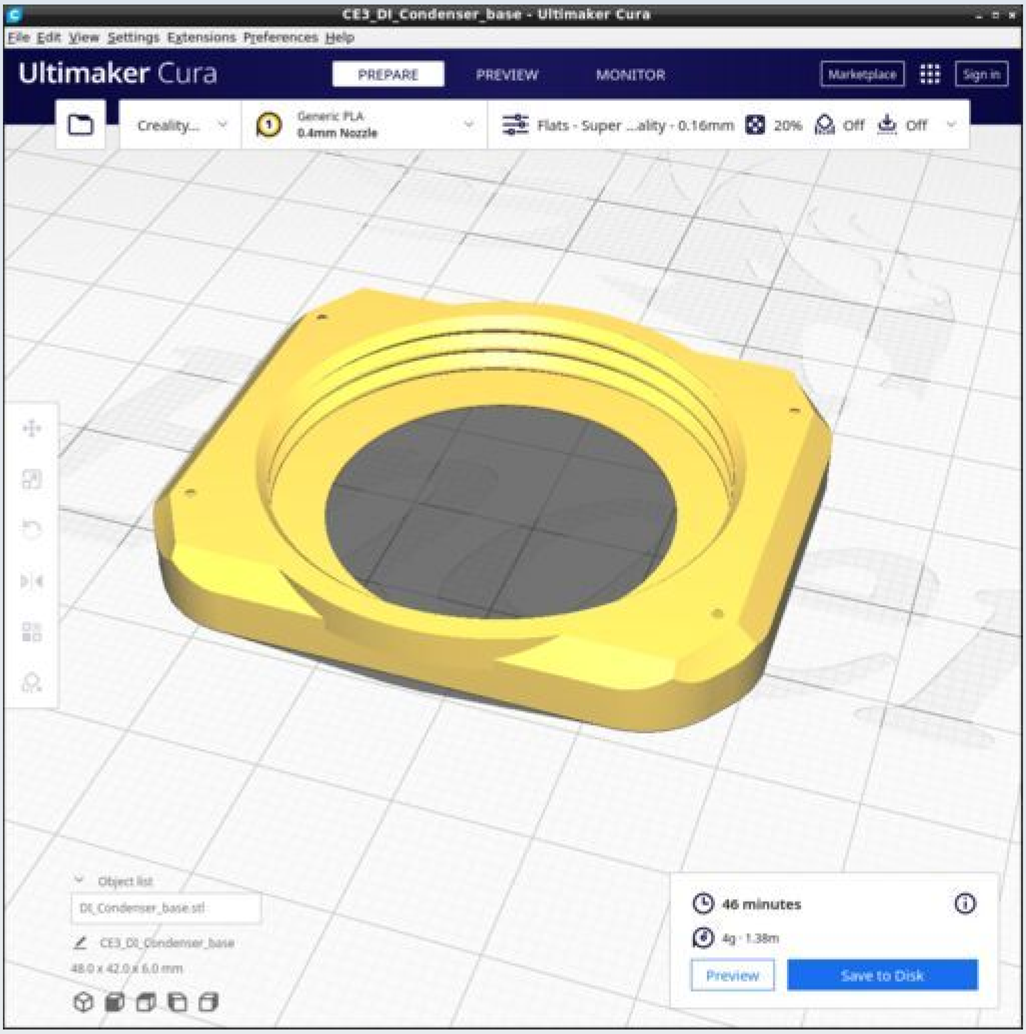


DI_Condenser_23_30



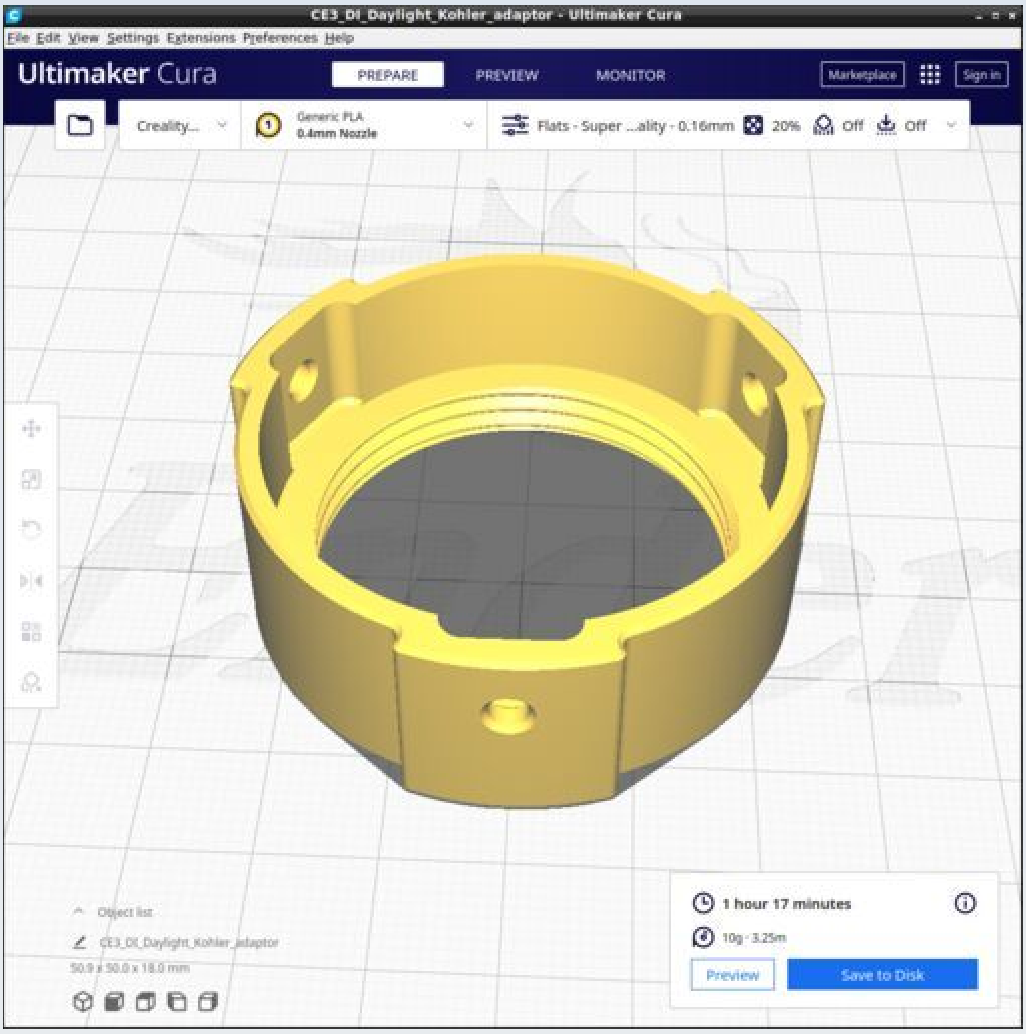
Must be printed with the special custom Cura profile called 'Condenser' which I made to ensure both strength and proper overhang tree supports to the centration flange disc.

DI_Condenser_base



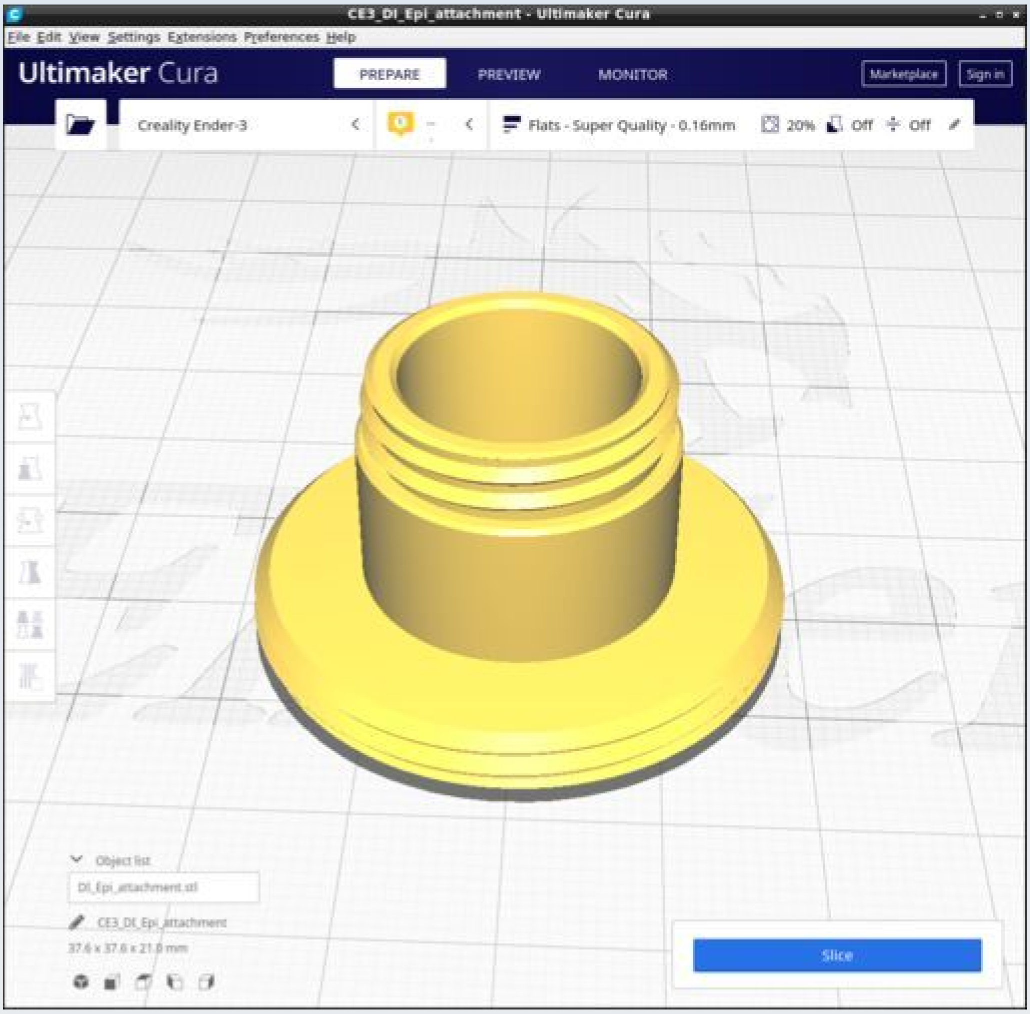
Ensure the ‘Top/bottom Pattern’ is set to ‘Concentric’. This avoids nozzle blebs on the diaphragm surface (they can cause deformations upwards when the condenser attachment is screwed in and such deformations can hinder passage of IAD filters).

DI_Daylight_Kohler_adaptor

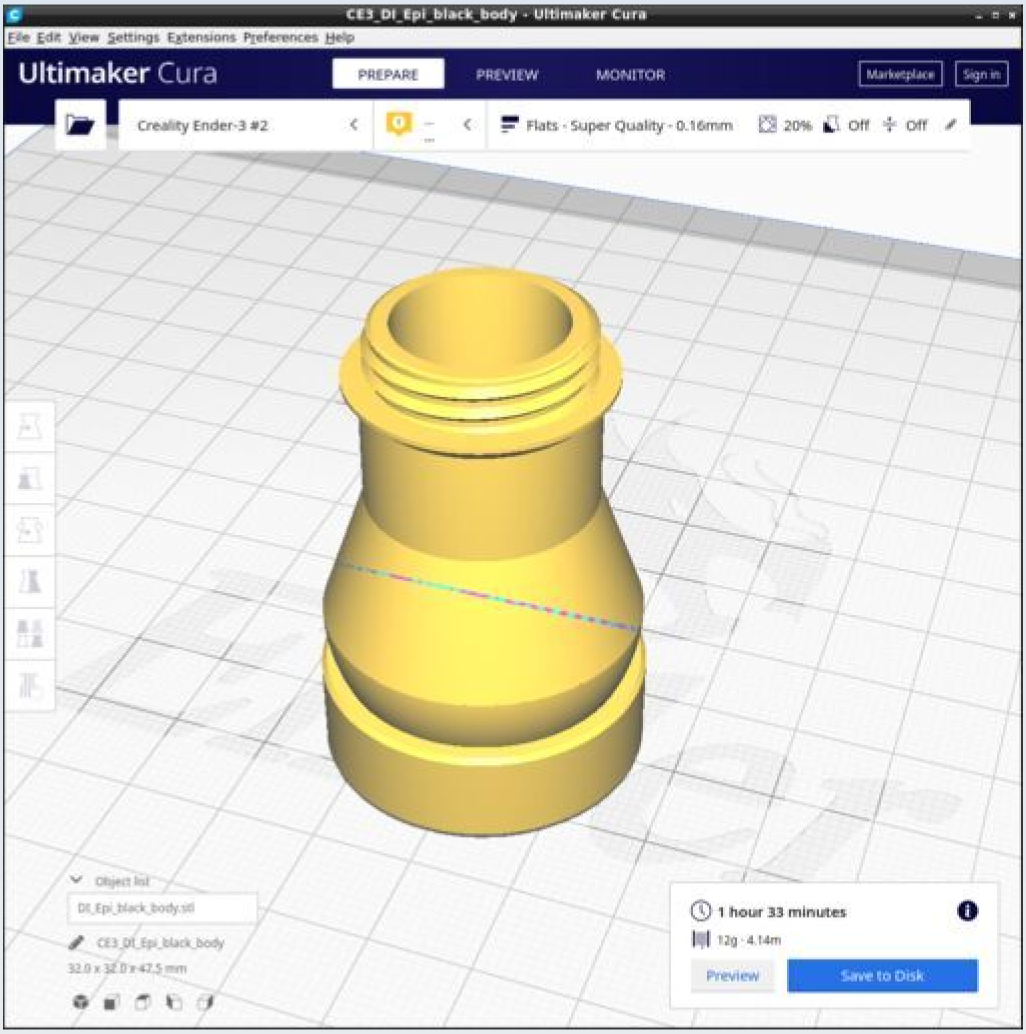


Ensure the ‘Top/bottom Pattern’ is set to ‘Concentric’. I suggest also that the infill pattern be set to ‘zig-zag’ to reduce retractions.

DI_Epi_attachment

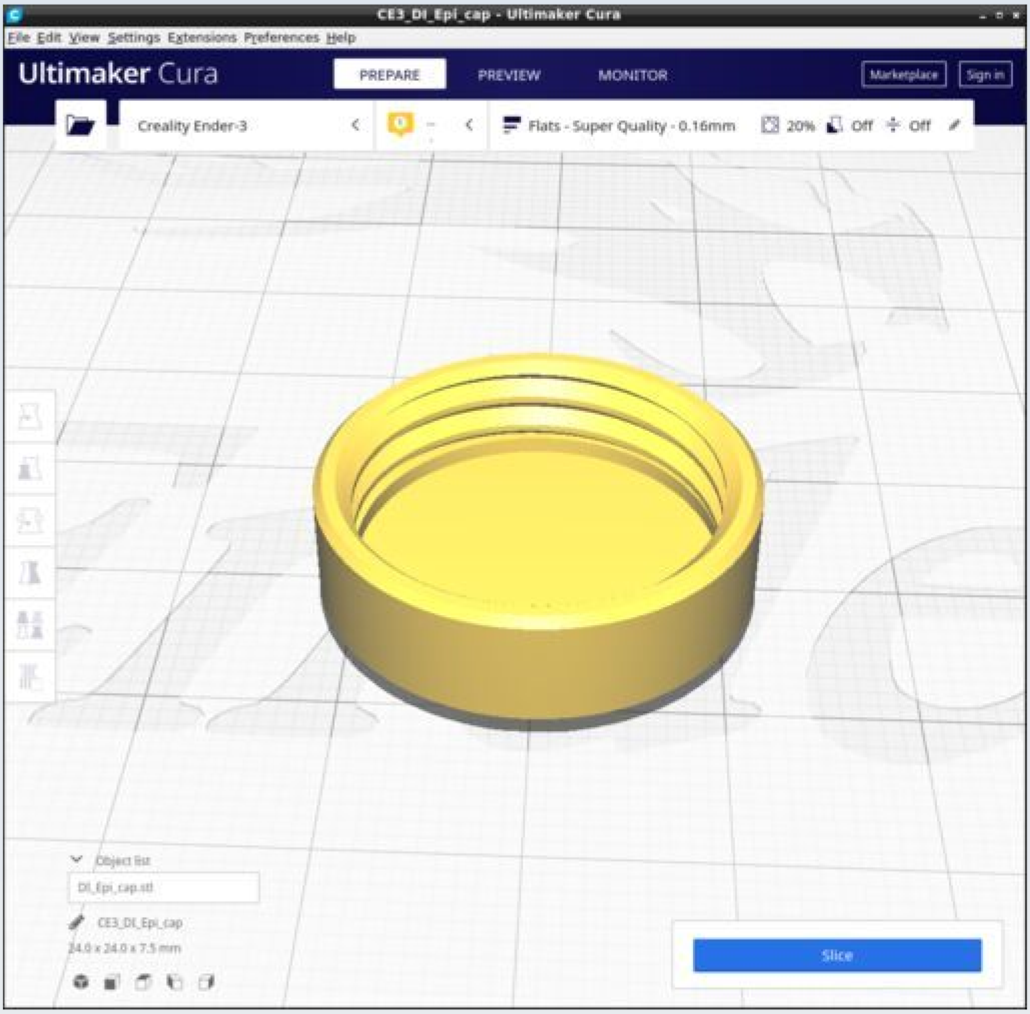


DI_Epi_black_body

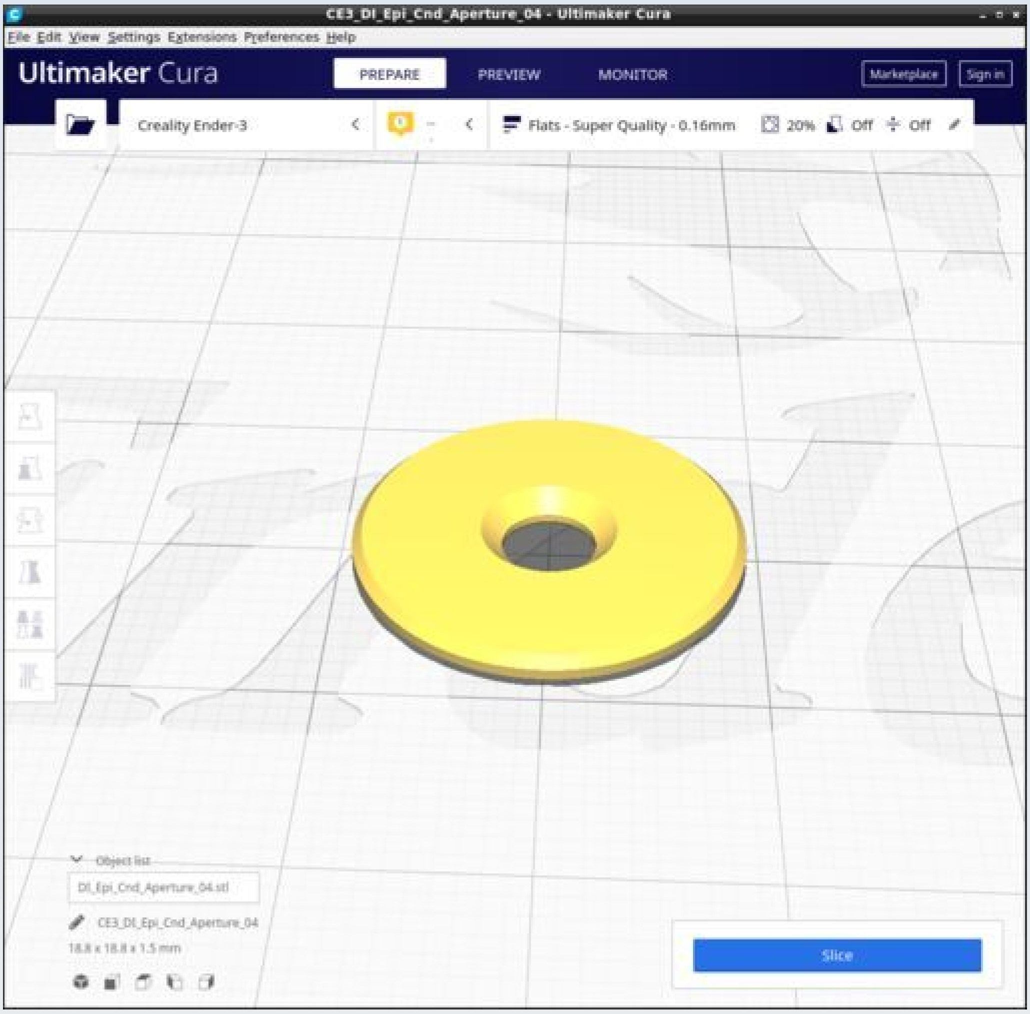


Use the standard 'Flats' profile and do not use supports.

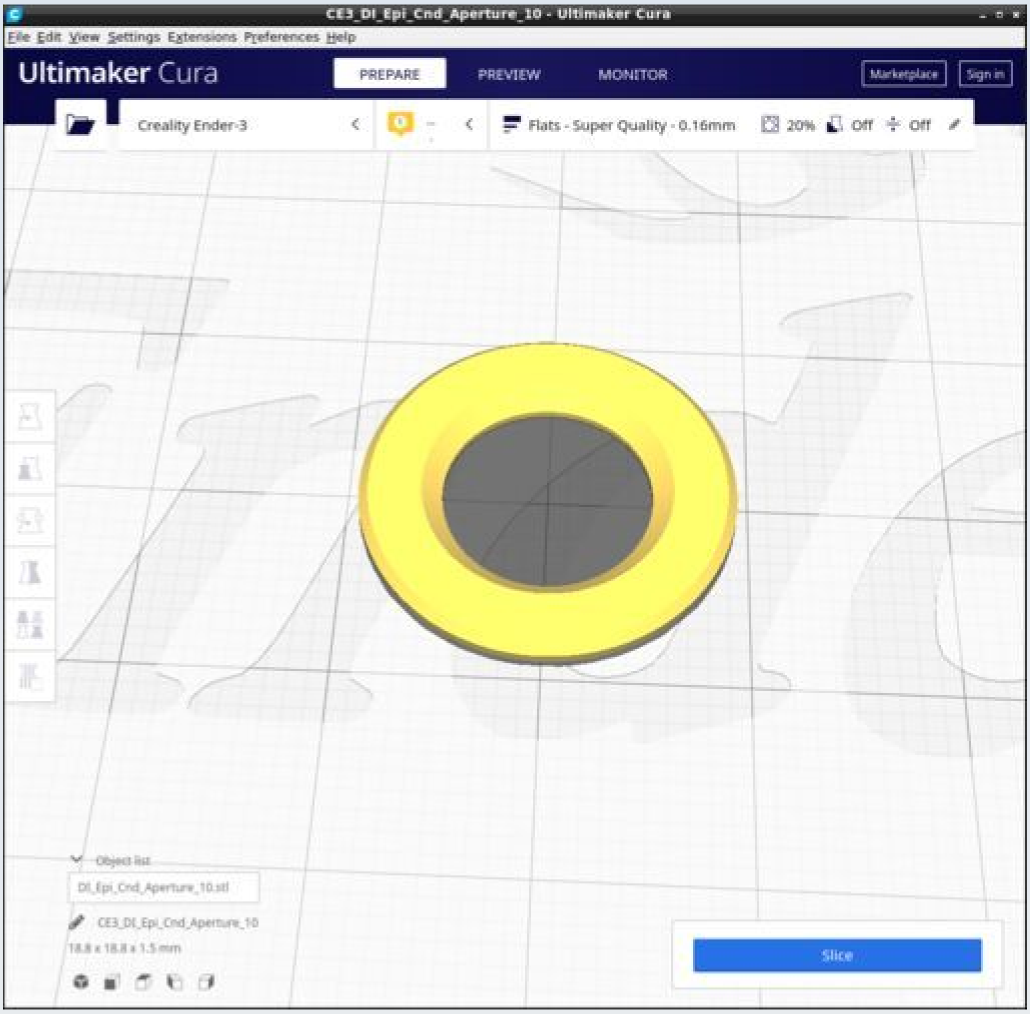
DI_Epi_cap


CE3_DI_Epi_cap - Ultimaker Cura
File Edit View Settings Extensions Preferences Help
Ultimaker Cura
PREPARE
PREVIEW
MONITOR
Marketplace
Sign in
Creality Ender-3
Flats - Super Quality - 0.16mm
20%
Off
Off
Object list
DI_Epi_cap.stl
CE3_DI_Epi_cap
24.0 x 24.0 x 7.5 mm
Slice

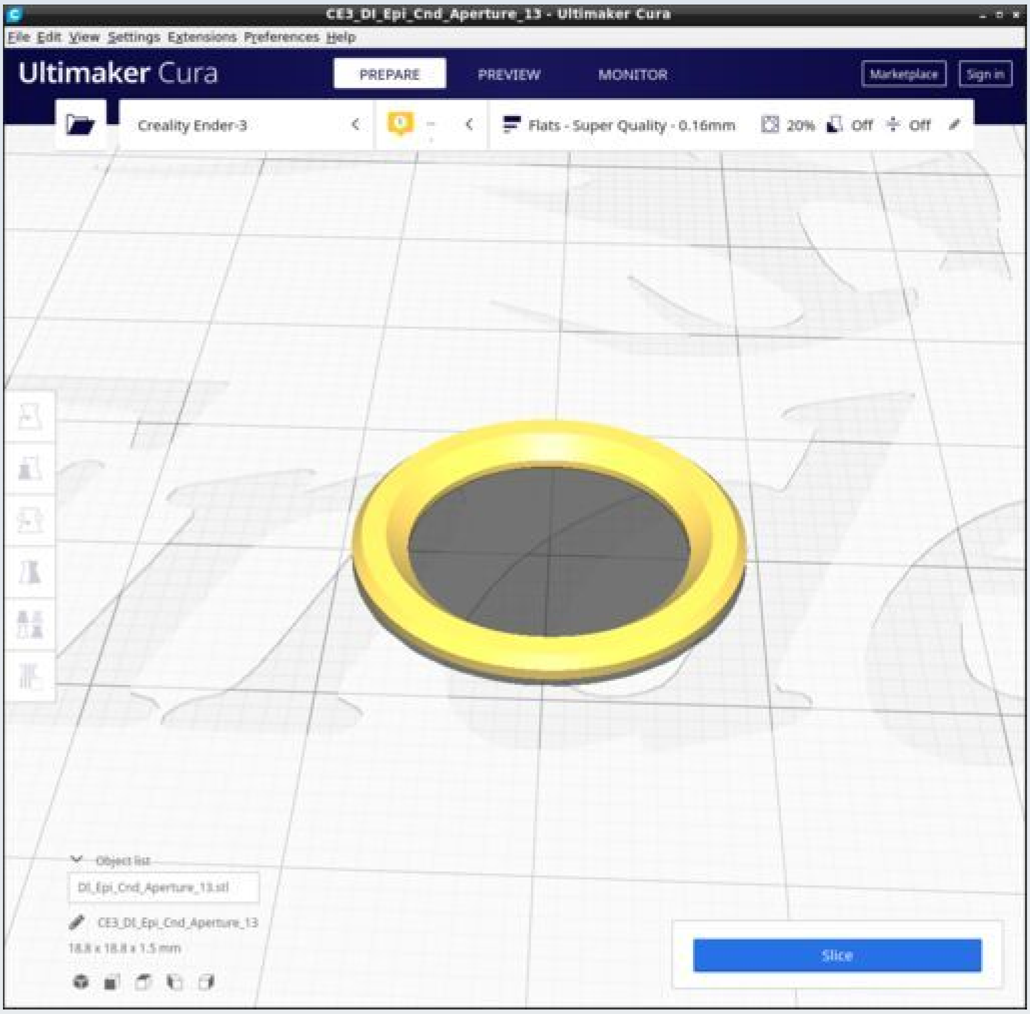
DI_Epi_Cnd_Aperture_04



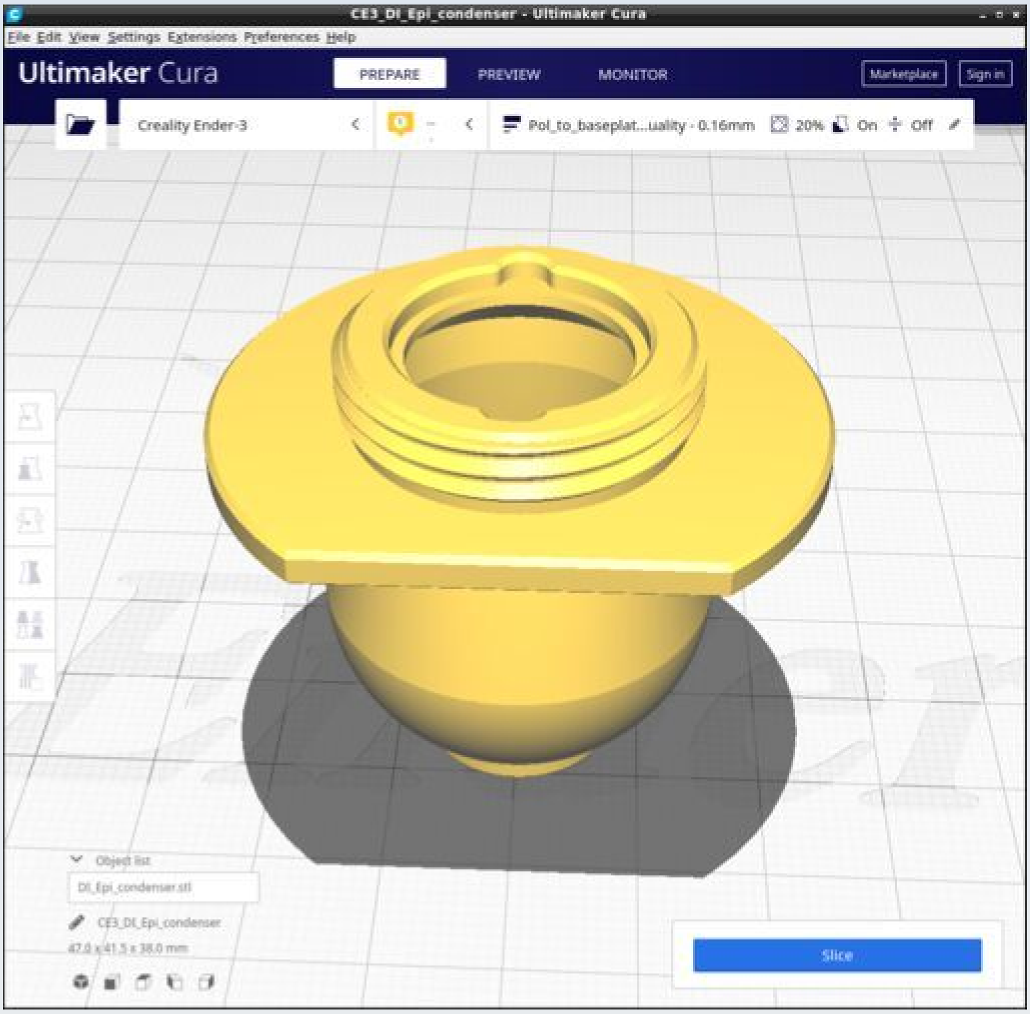
DI_Epi_Cnd_Aperture_10



DI_Epi_Cnd_Aperture_13

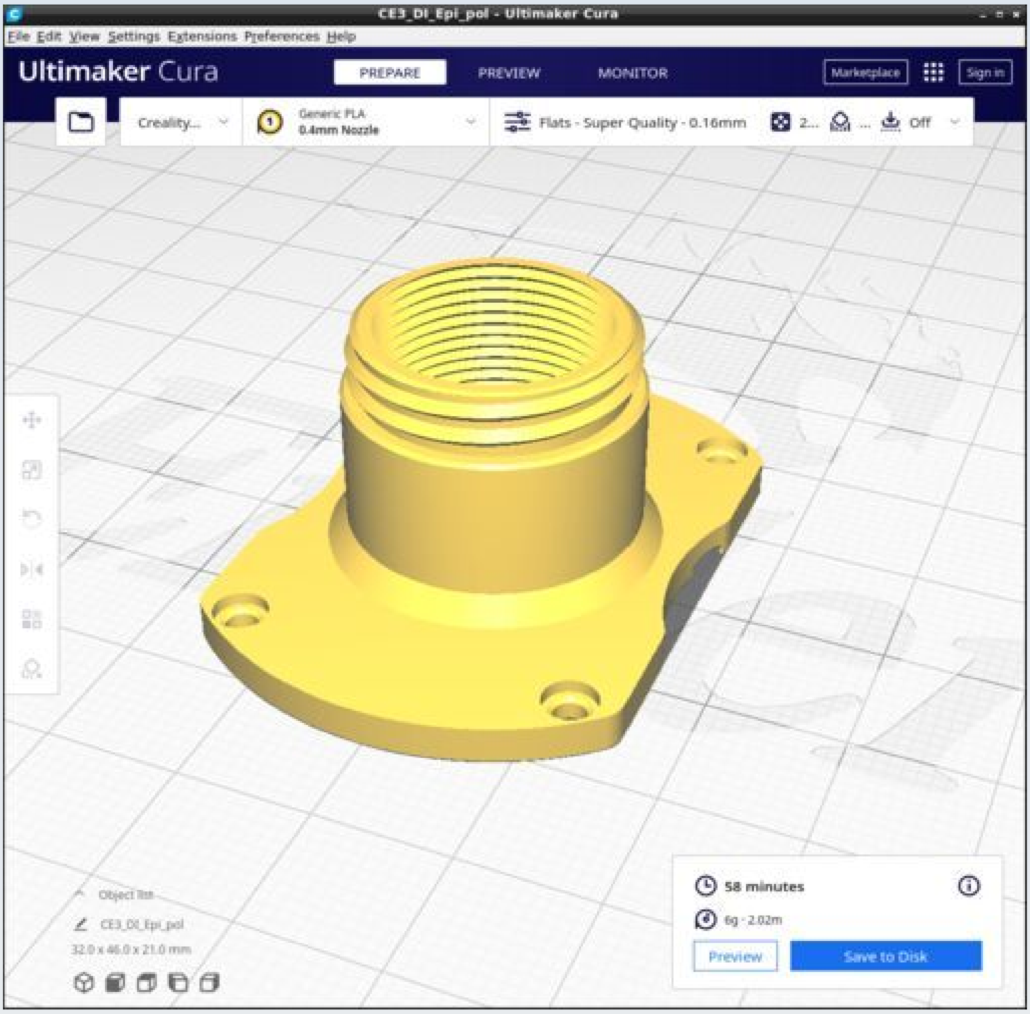


DI_Epi_condenser



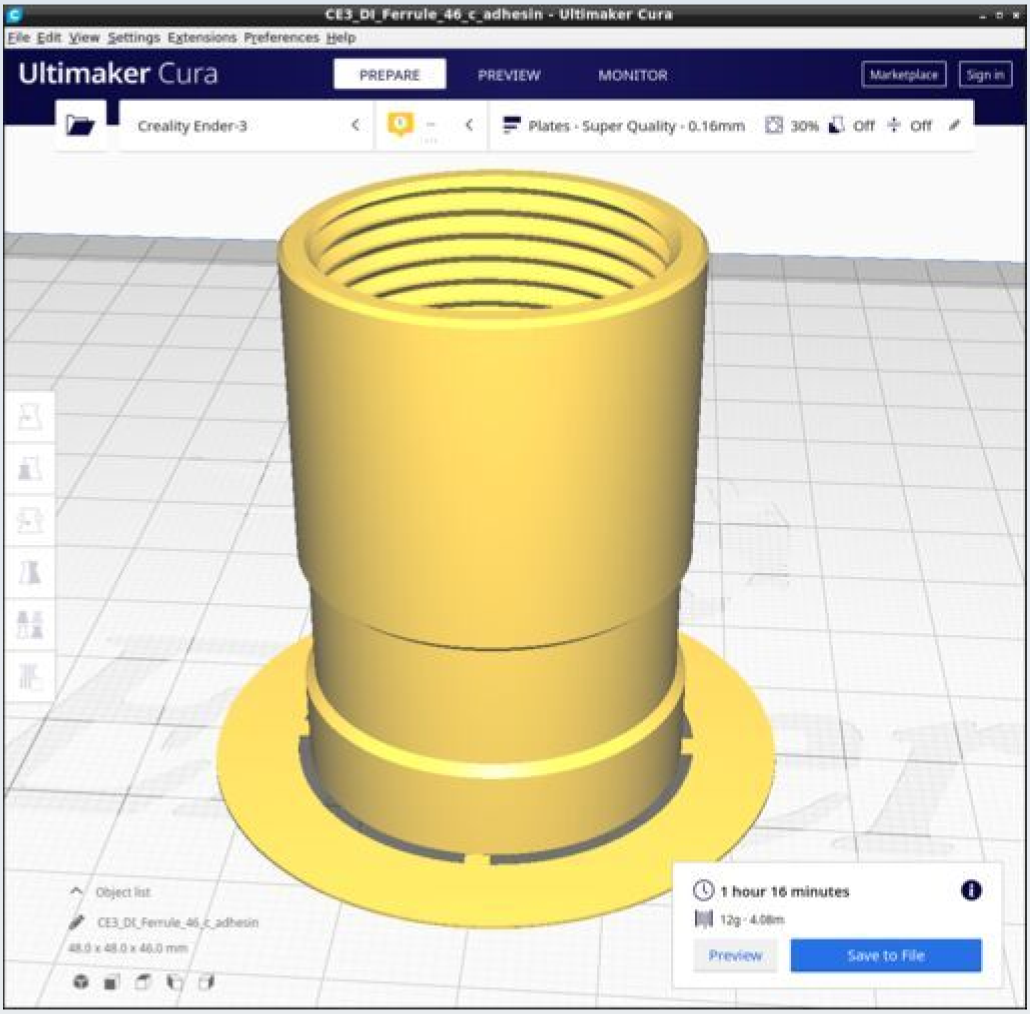
Use the 'Pol_to_baseplate' Cura profile.

DI_Epi_pol

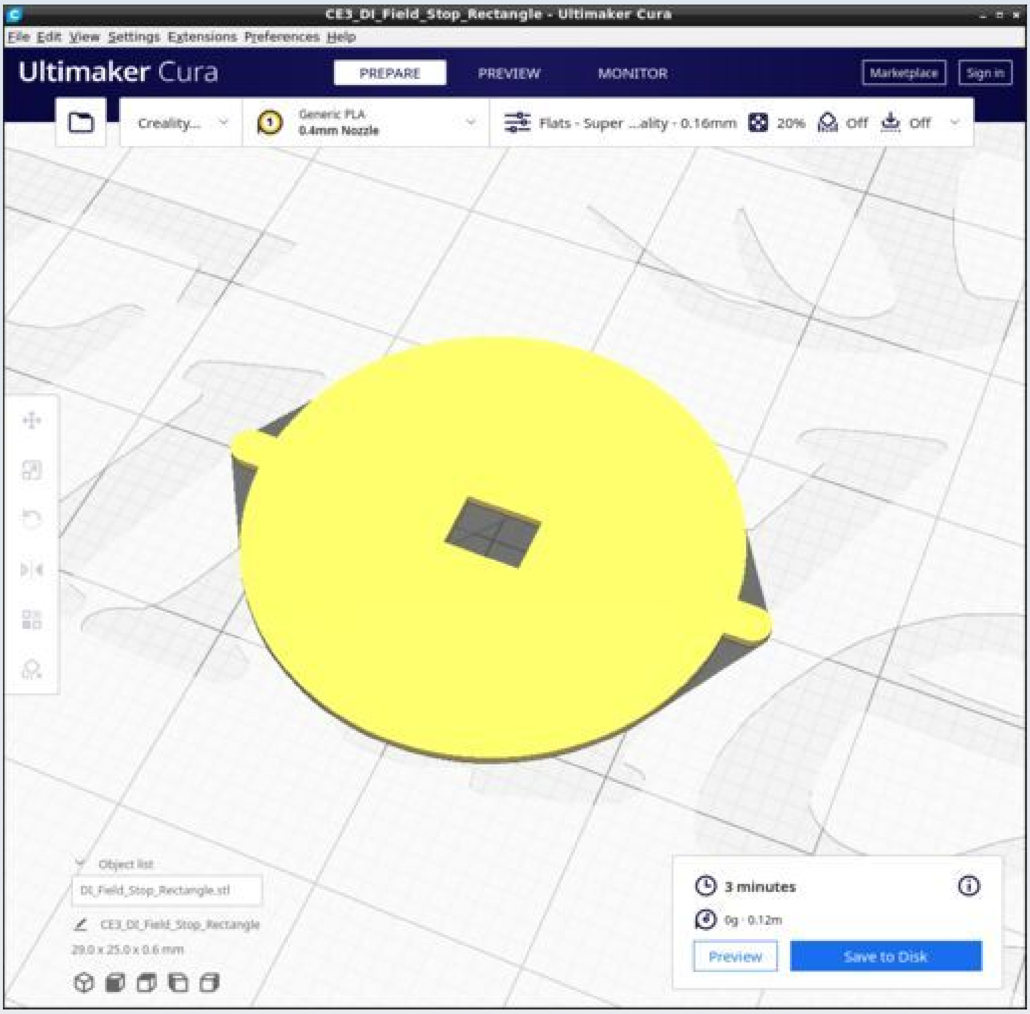


CE3_DI_Epi_pol - Ultimaker Cura
File Edit View Settings Extensions Preferences Help
Ultimaker Cura
PREPARE
PREVIEW
MONITOR
Marketplace
Sign in
Creality...
Generic PLA
0.4mm Nozzle
Flats - Super Quality - 0.16mm
Off
Object list
CE3_DI_Epi_pol
32.0 x 46.0 x 21.0 mm
58 minutes
6g · 2.02m
Preview
Save to Disk

DI_Ferrule_46_c_adhesin



DI_Field_Stop_Rectangle



Note that the Field_Stop models are thicker (have more print layers) than the DI_IFD_Filter_Crosshairs. This is because it is beneficial for the crosshairs to be semitransparent to be able to see the image of the light source behind it for centration purposes but true field stops should be fully opaque.

In FreeCAD:

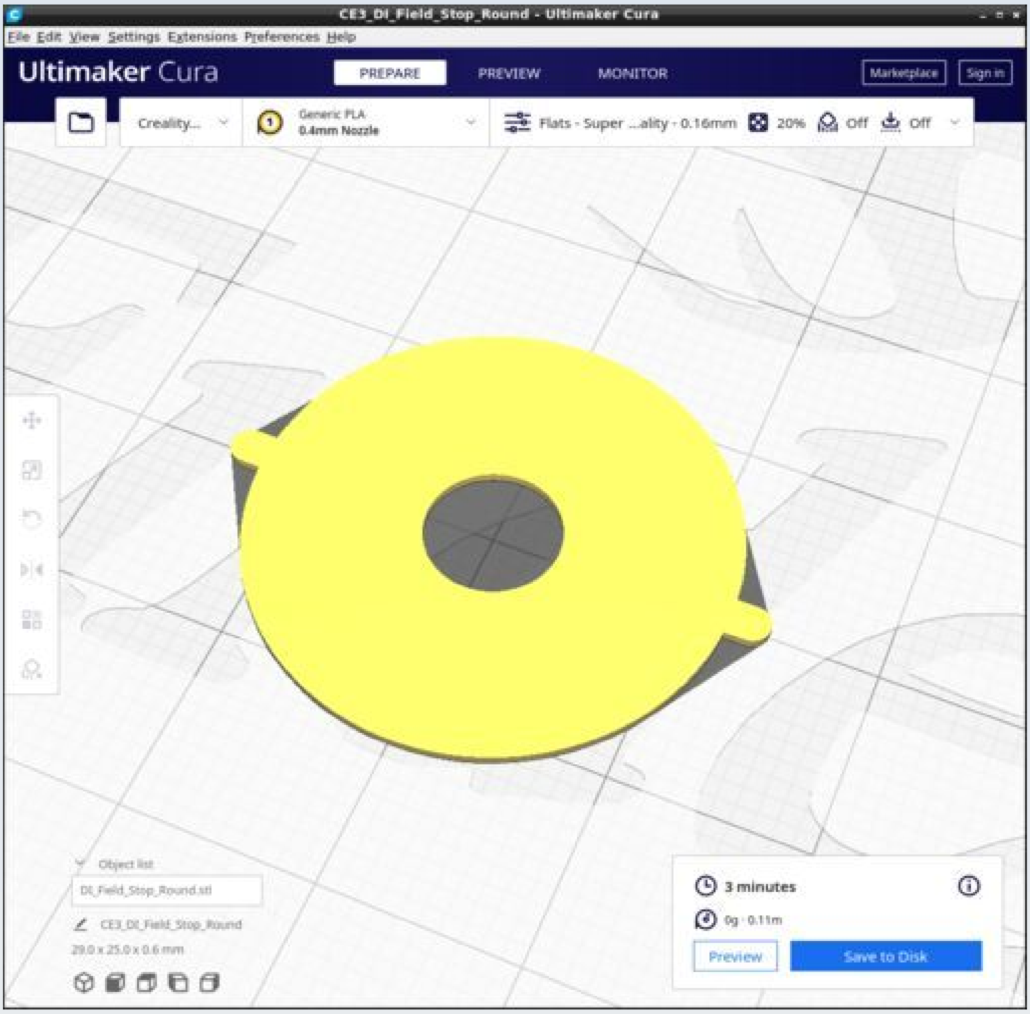
To change the aperture of the Field_Stop_Rectangle alter the dimensions (and XY offset positions accordingly to maintain central position) of the box called 'Aperture_rectangle' here (the default size is 4 mm by 3 mm):

Field_Stop_Rectangle

|_ Sehfeldblende_4x3

|_Aperture_rectangle

DI_Field_Stop_Round



Note that the Field_Stop models are thicker (have more print layers) than the DI_IFD_Filter_Crosshairs. This is because it is beneficial for the crosshairs to be semitransparent to be able to see the image of the light source behind it for centration purposes but true field stops should be fully opaque.

In FreeCAD:

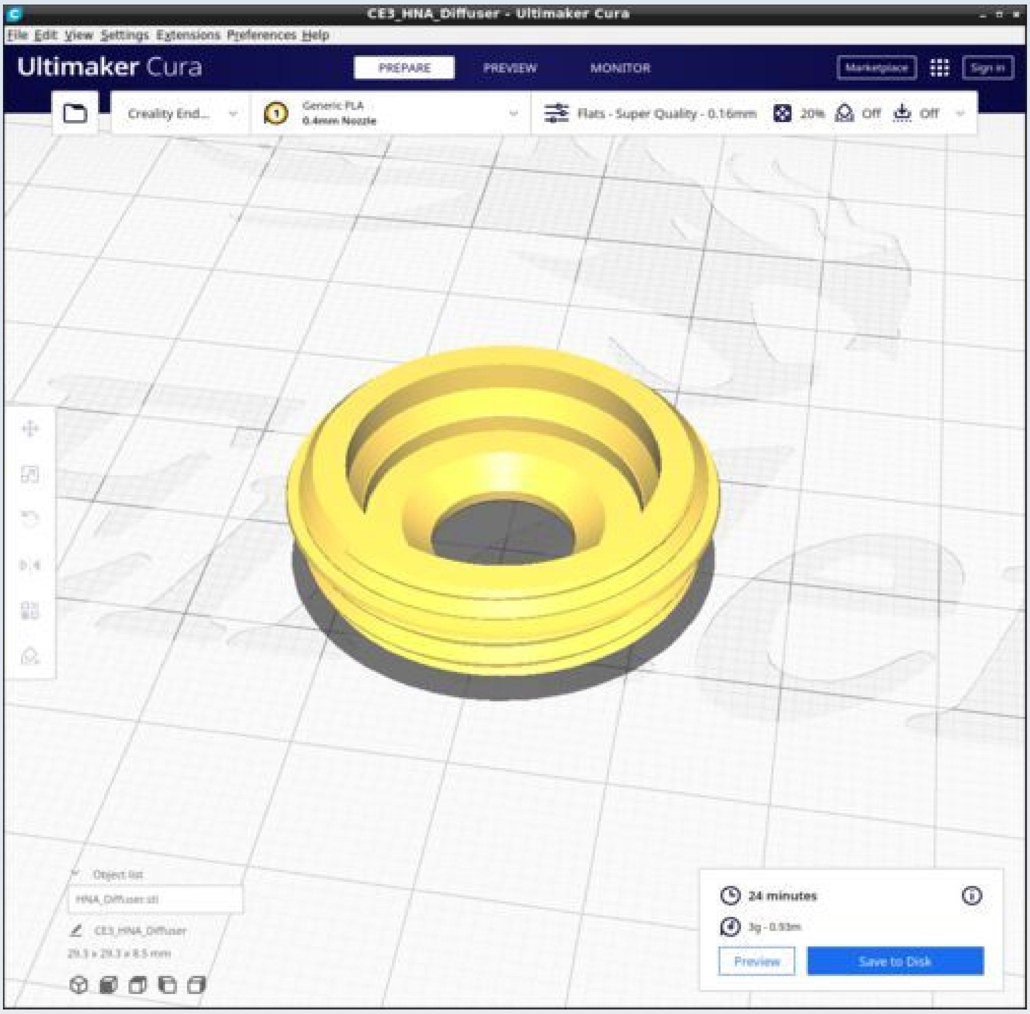
To change the aperture of the Field_Stop_Round alter the radius value of the cylinder called 'Aperture_hole' here (the default radius is 3.5 mm to give a 7 mm diameter aperture):

Field_Stop_Round

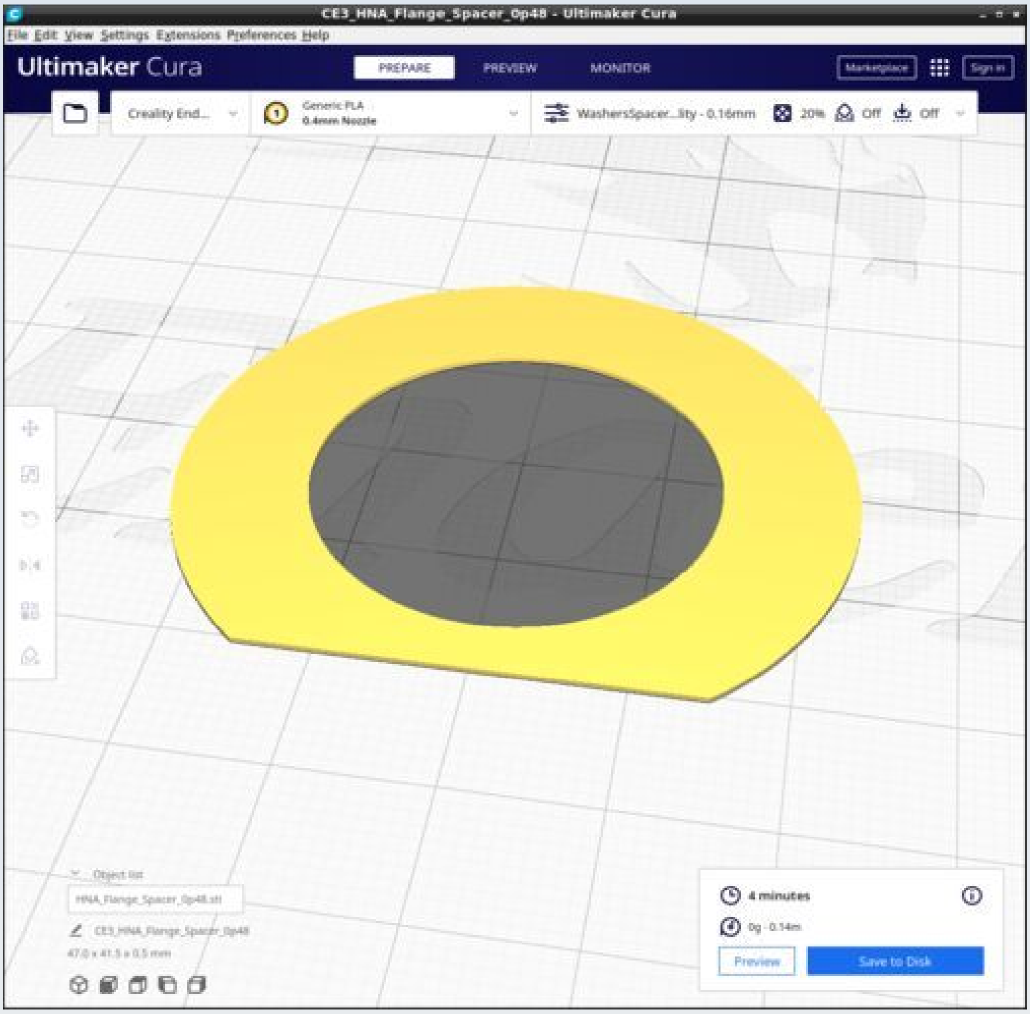
|_ Sehfeldblende

|_Aperture_hole

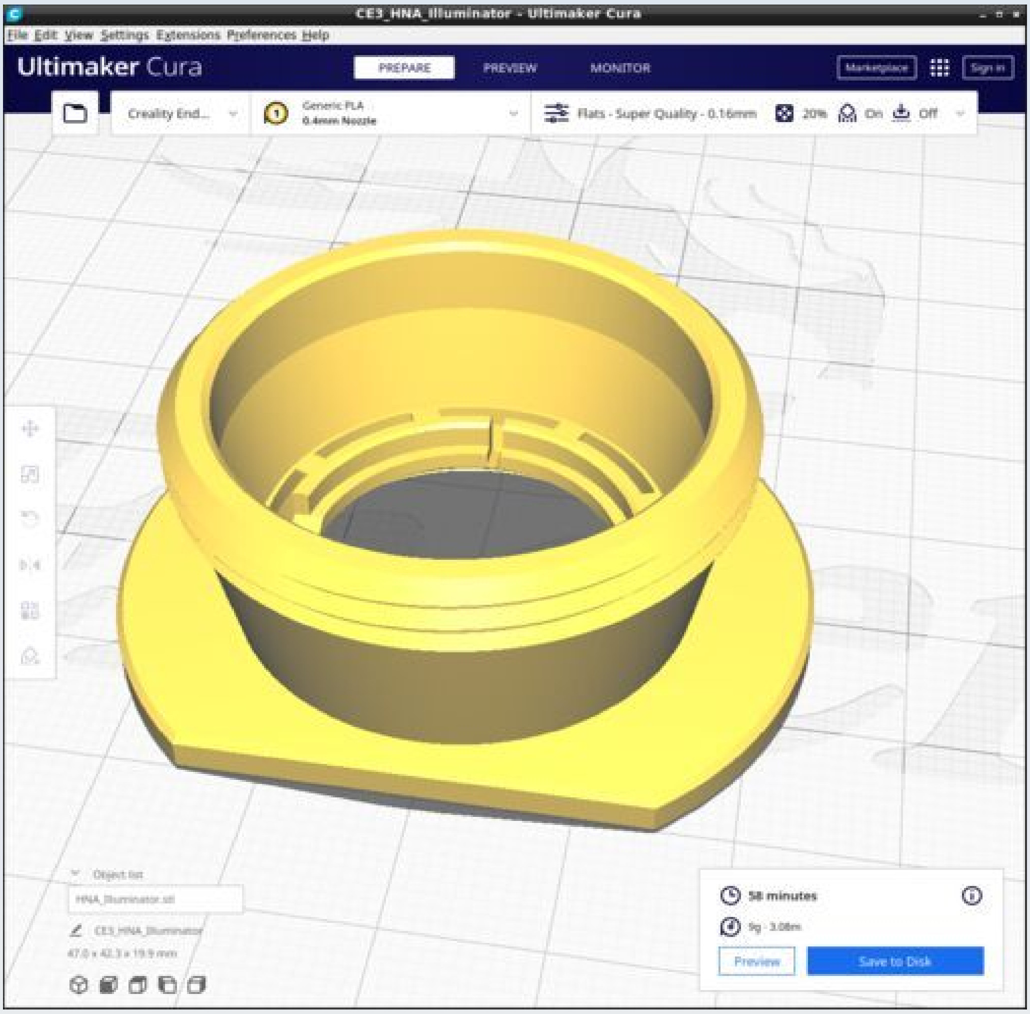
DI_HNA_Diffuser



DI_HNA_Flange_Spacer_0p48

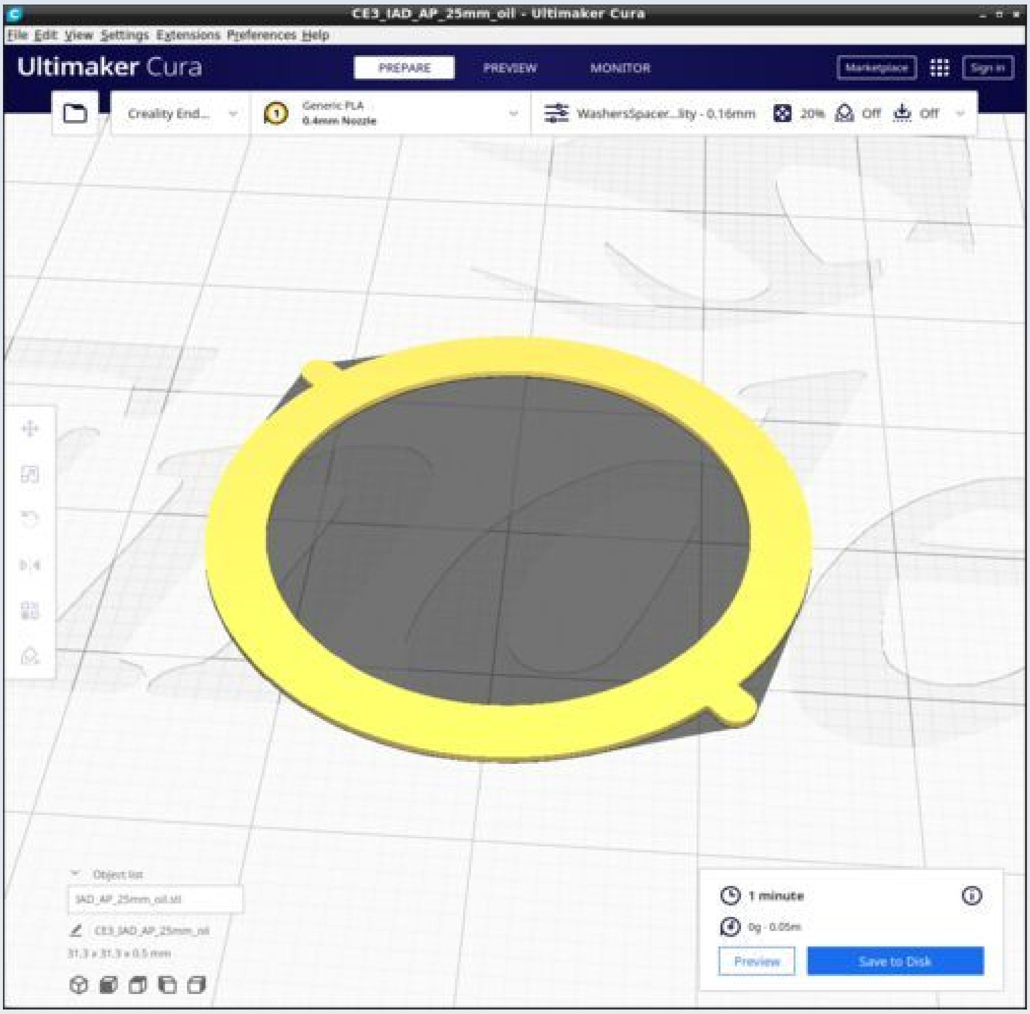


DI_HNA_Illuminator

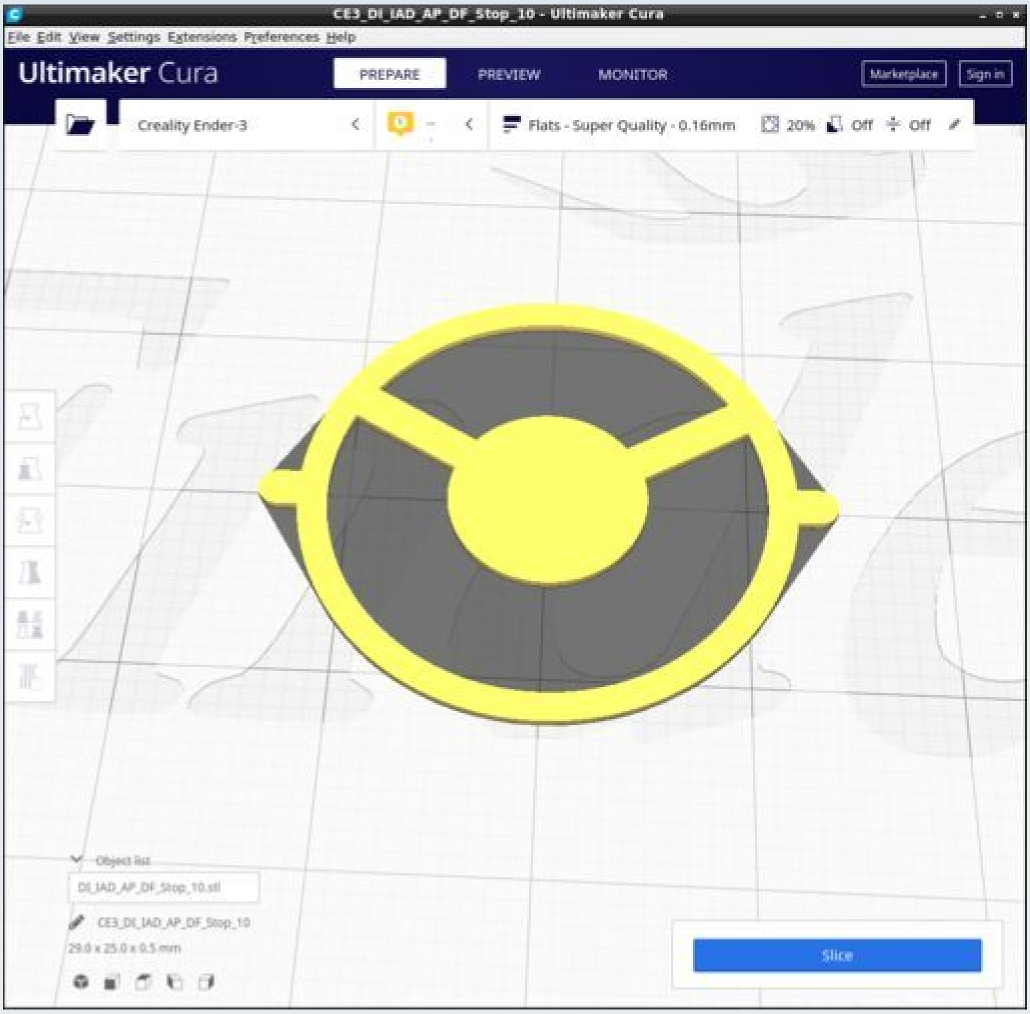


Supports on for 'touching build plate only'

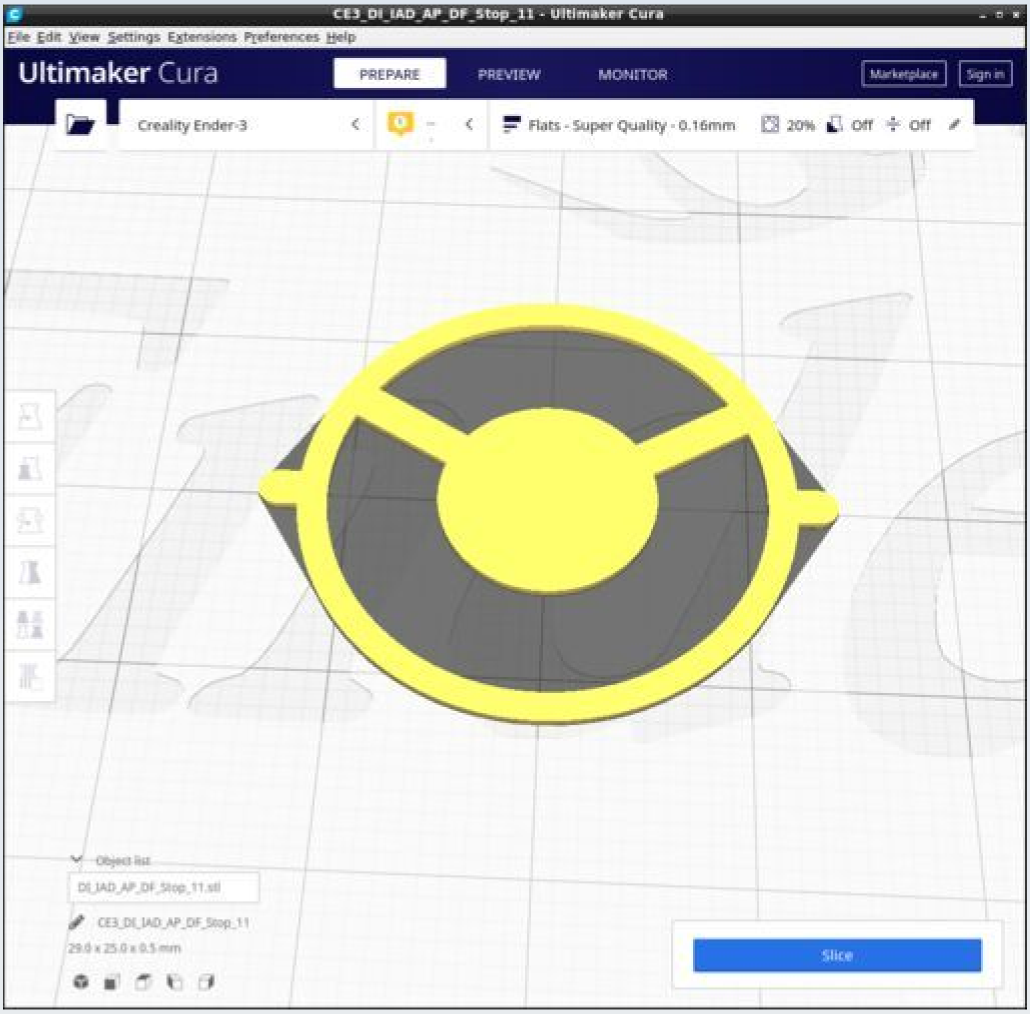
DI_IAD_AP_25mm_oil



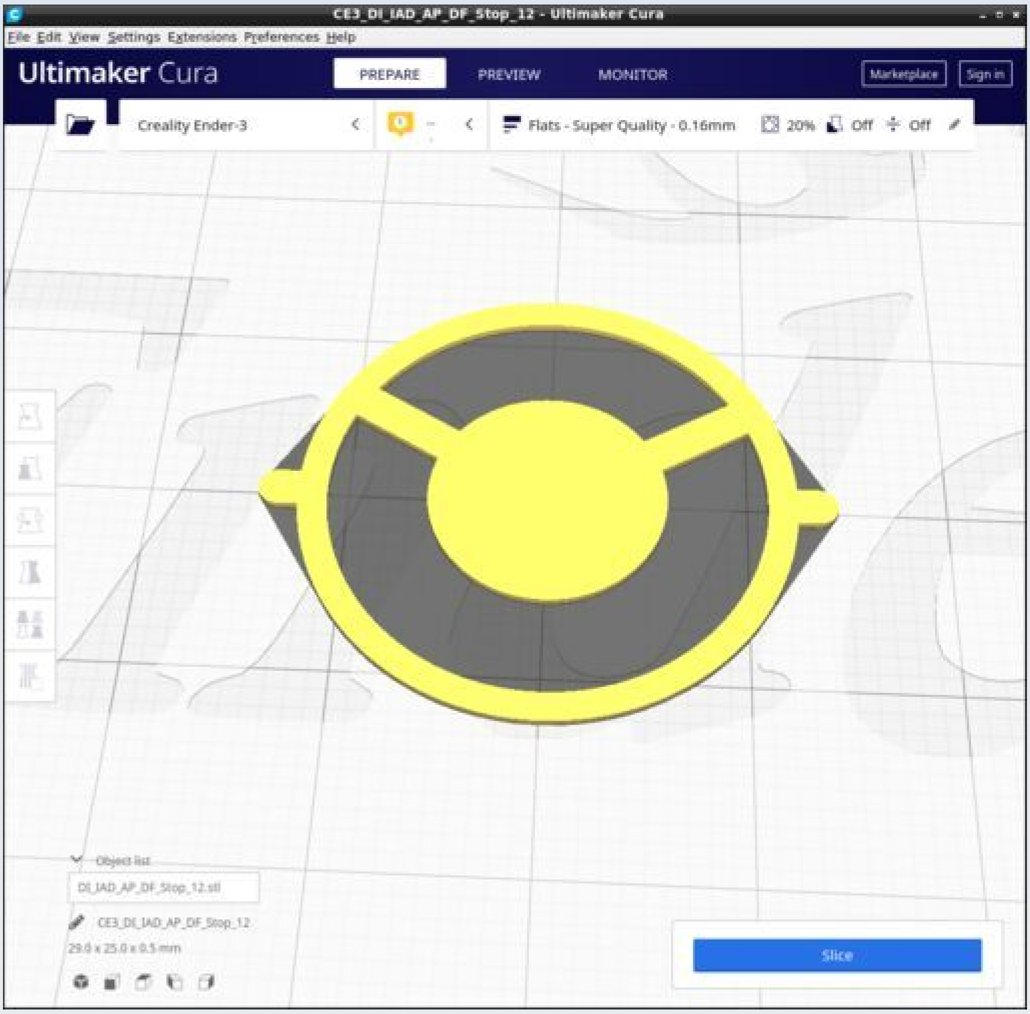
DI_IAD_AP_DF_Stop_10



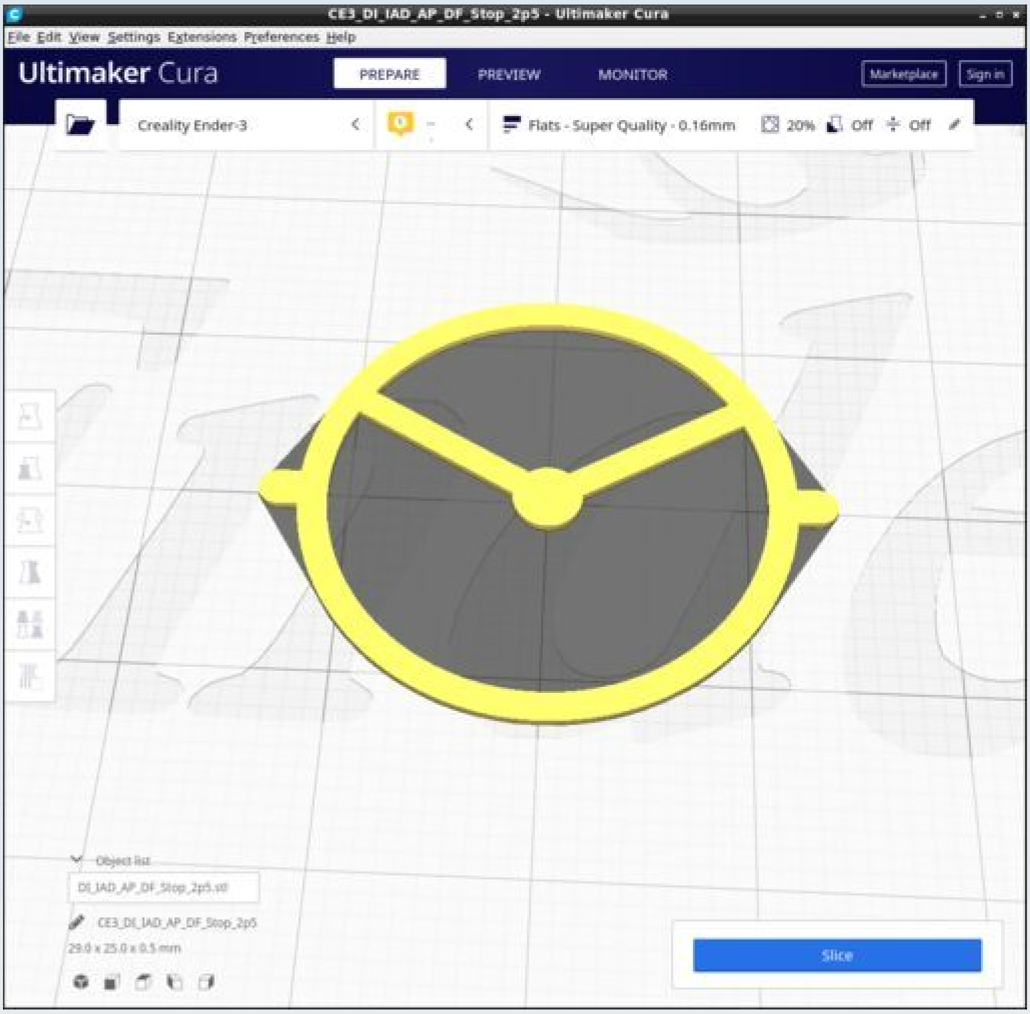
DI_IAD_AP_DF_Stop_11



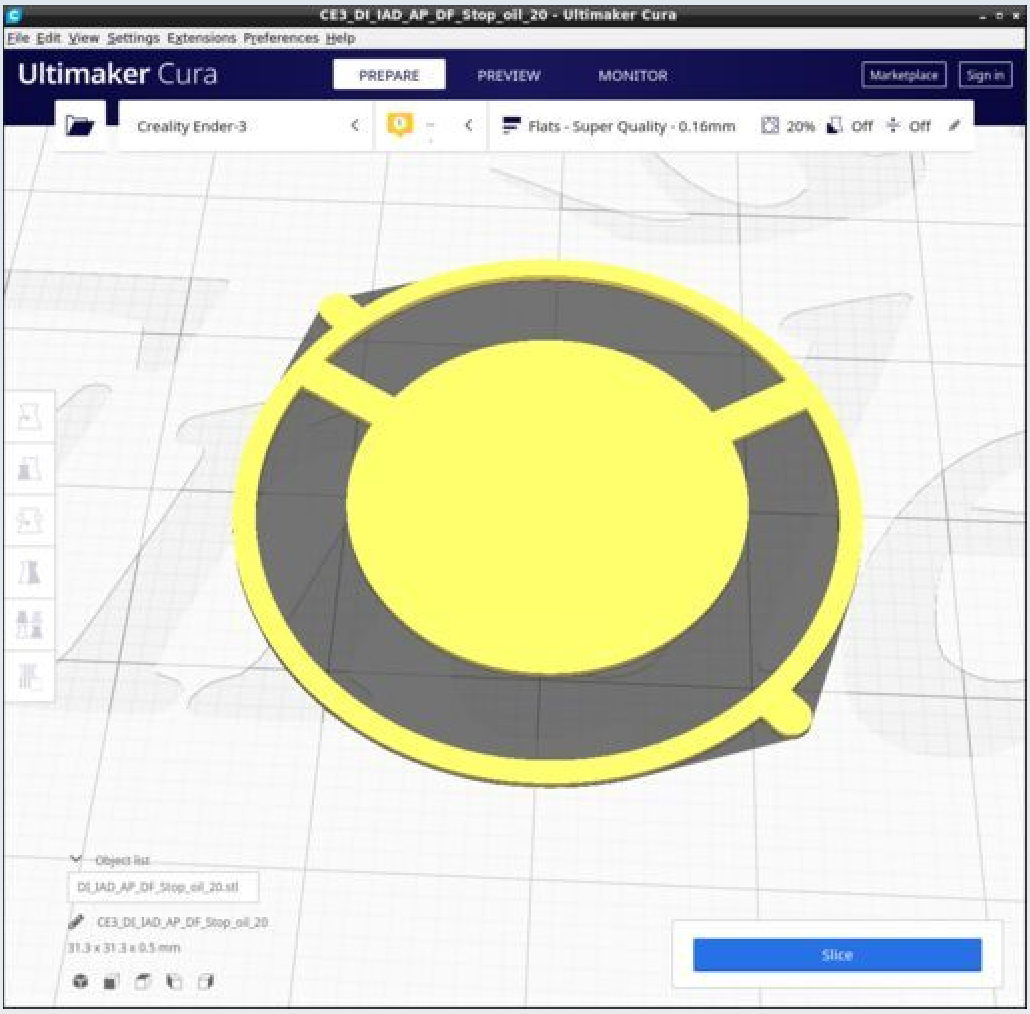
DI_IAD_AP_DF_Stop_12



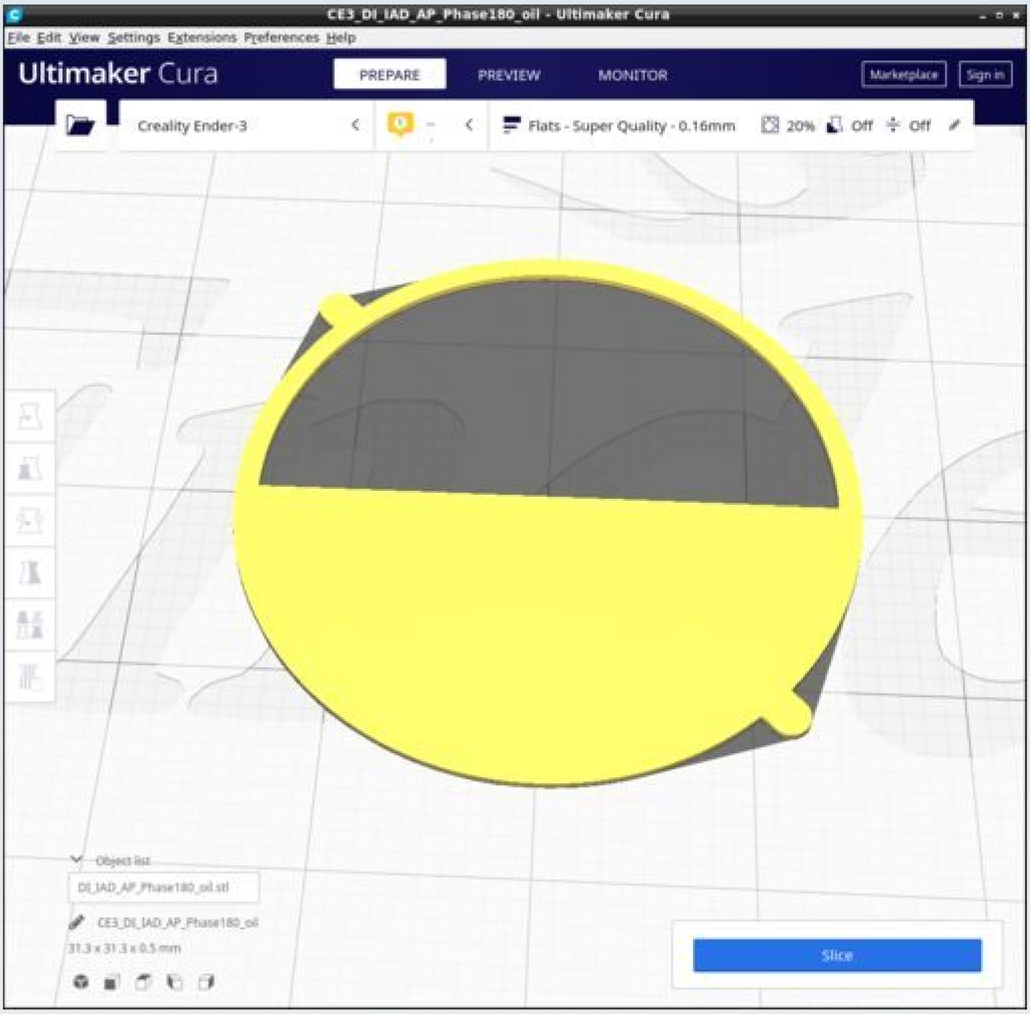
DI_IAD_AP_DF_Stop_2p5



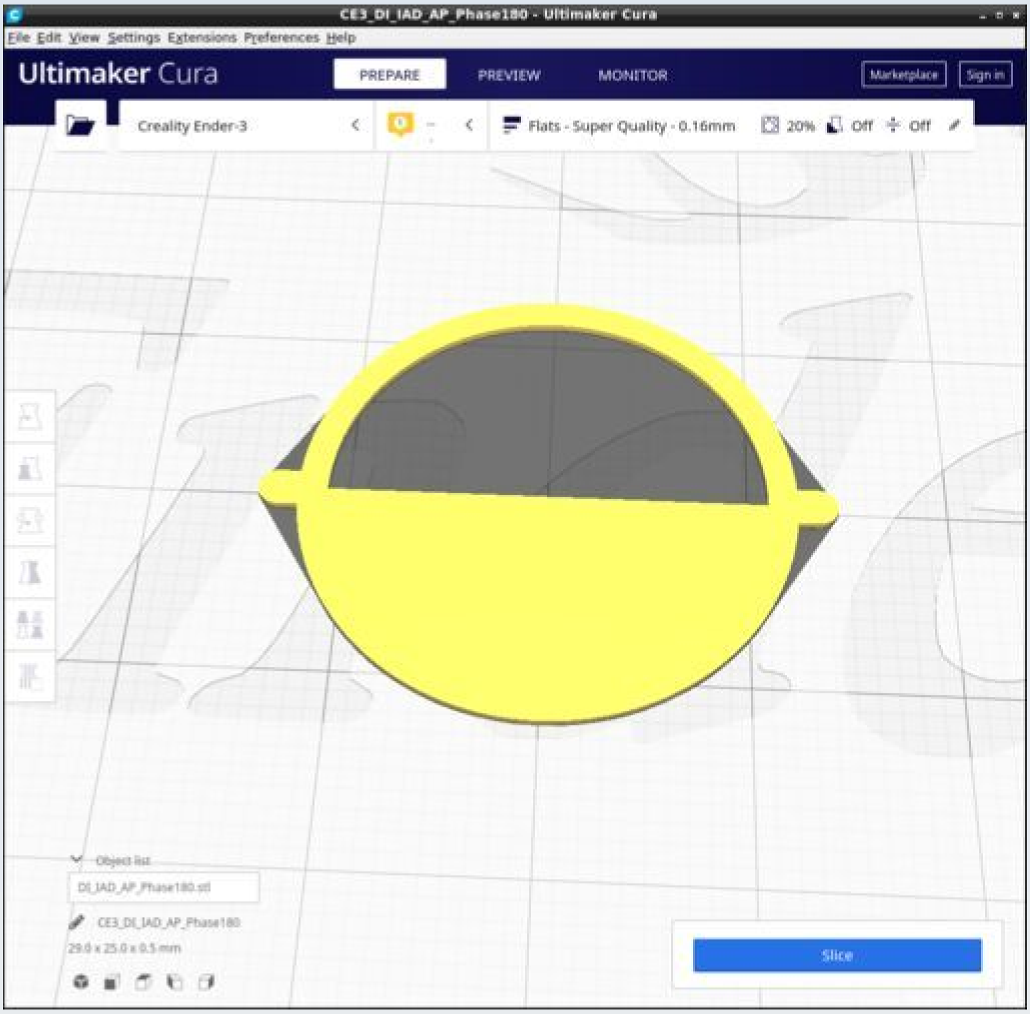
DI_IAD_AP_DF_Stop_oil_20



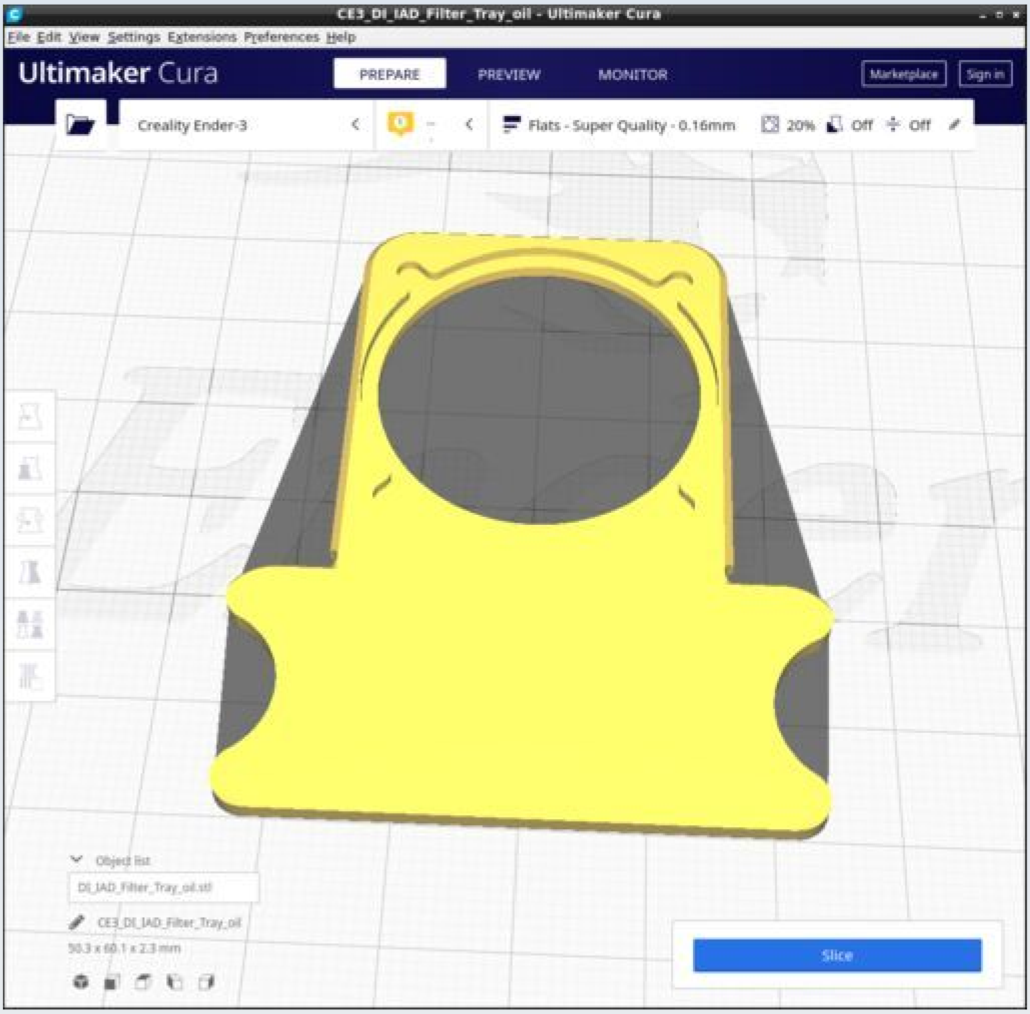
DI_IAD_AP_Phase180_oil



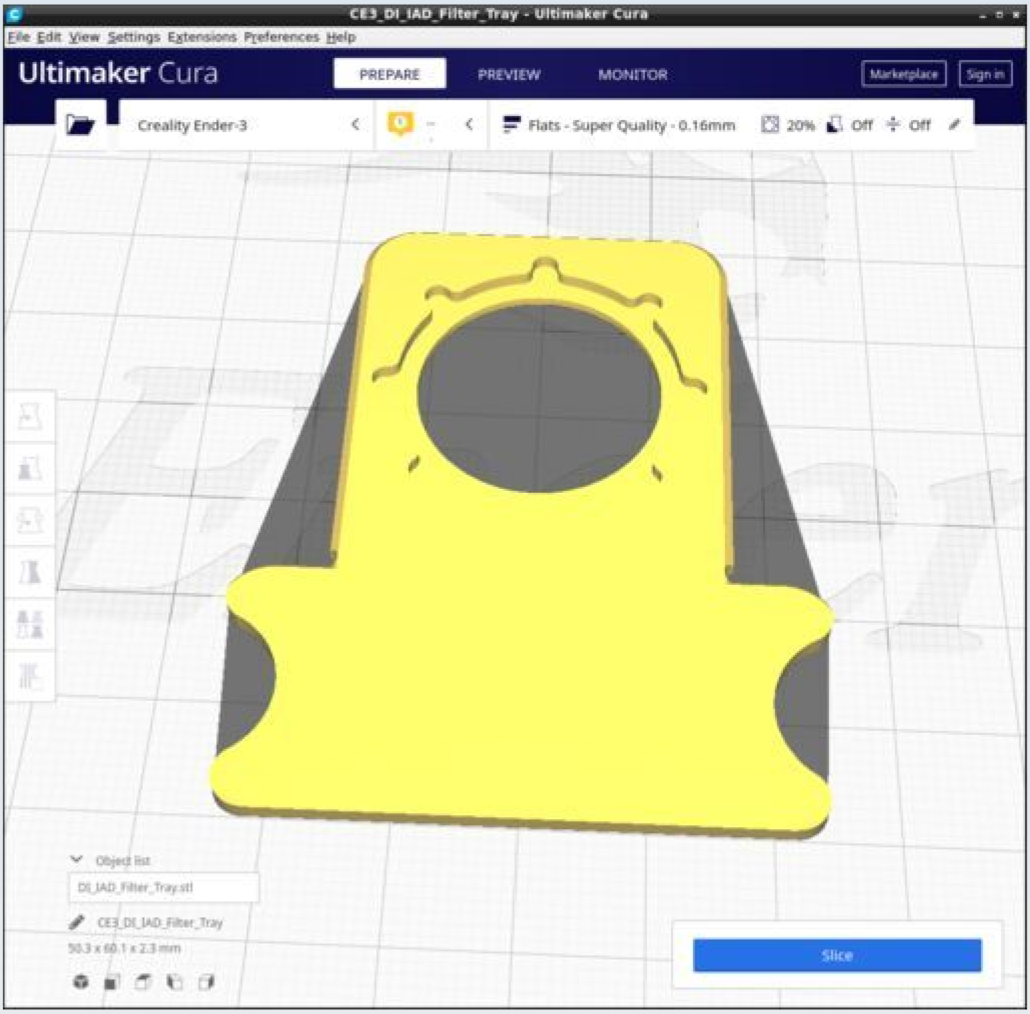
DI_IAD_AP_Phase180



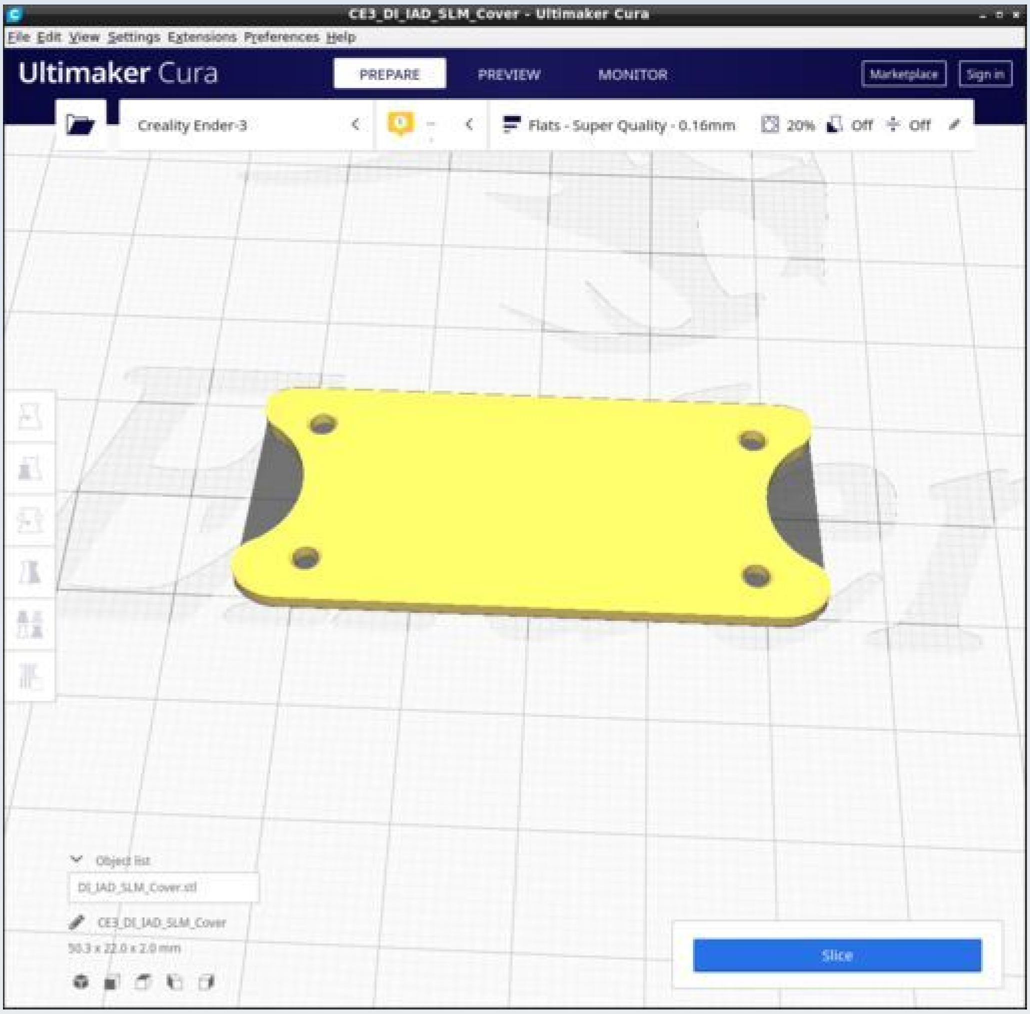
DI_IAD_Filter_Tray_oil



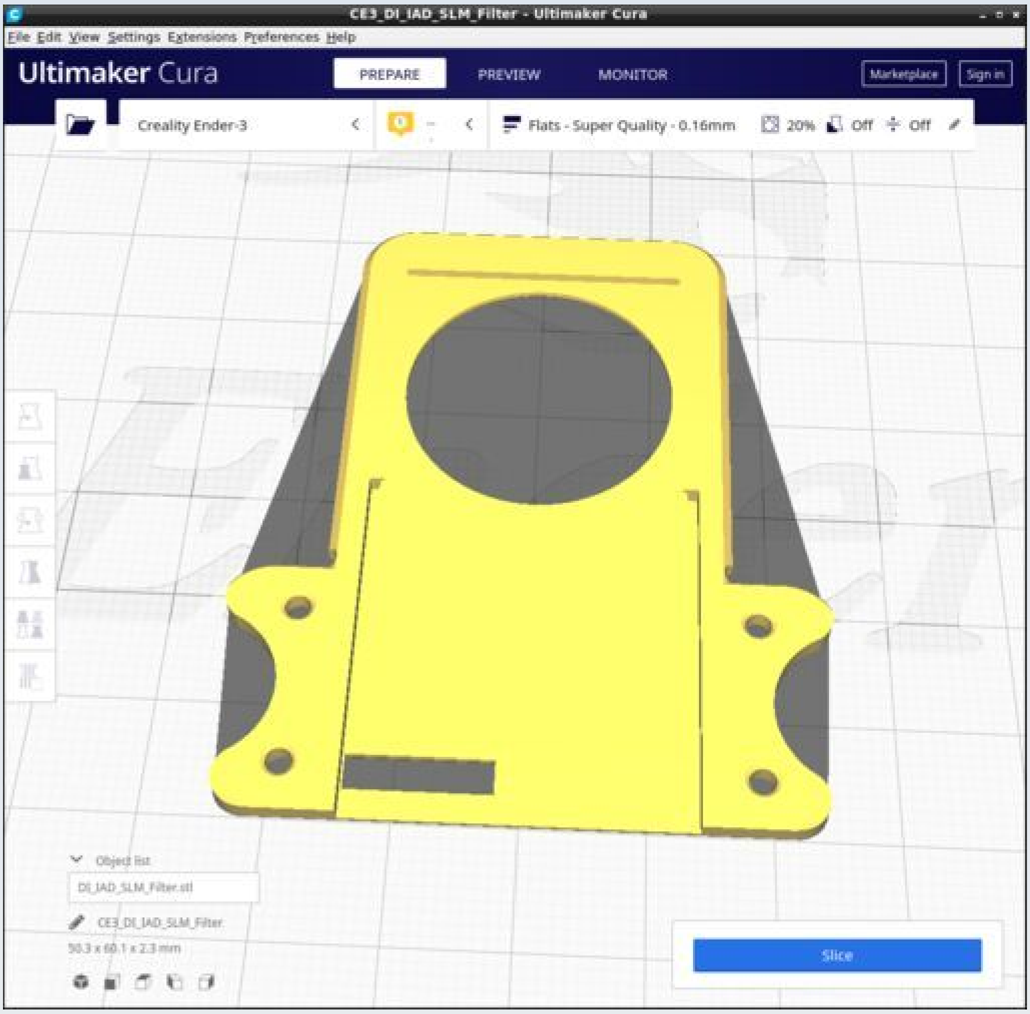
DI_IAD_Filter_Tray



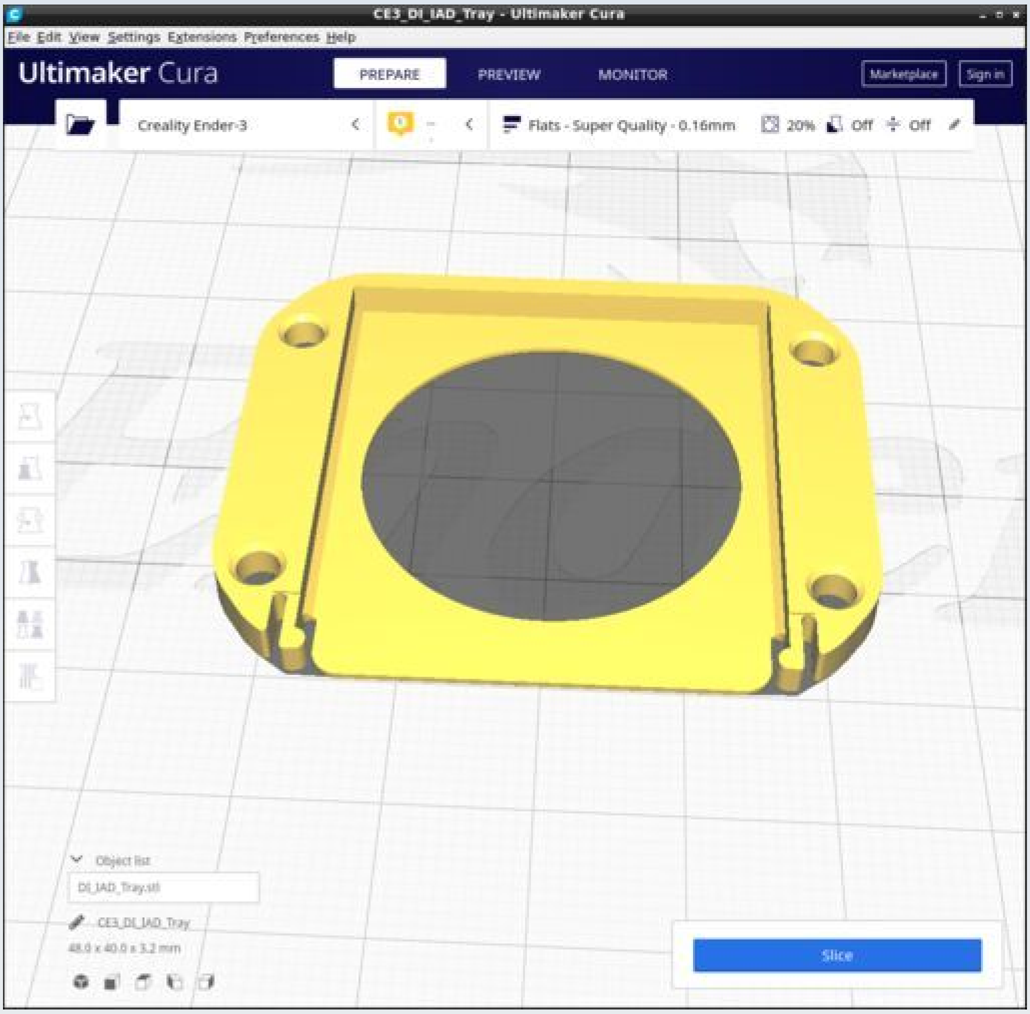
DI_IAD_SLM_Cover



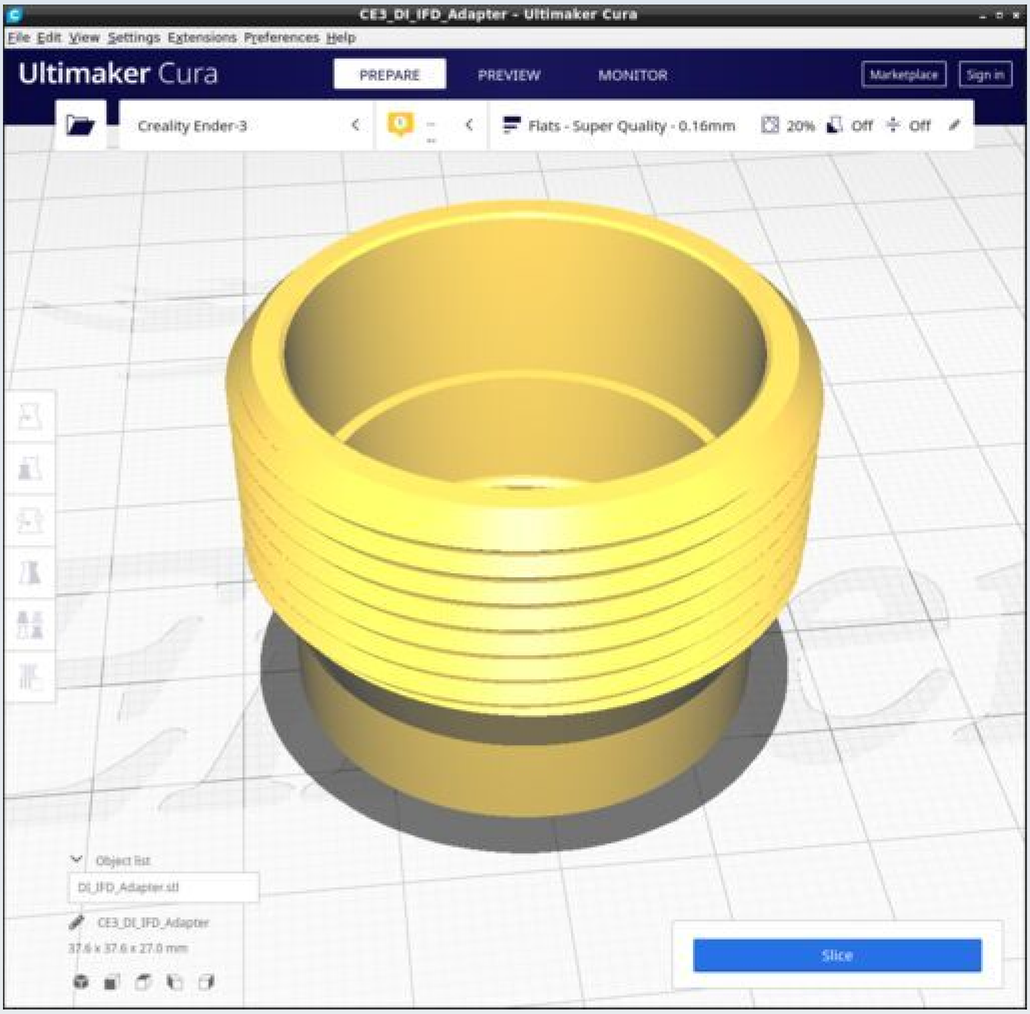
DI_IAD_SLM_Filter



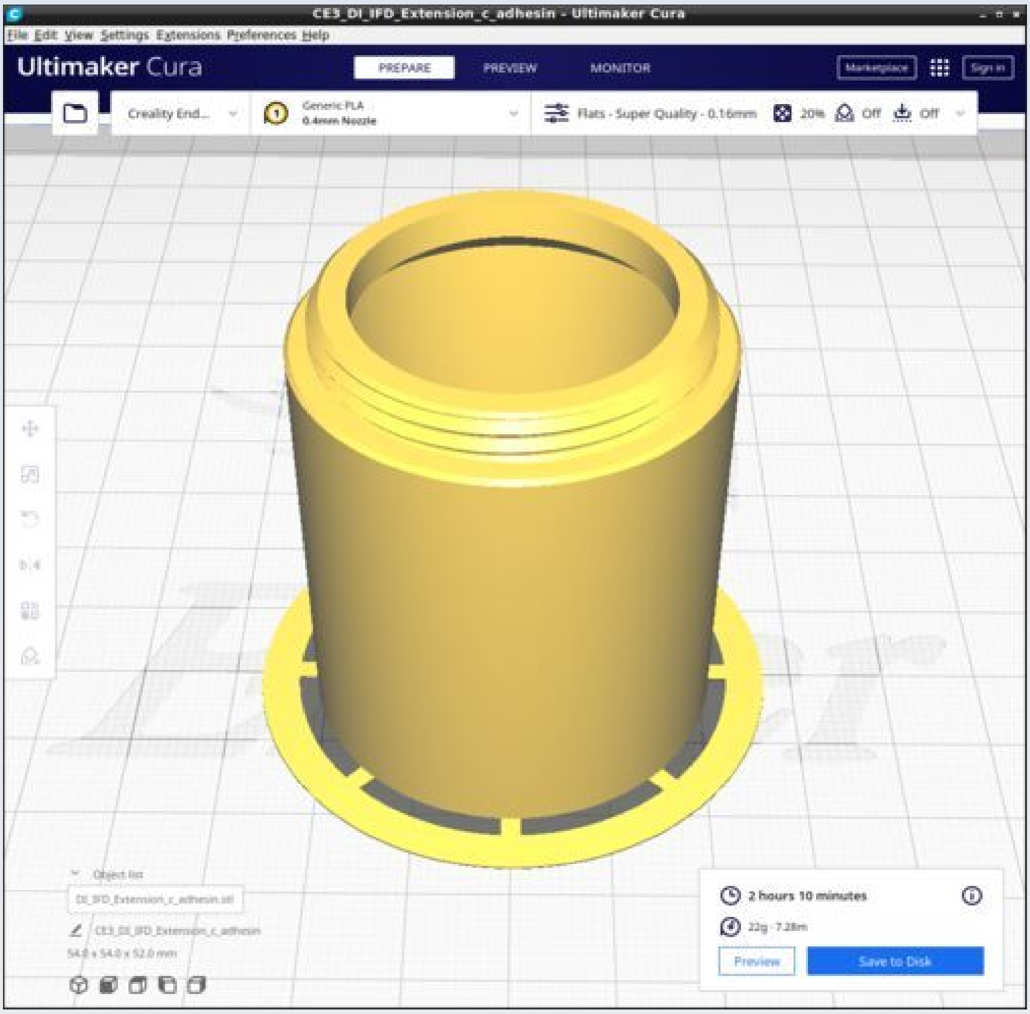
DI_IAD_Tray


CE3_DI_IAD_Tray - Ultimaker Cura
File Edit View Settings Extensions Preferences Help
Ultimaker Cura
PREPARE
PREVIEW
MONITOR
Marketplace
Sign in
Creality Ender-3
Flats - Super Quality - 0.16mm
20%
Off
Off
Object list
DI_IAD_Tray.stl
CE3_DI_IAD_Tray
48.0 x 40.0 x 3.2 mm
Slice

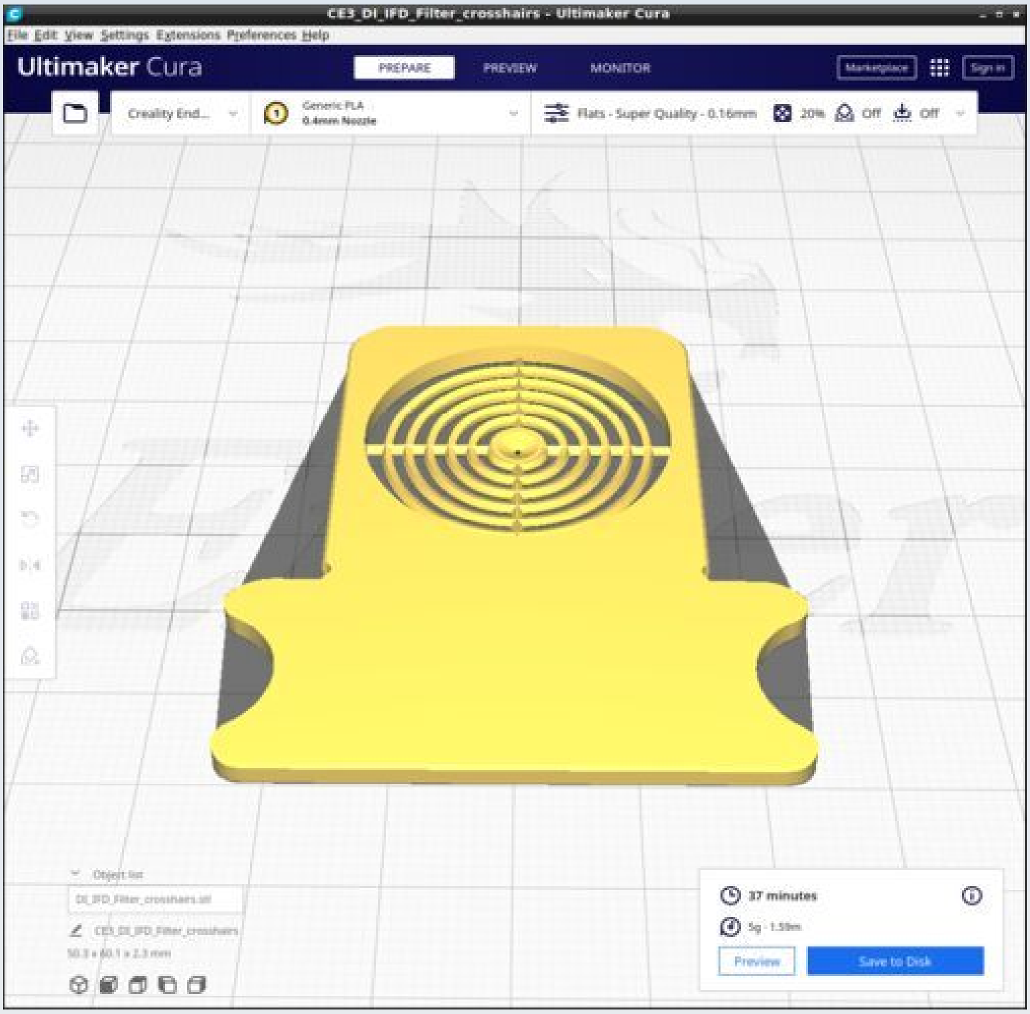
DI_IFD_Adapter



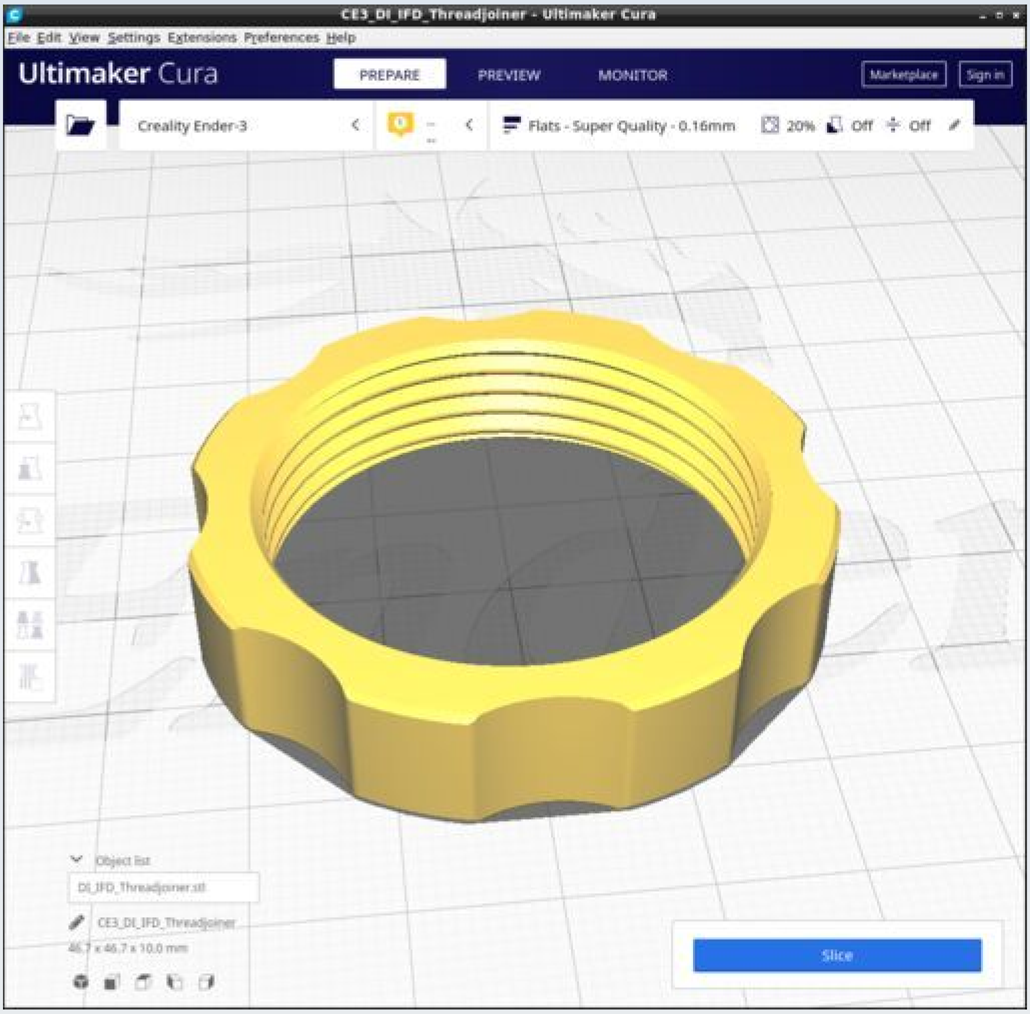
DI_IFD_Extension



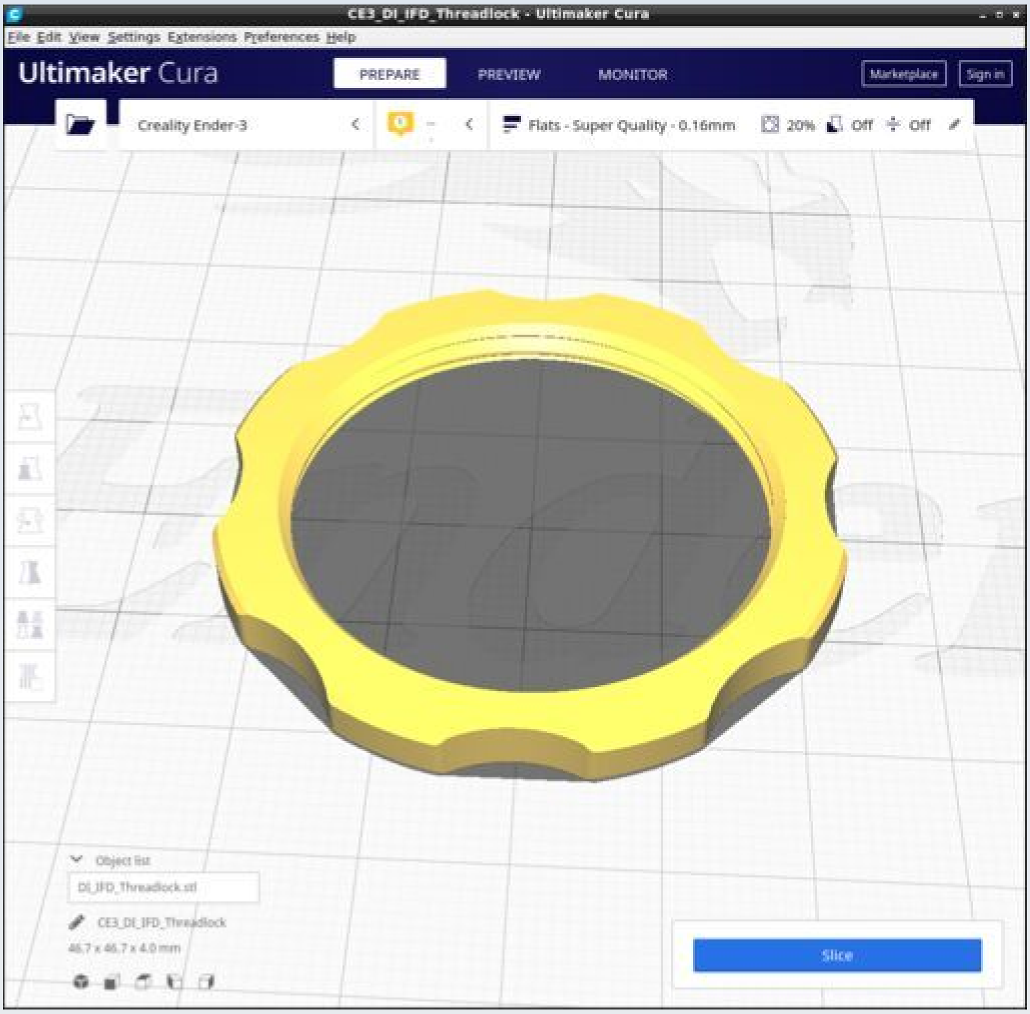
DI_IFD_Filter_crosshairs



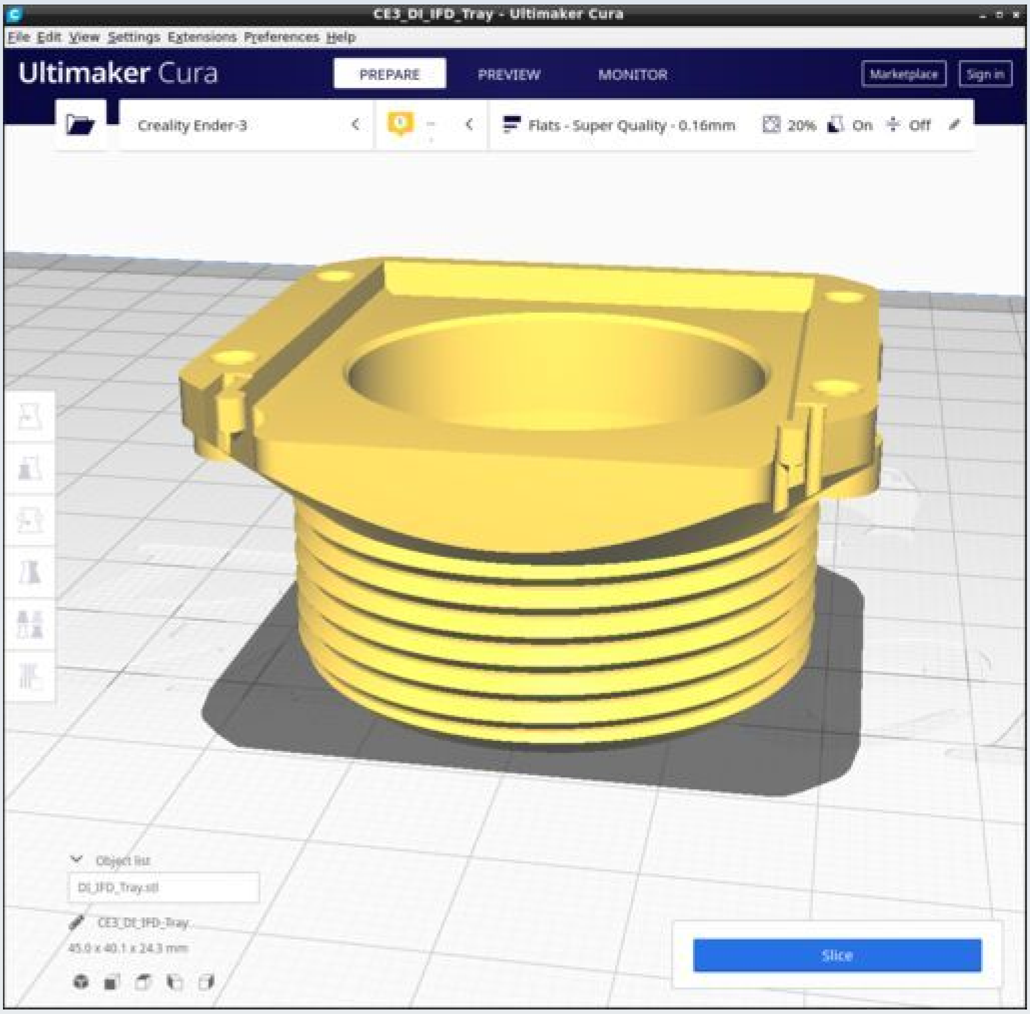
DI_IFD_Threadjoiner



DI_IFD_Threadlock

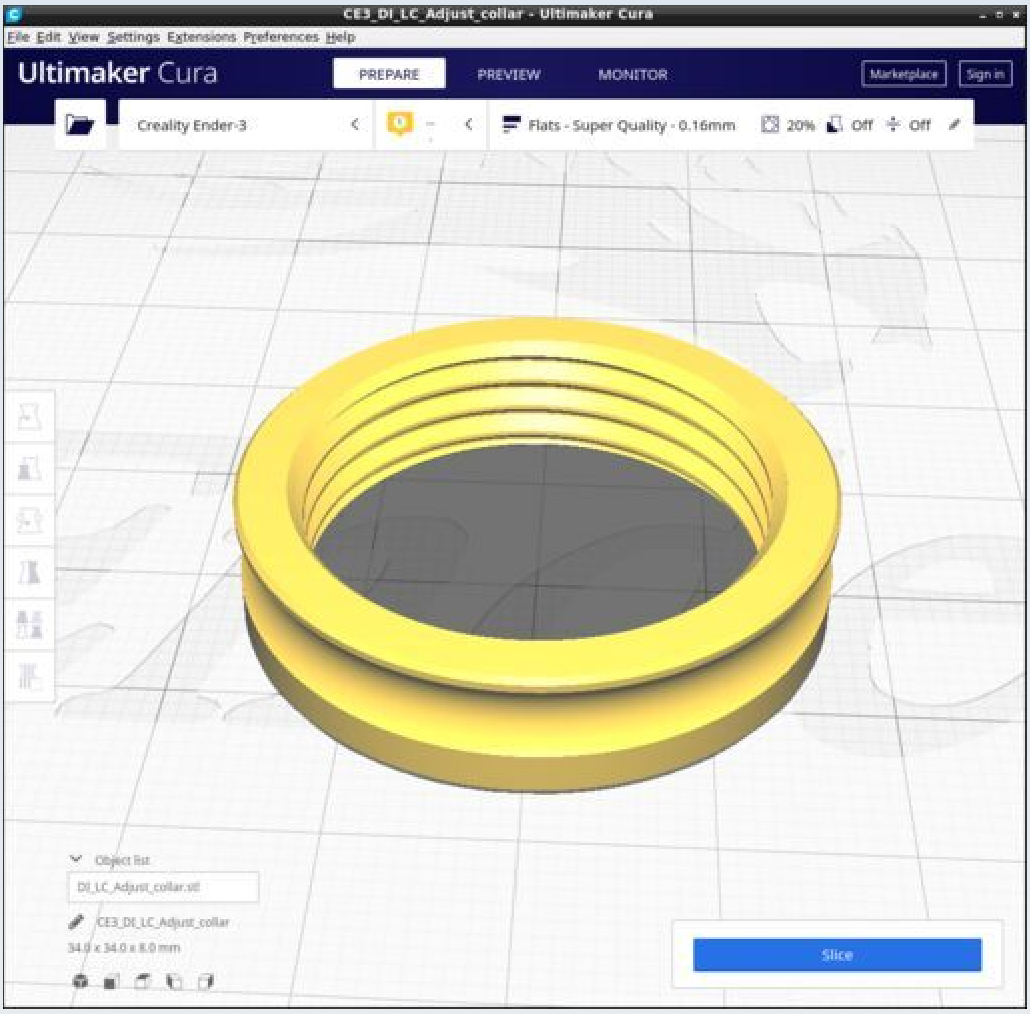


DI_IFD_Tray

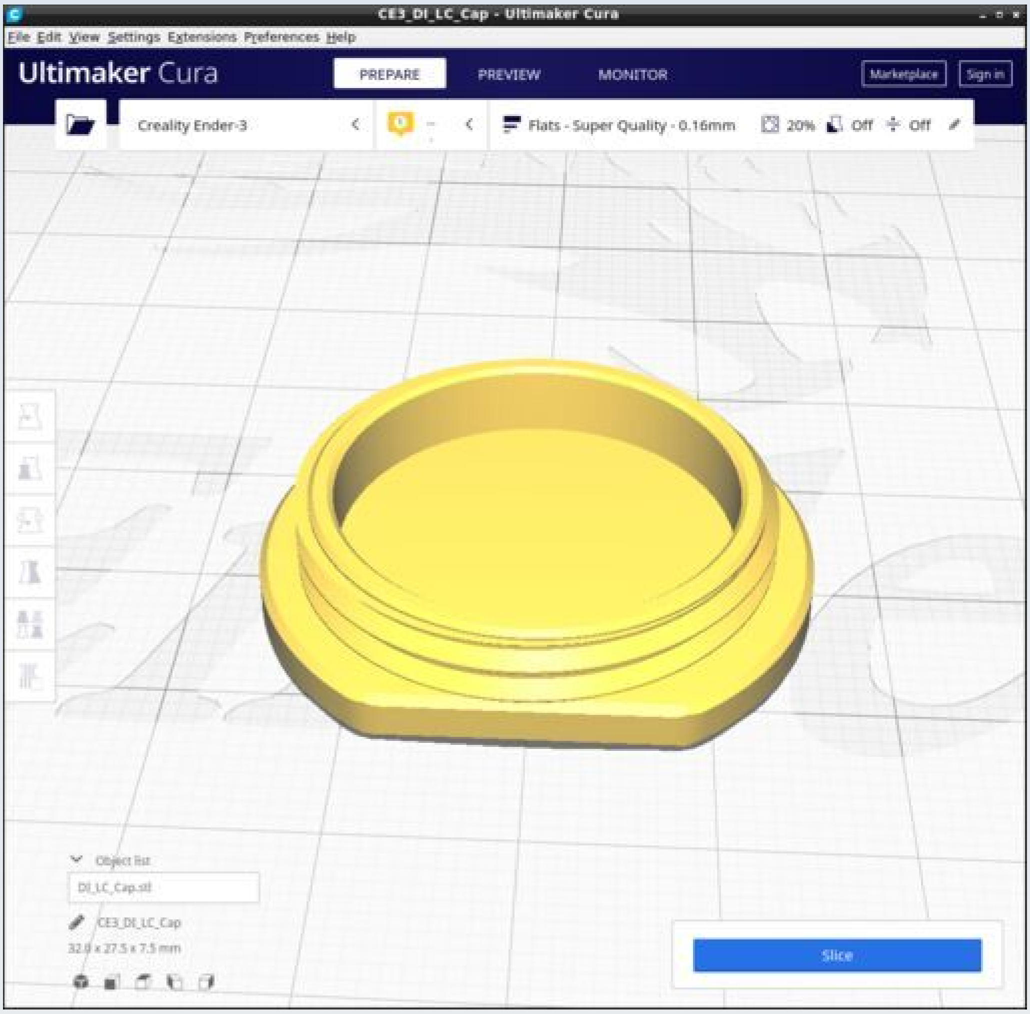


Supports on for 'touching build plate only'

DI_LC_Adjust_collar

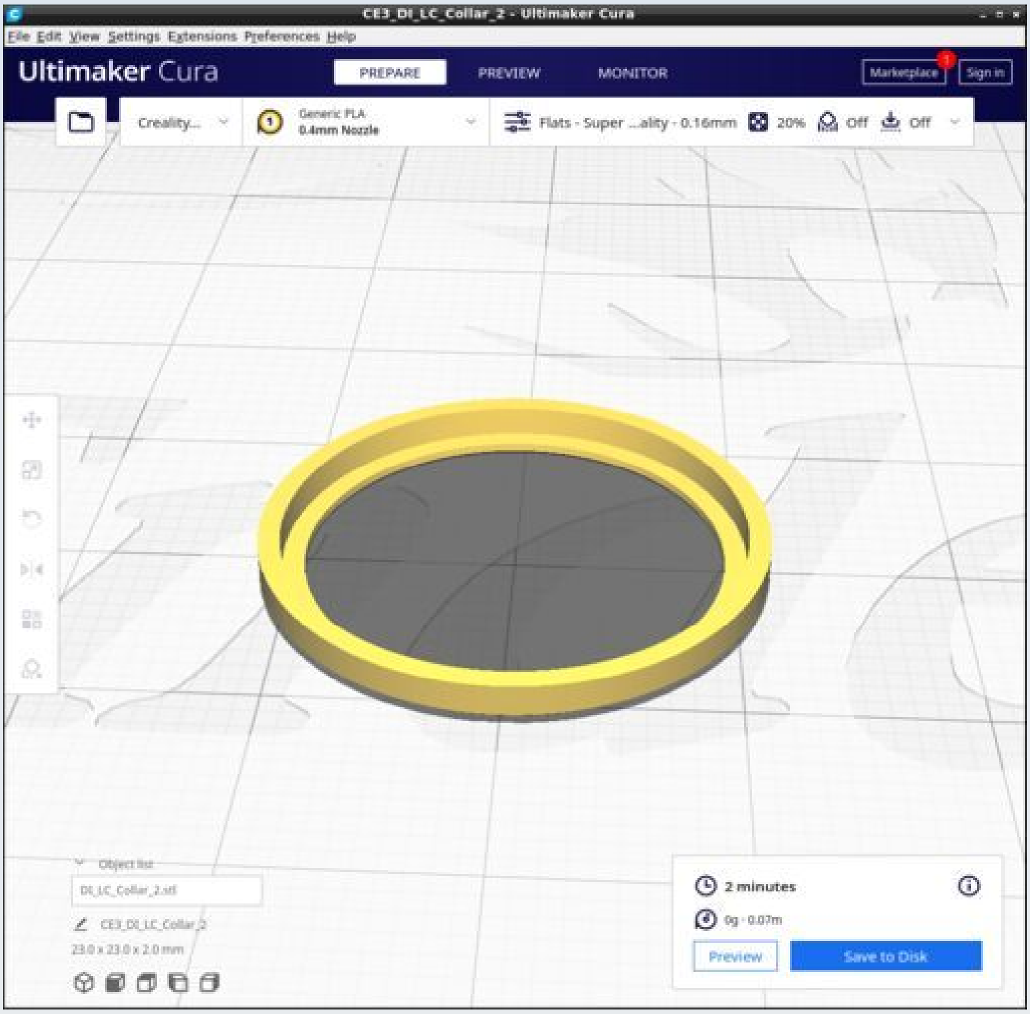


DI_LC_Cap

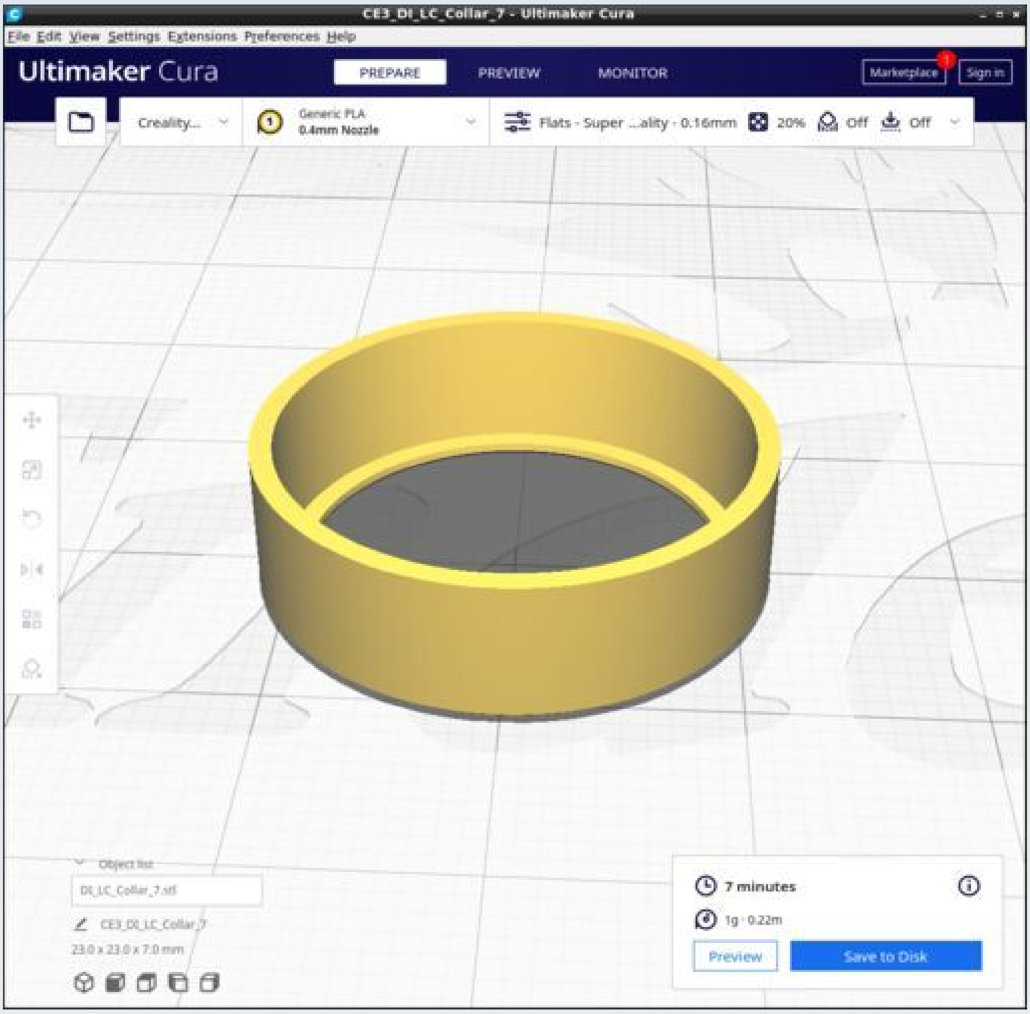


CE3_DI_LC_Cap - Ultimaker Cura
File Edit View Settings Extensions Preferences Help
Ultimaker Cura
PREPARE
PREVIEW
MONITOR
Marketplace
Sign in
Creality Ender-3
Flats - Super Quality - 0.16mm
20%
Off
Off
Object list
DI_LC_Cap.stl
CE3_DI_LC_Cap
32.0 x 27.5 x 7.5 mm
Slice

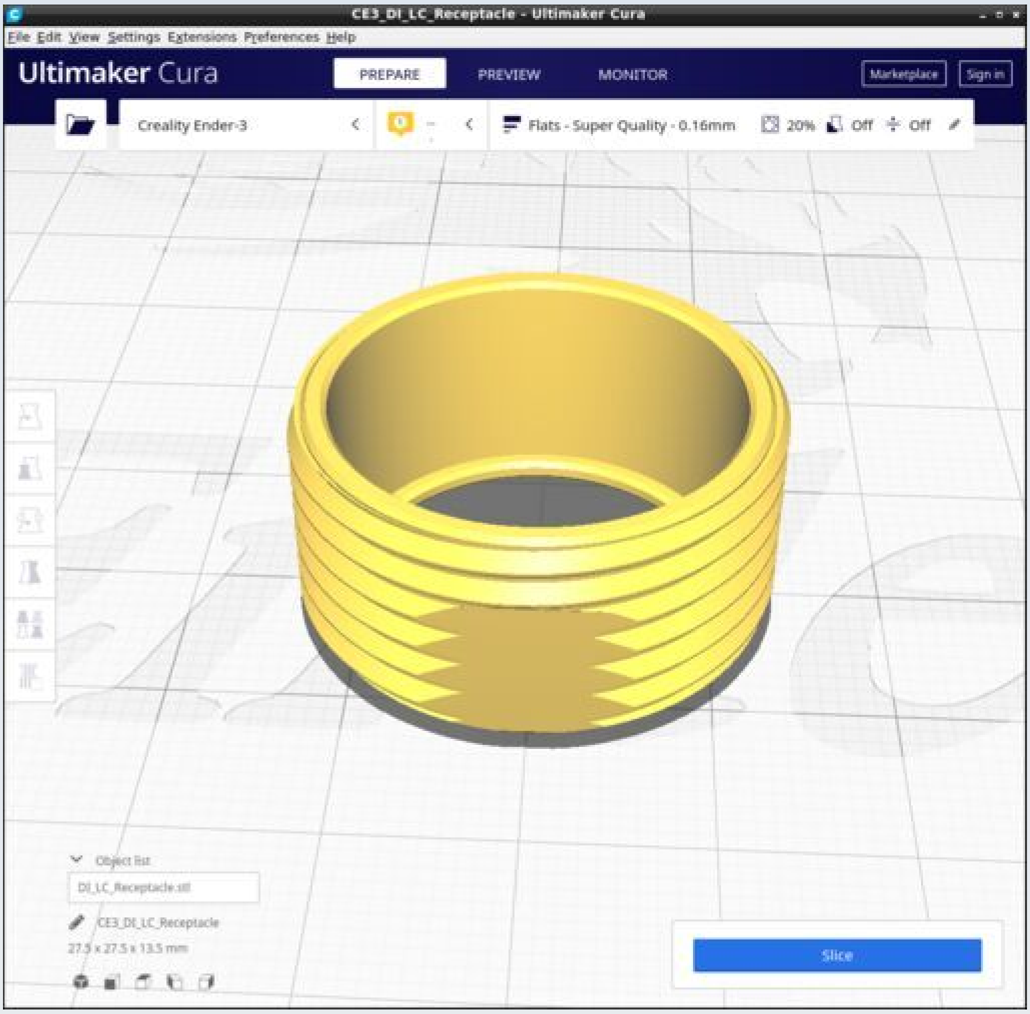
DI_LC_Collar_2



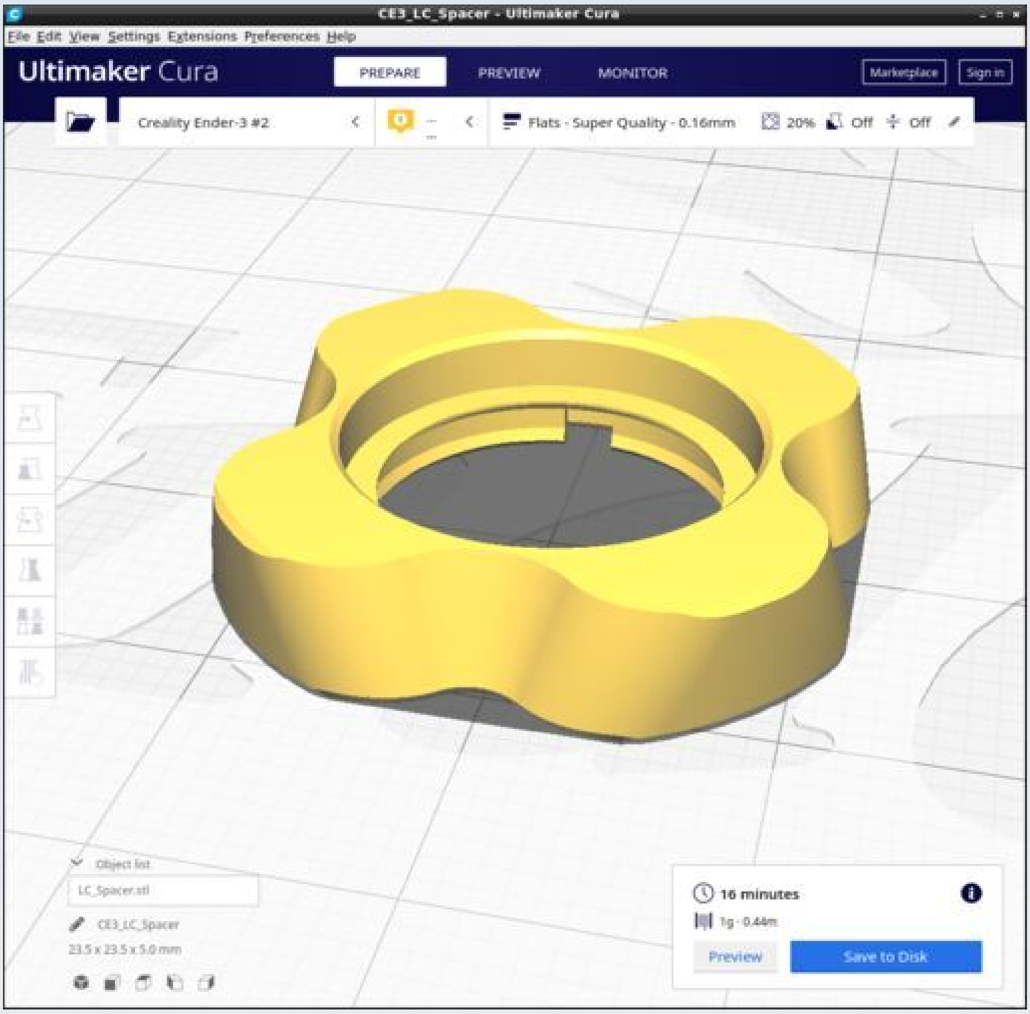
DI_LC_Collar_7



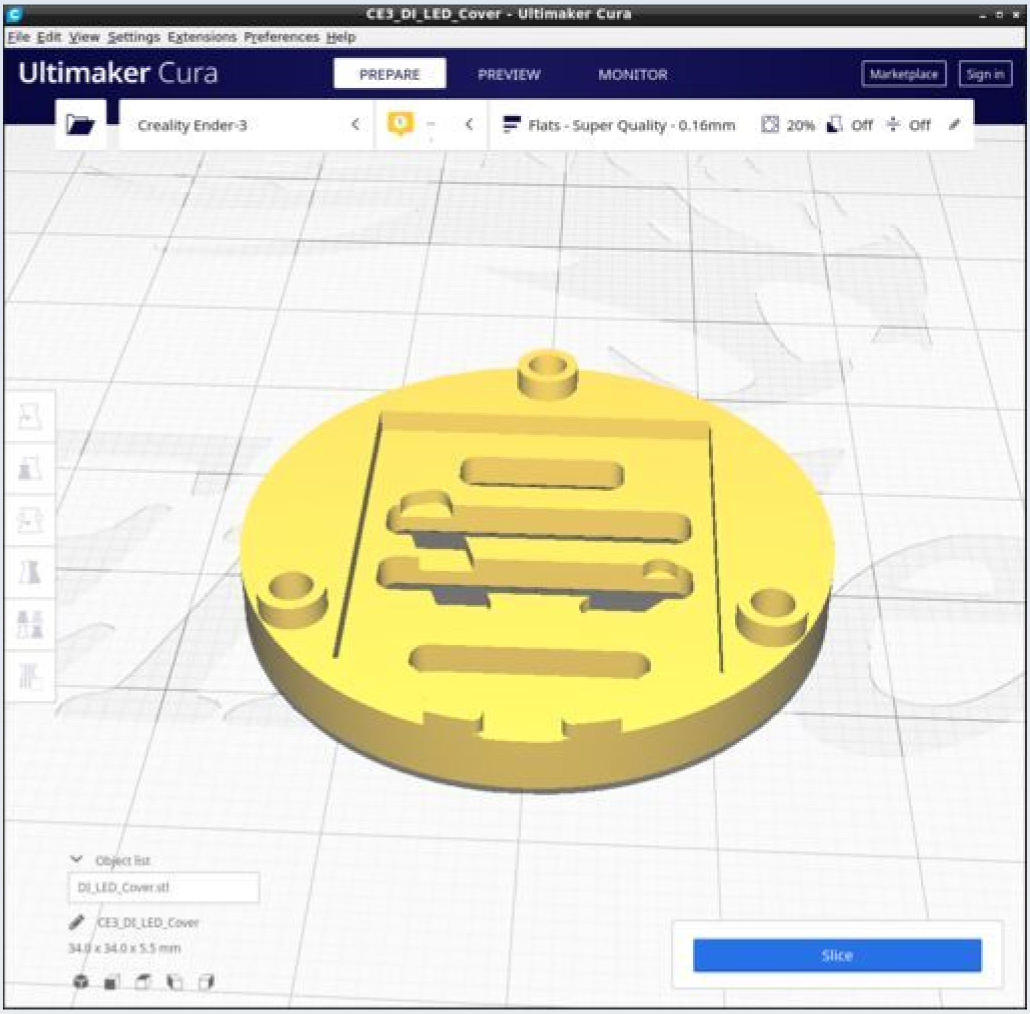
DI_LC_Receptacle



DI_LC_Spacer

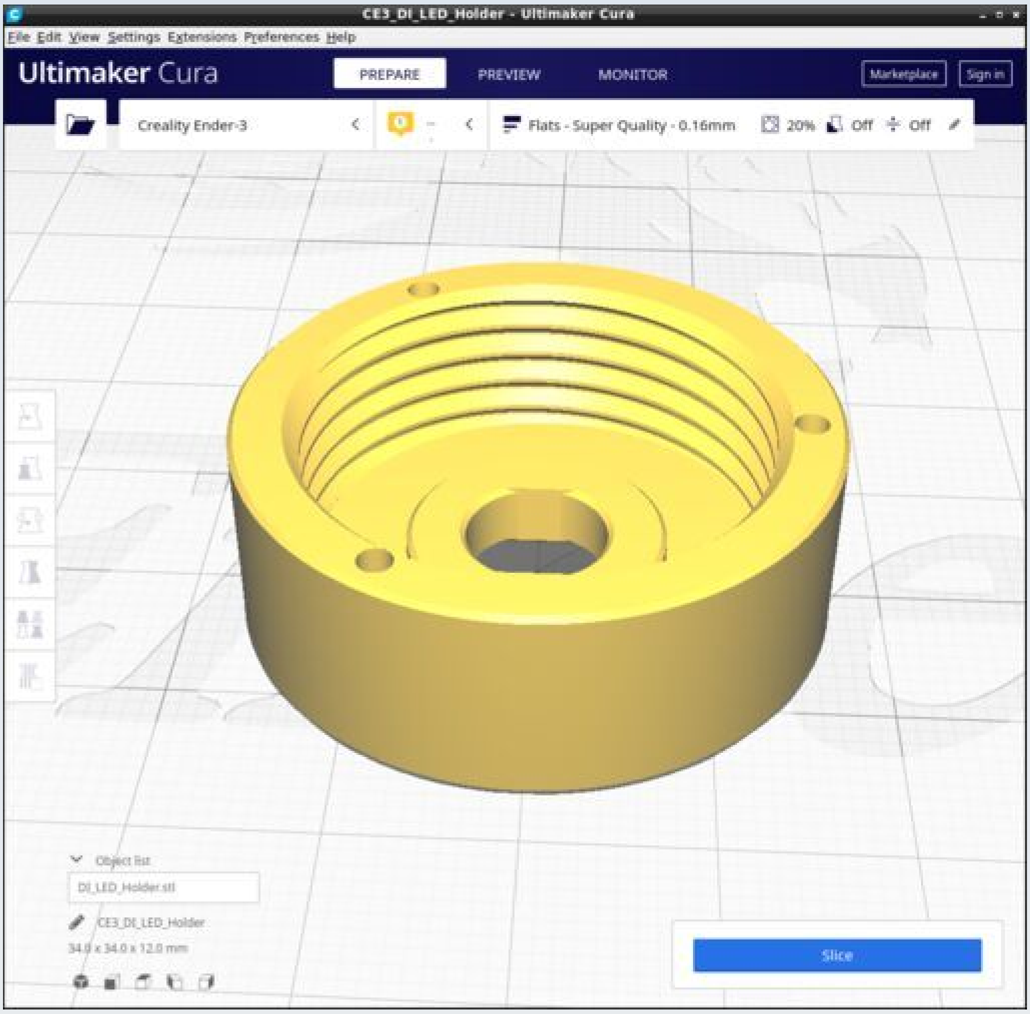

CE3_LC_Spacer - Ultimaker Cura
File Edit View Settings Extensions Preferences Help
Ultimaker Cura
PREPARE
PREVIEW
MONITOR
Marketplace
Sign in
Creality Ender-3 #2
Flats - Super Quality - 0.16mm
20%
Off
Off
Object list
LC_Spacer.stl
CE3_LC_Spacer
23.5 x 23.5 x 5.0 mm
16 minutes
1g · 0.44m
Preview
Save to Disk

DI_LED_Cover

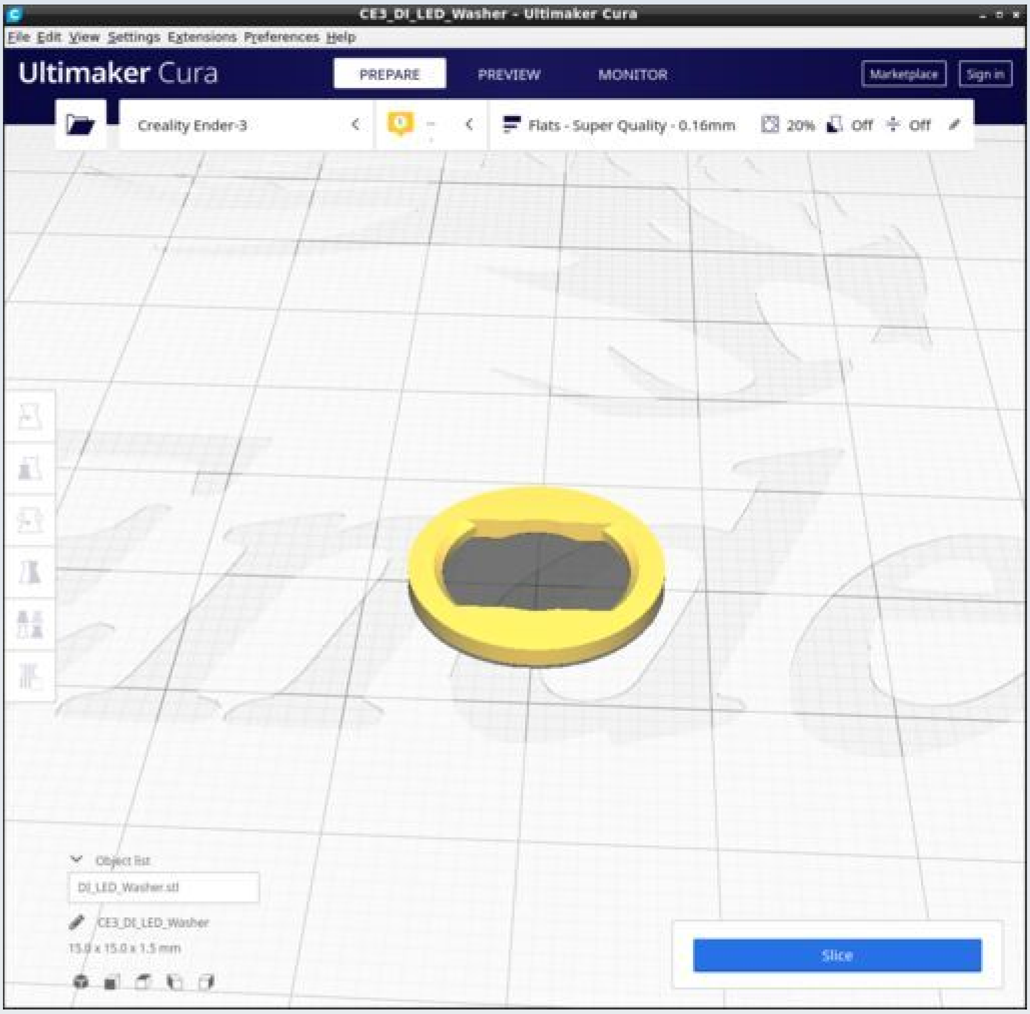


CE3_DI_LED_Cover - Ultimaker Cura
File Edit View Settings Extensions Preferences Help
Ultimaker Cura
PREPARE
PREVIEW
MONITOR
Marketplace
Sign in
Creality Ender-3
Flats - Super Quality - 0.16mm
20%
Off
Off
Object list
DI_LED_Cover.stl
CE3_DI_LED_Cover
34.0 x 34.0 x 5.5 mm
Slice

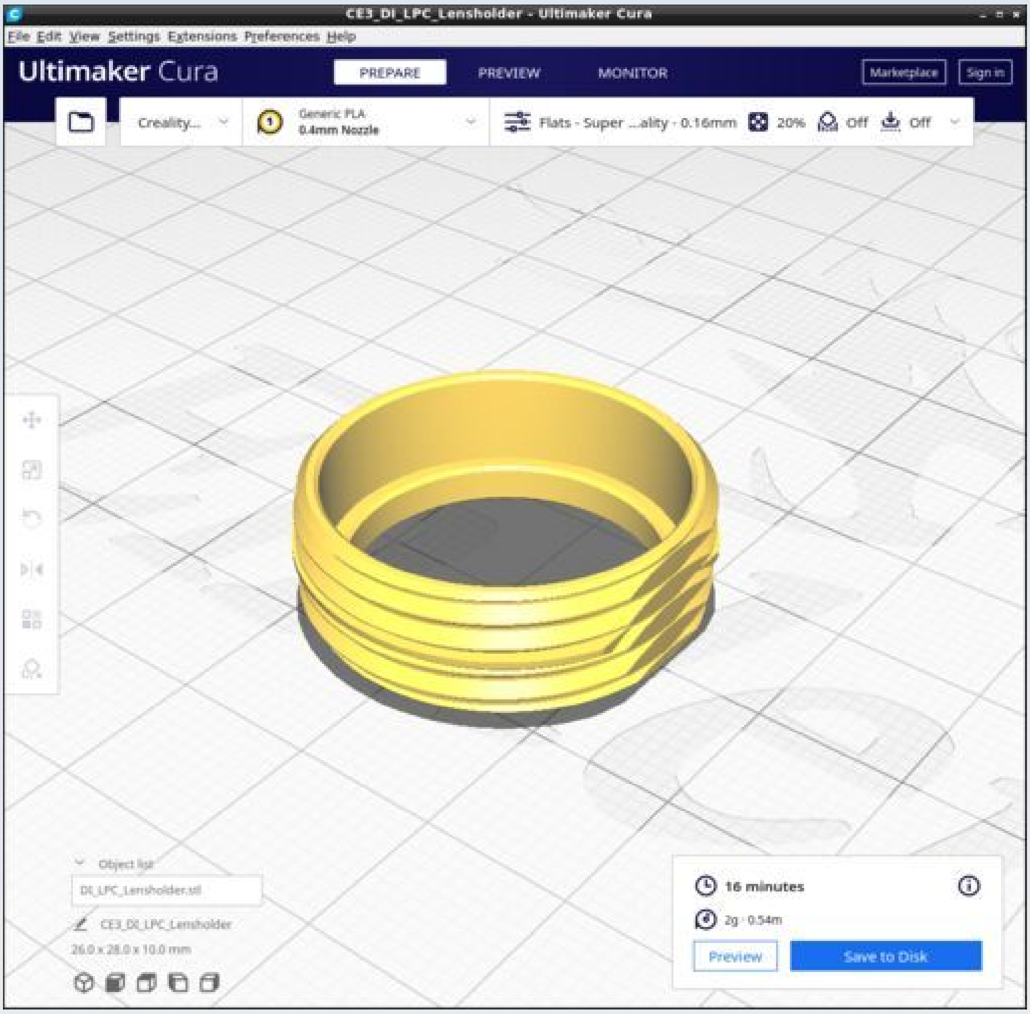
DI_LED_Holder



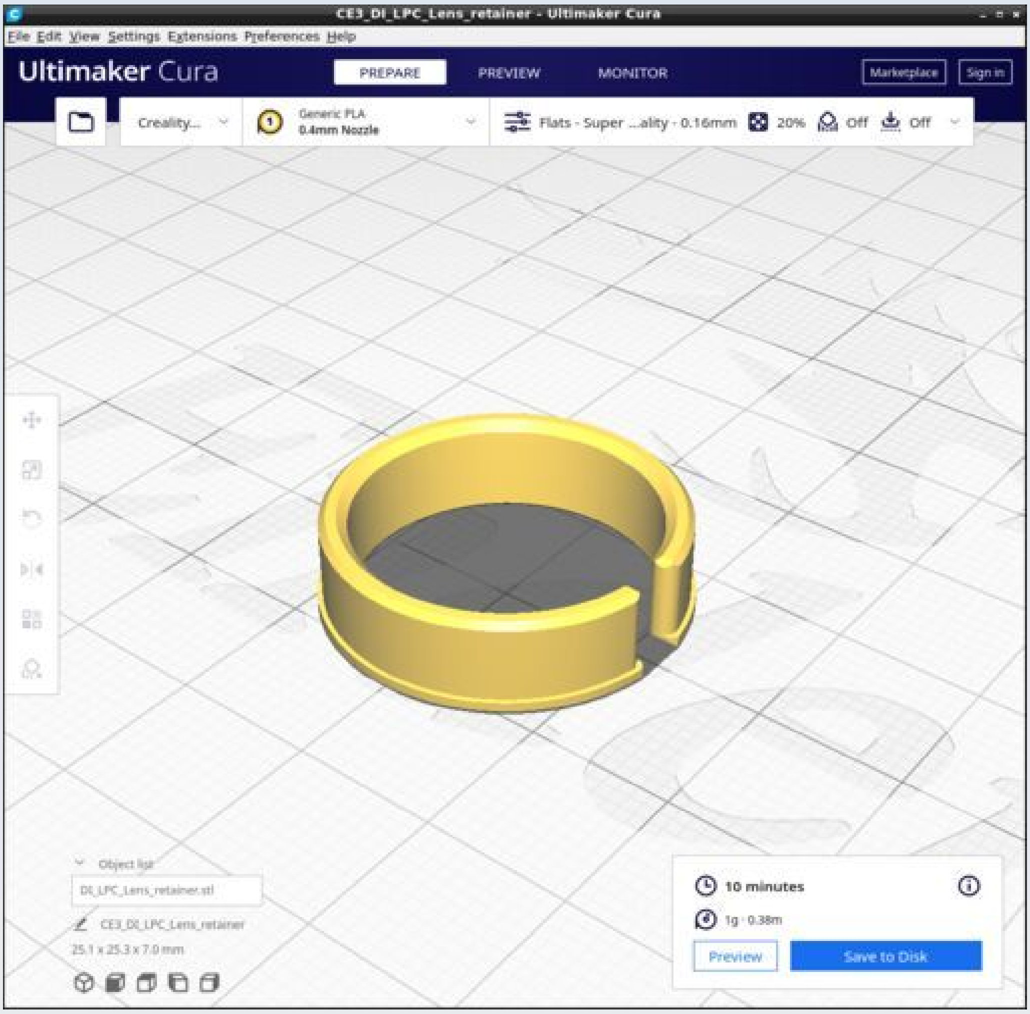
DI_LED_Washer



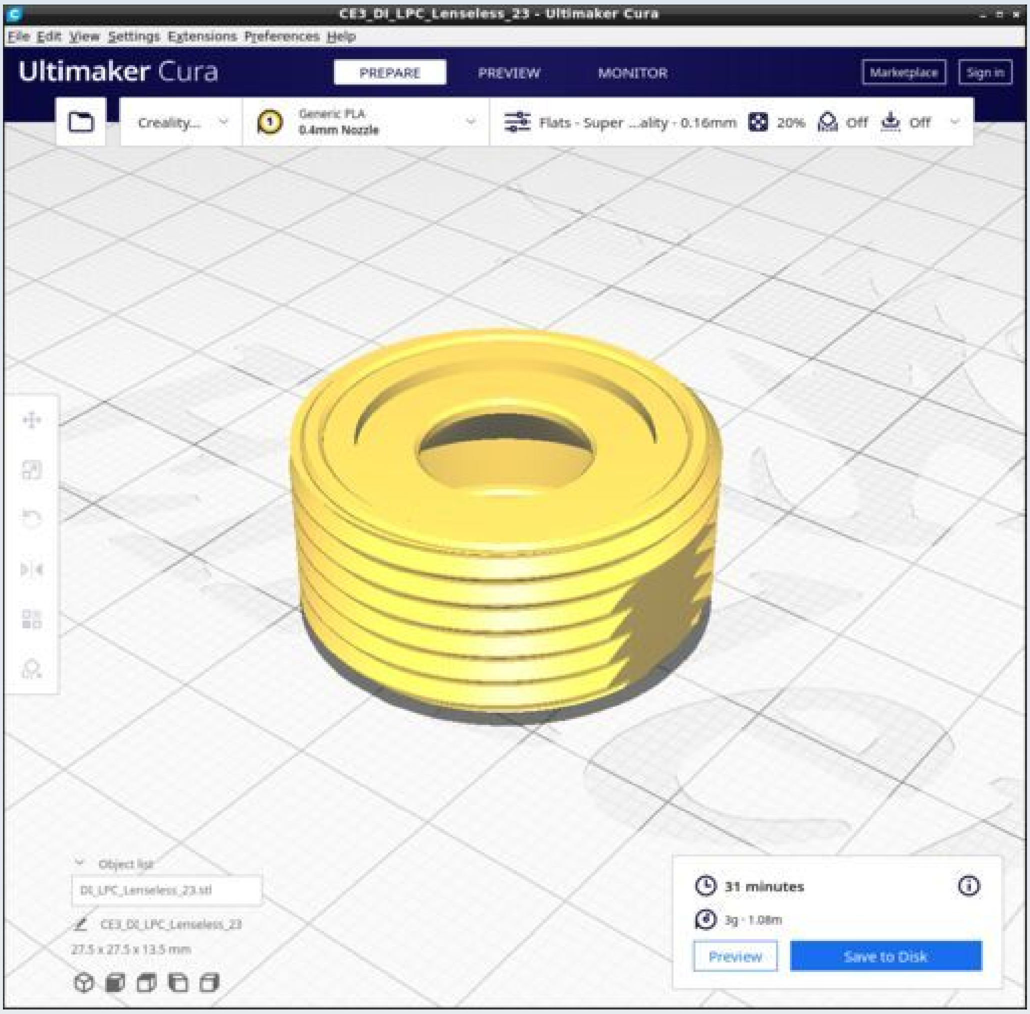
DI_LPC_Lensholder



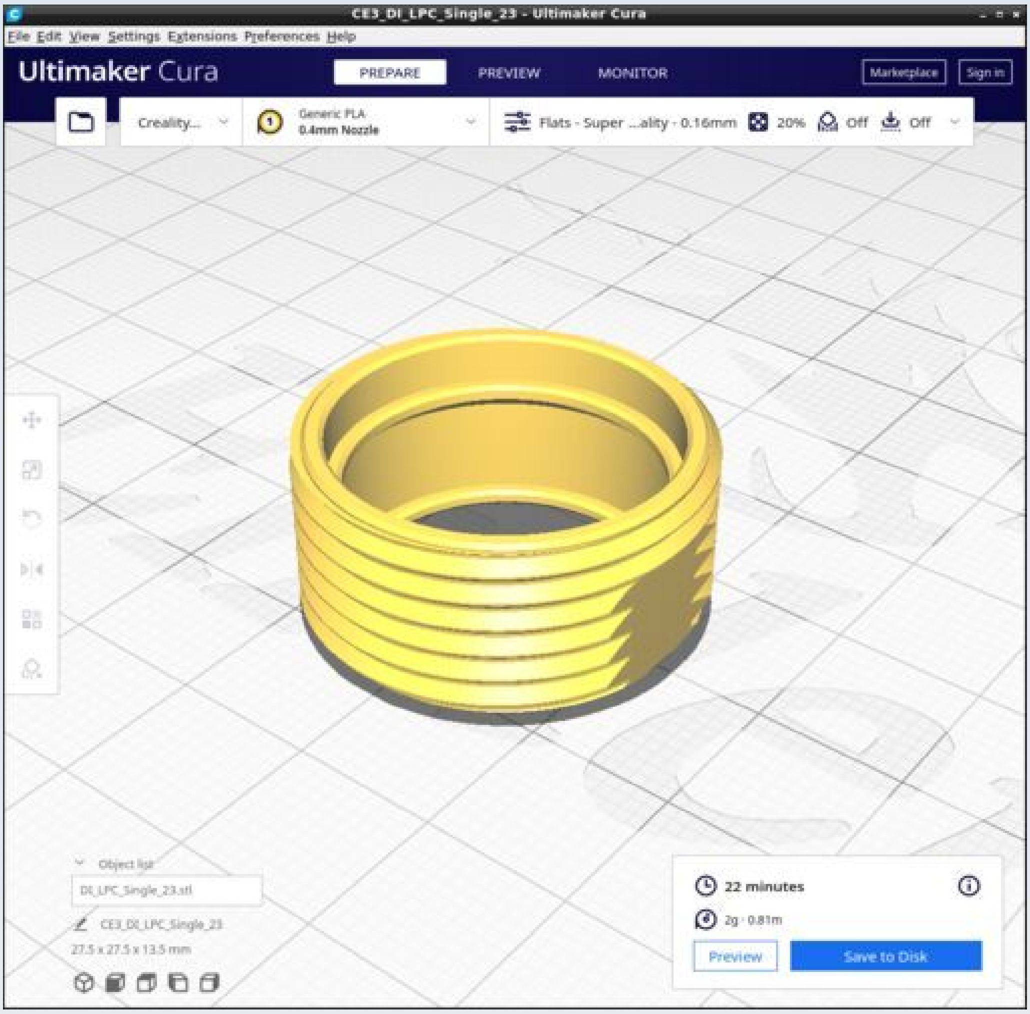
DI_LPC_Lens_retainer



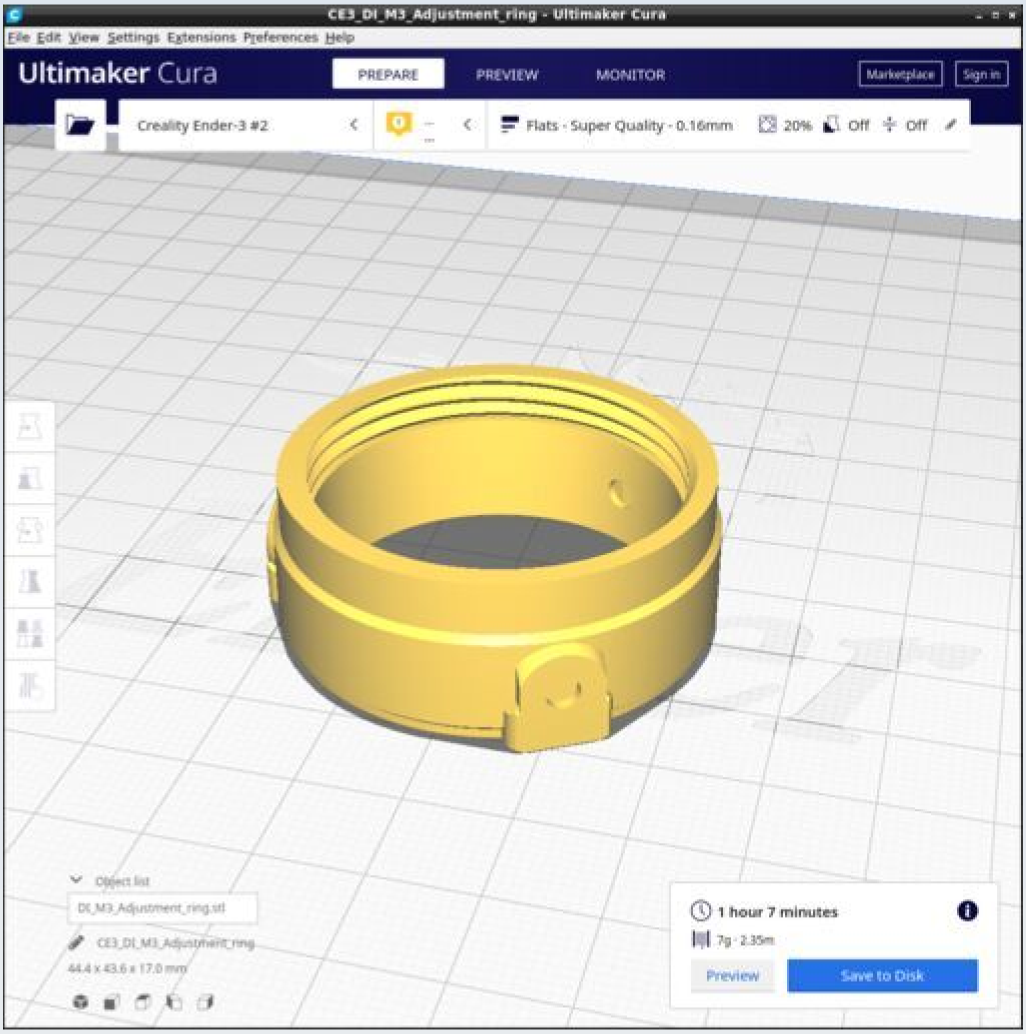
DI_LPC_Lensless_23



DI_LPC_Single_23

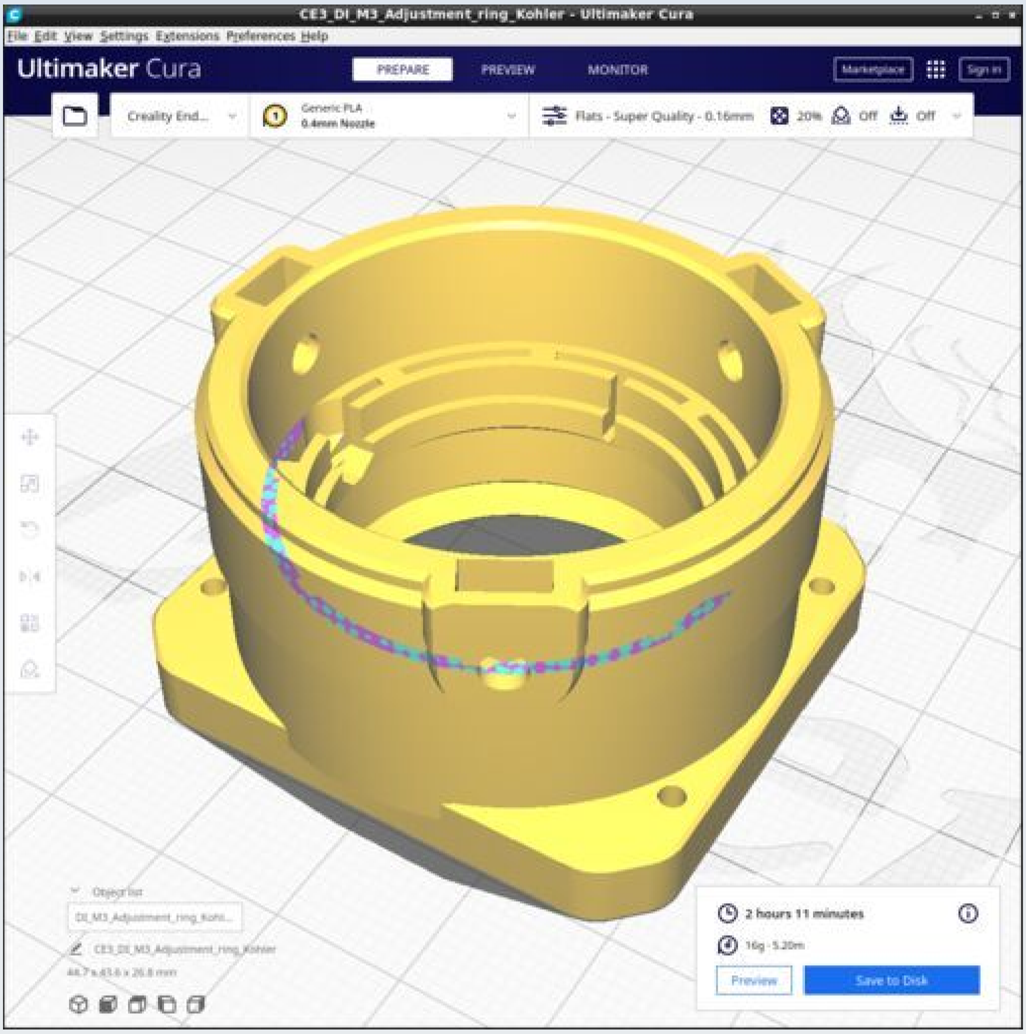


DI_M3_Adjustment_ring



Ensure all supports are OFF

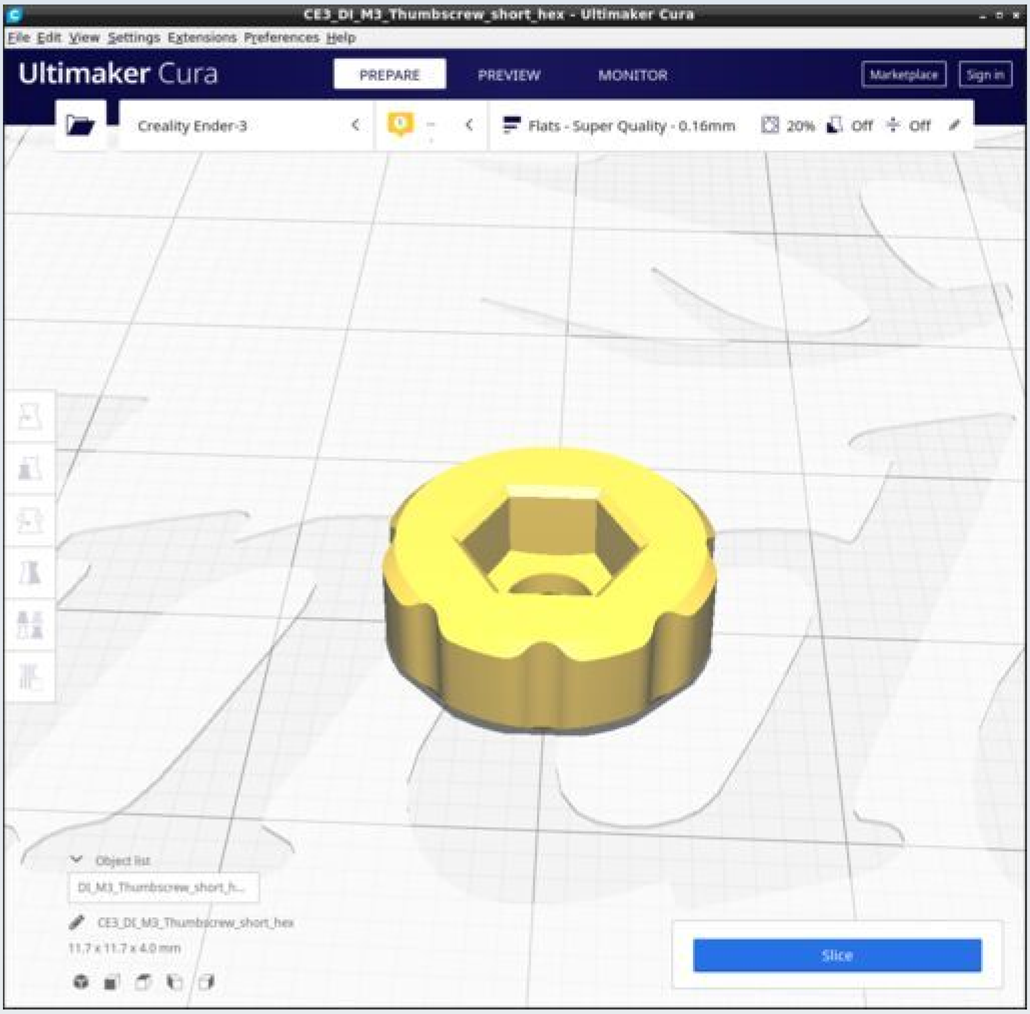
DI_M3_Adjustment_ring_Kohler



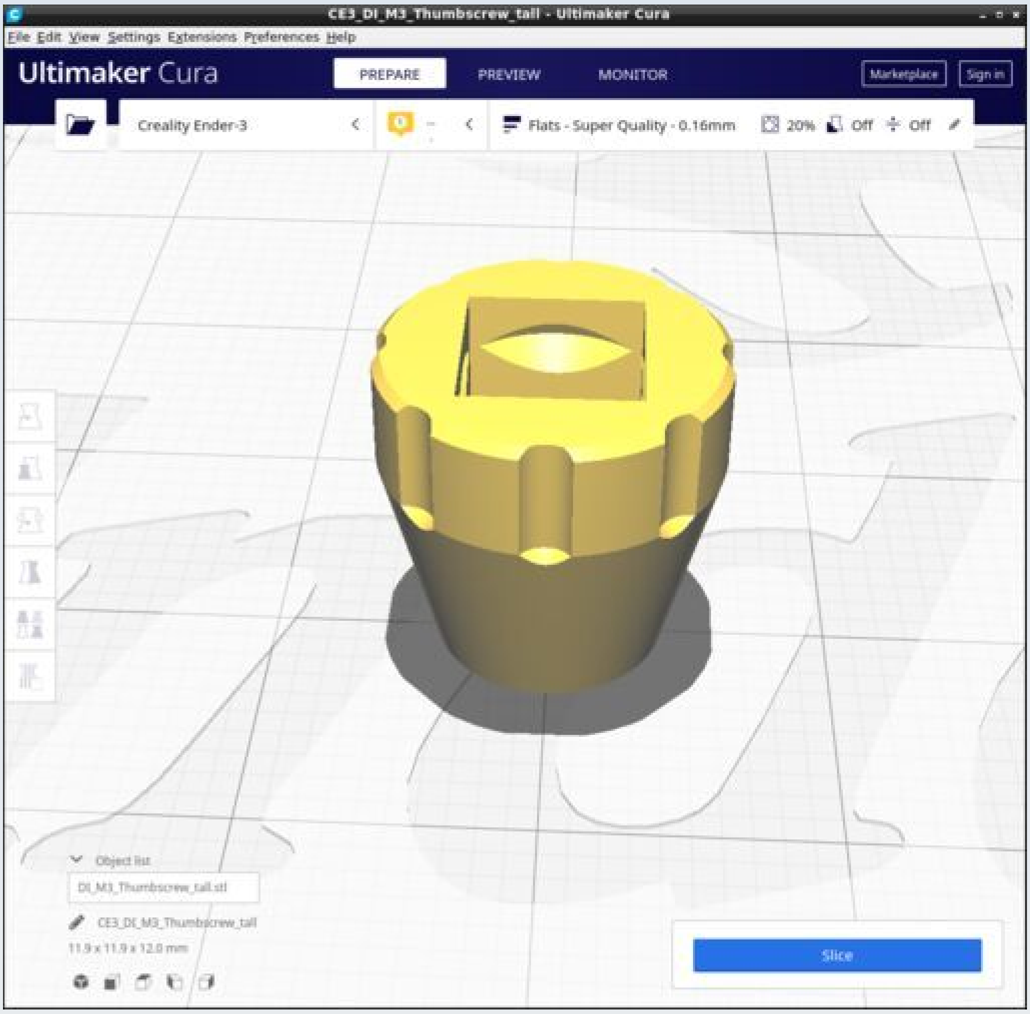
Ensure all supports are OFF.

Ignore the ‘model error’ / ‘mesh error’ warnings.

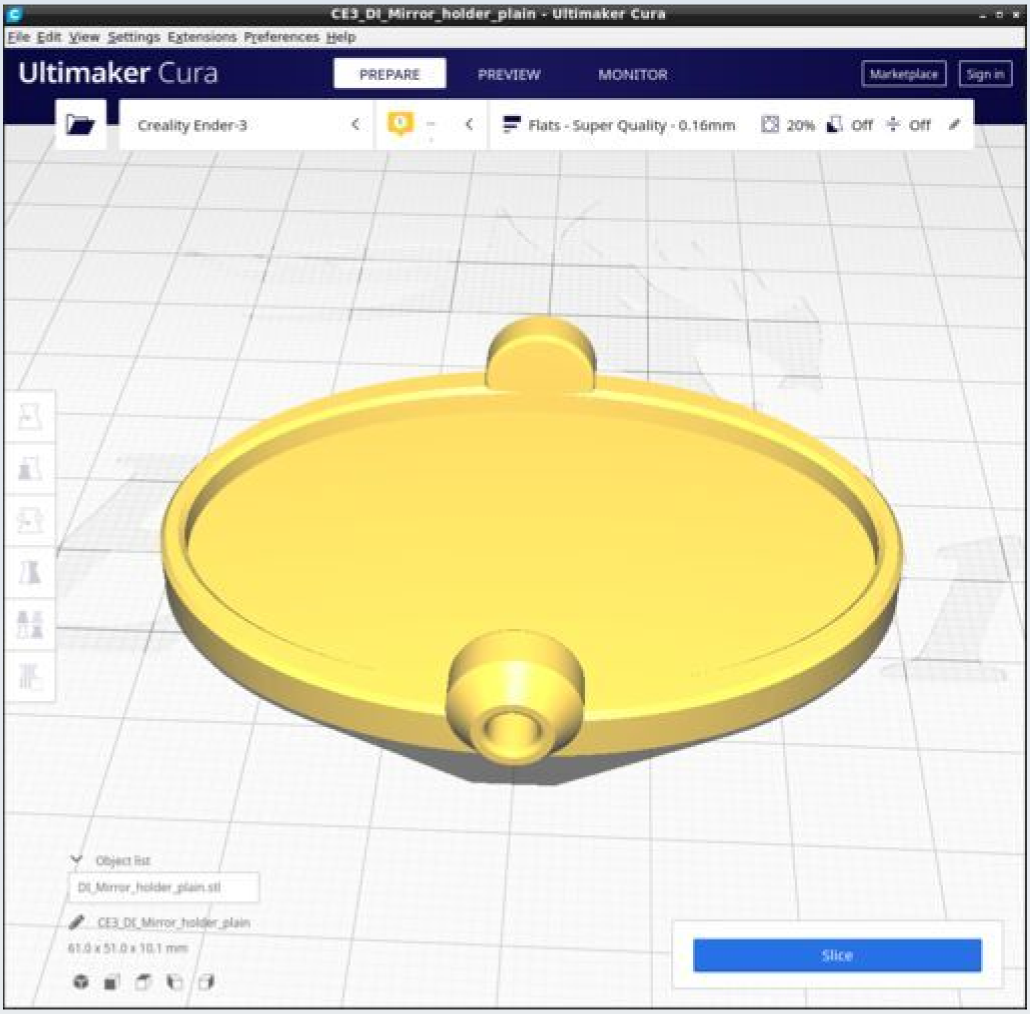
DI_M3_Thumbscrew_short_hex



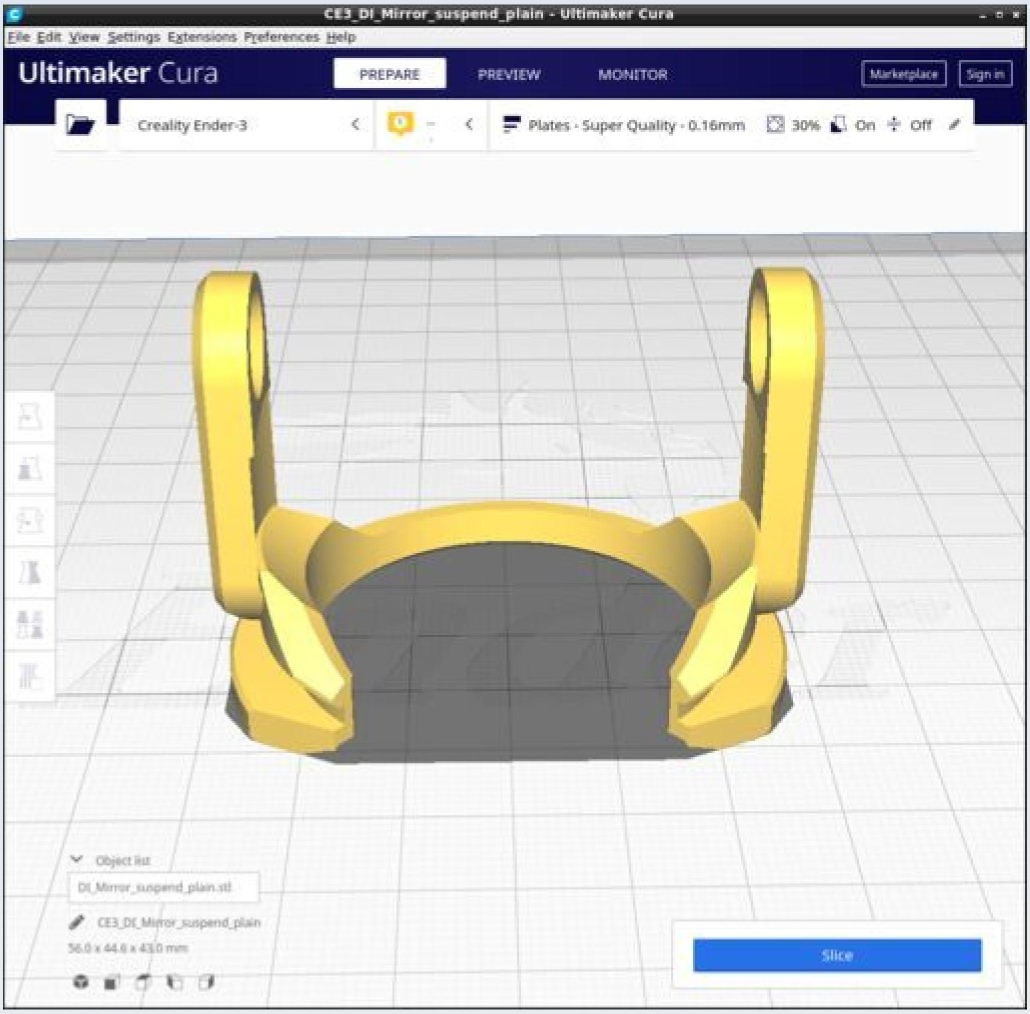
DI_M3_Thumbscrew_tall



DI_Mirror_holder_plain

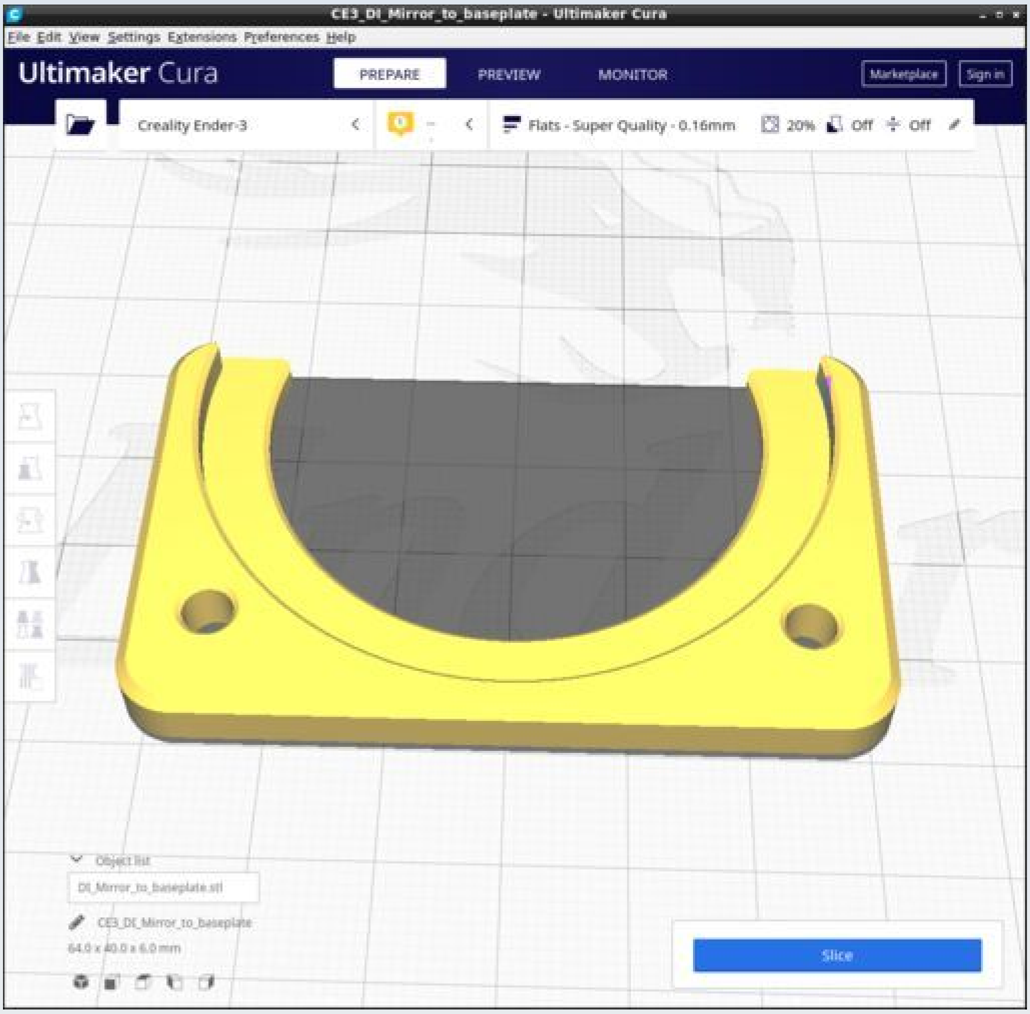


DI_Mirror_suspend_plain

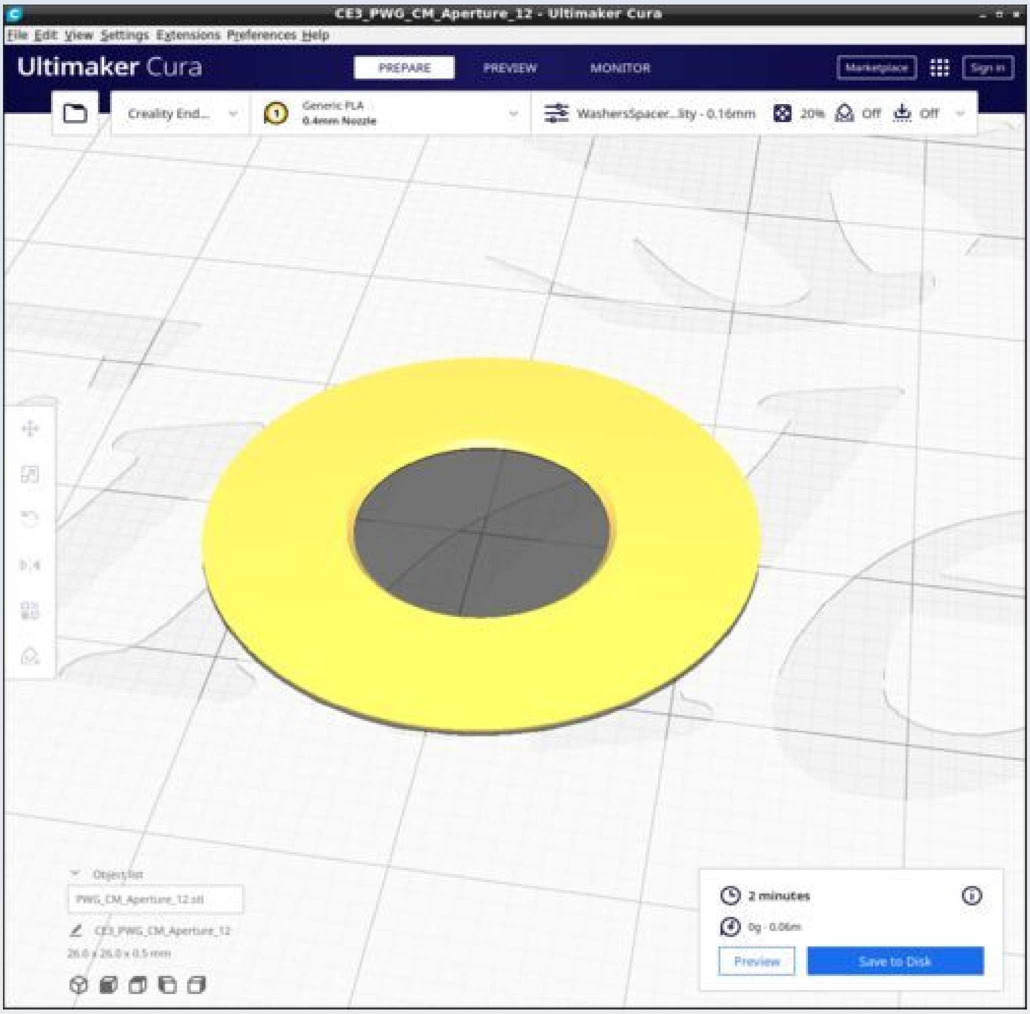


Use the ‘Plates’ custom Cura profile and enable supports 'touching baseplate only'.

DI_Mirror_to_baseplate

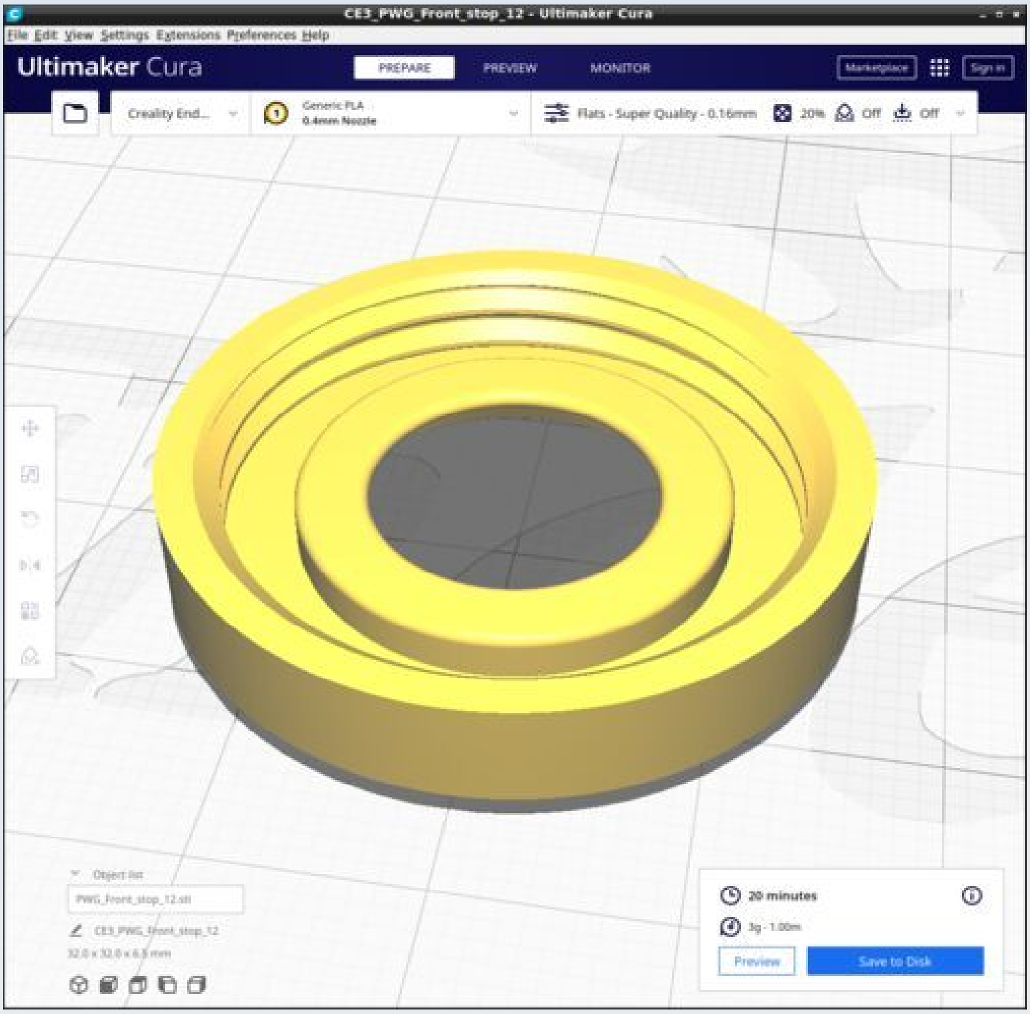


DI_PWG_CM_Aperture_12

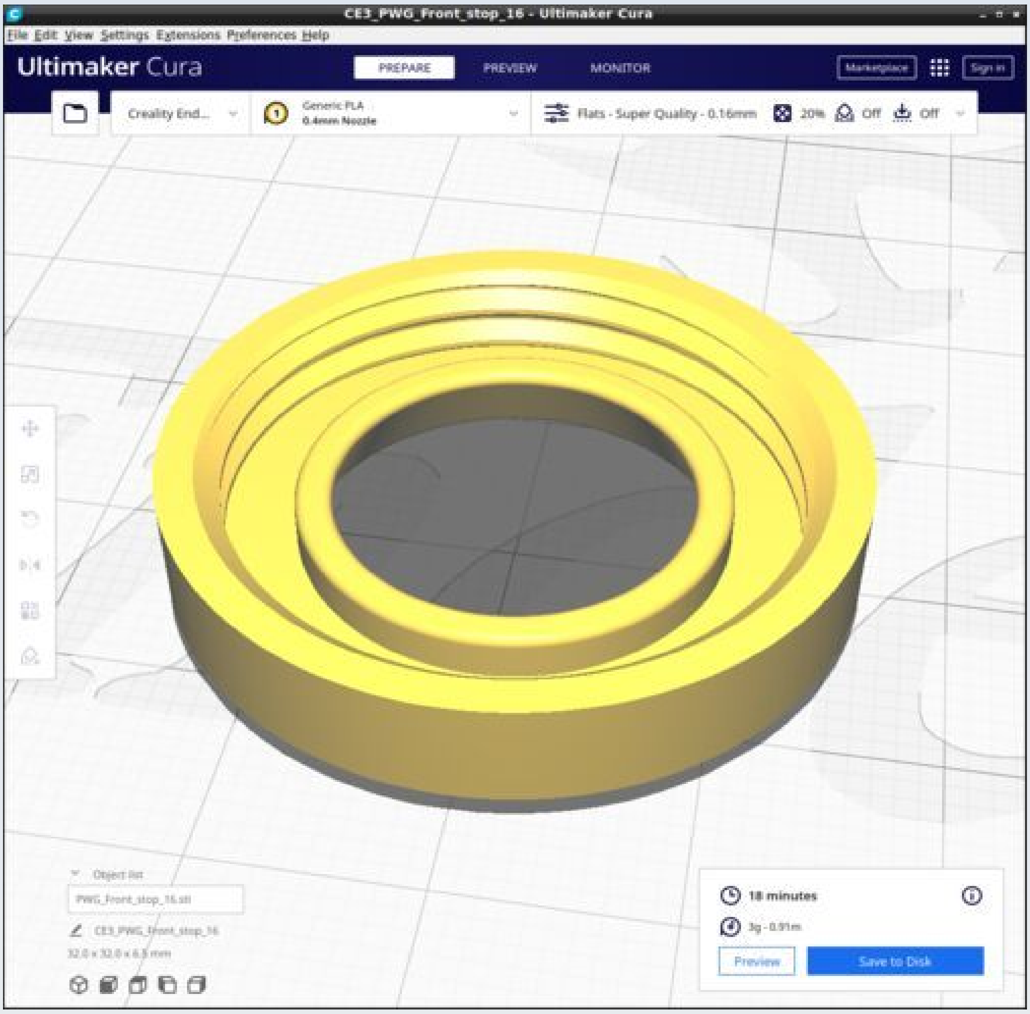


Use ‘WasherSpacer’ Cura profile.

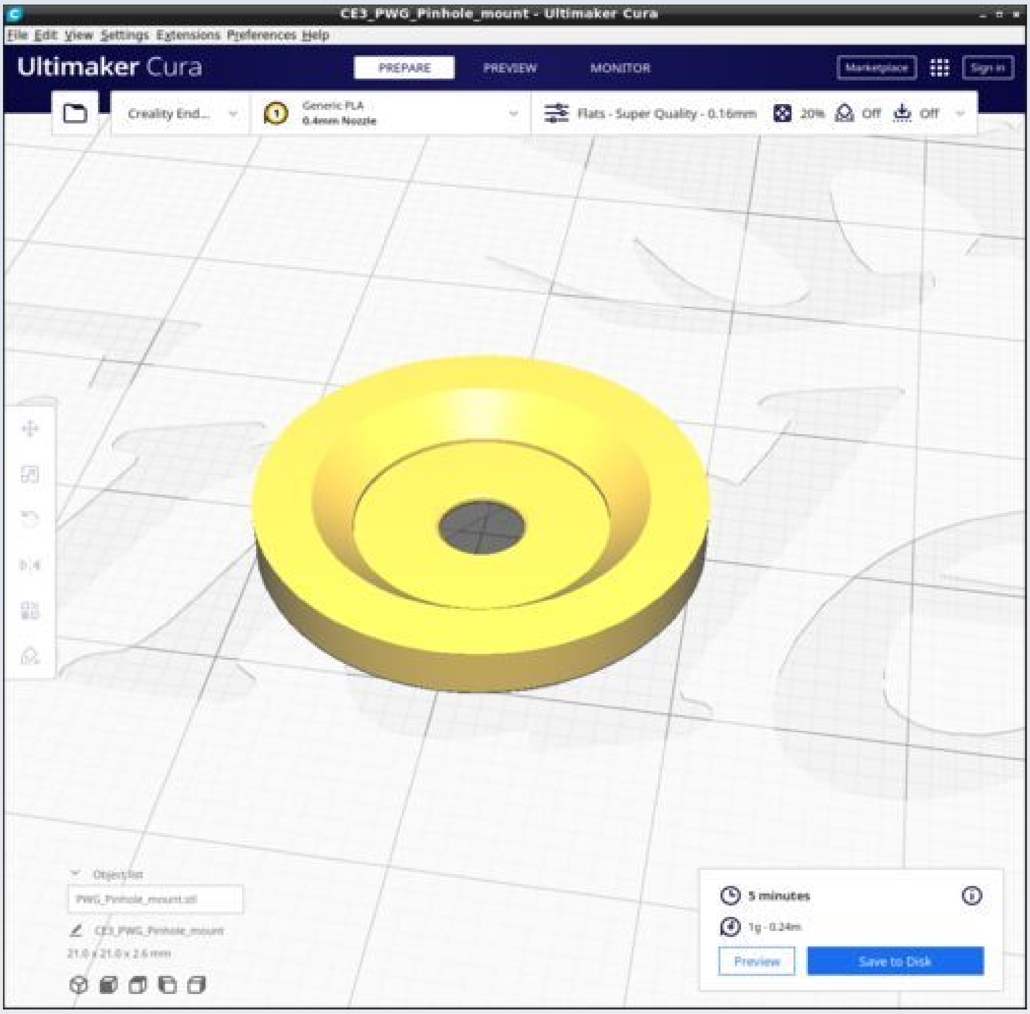
DI_PWG_Front_stop_12



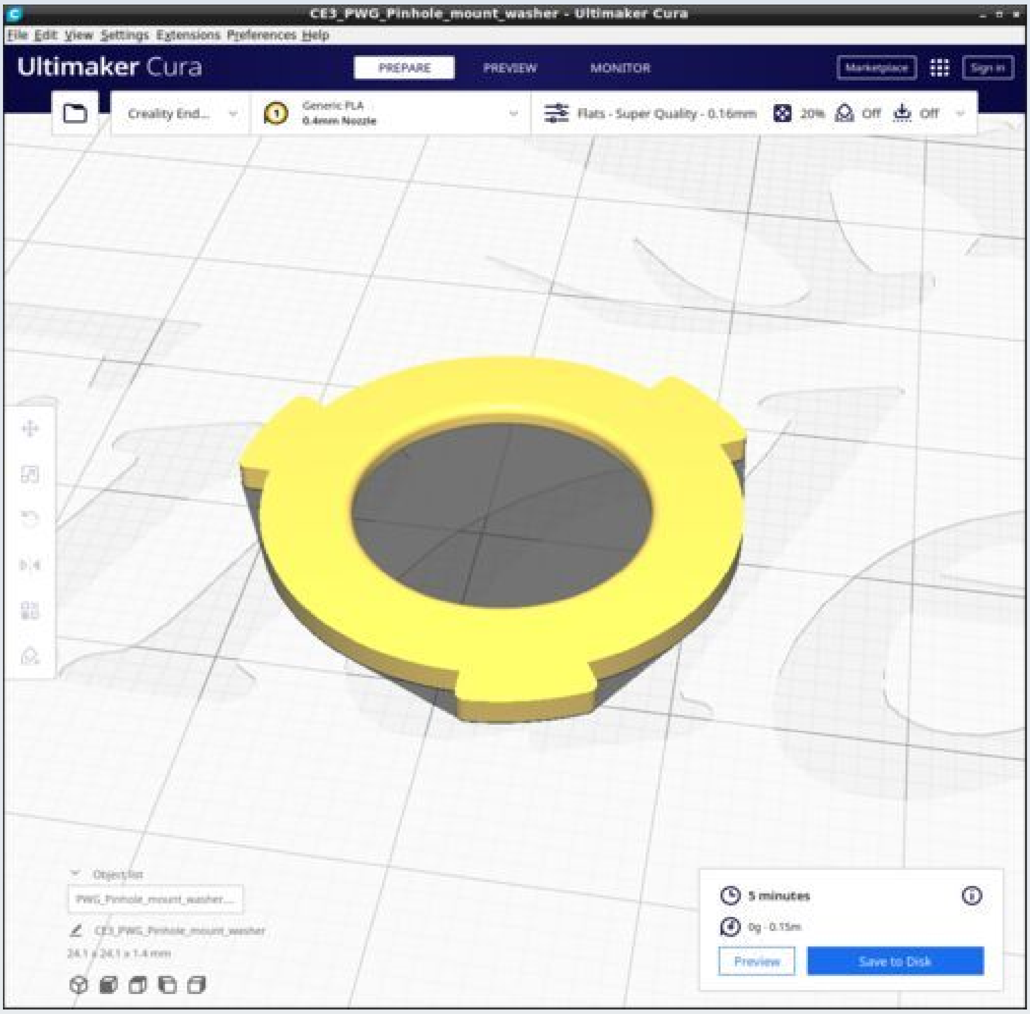
DI_PWG_Front_stop_16



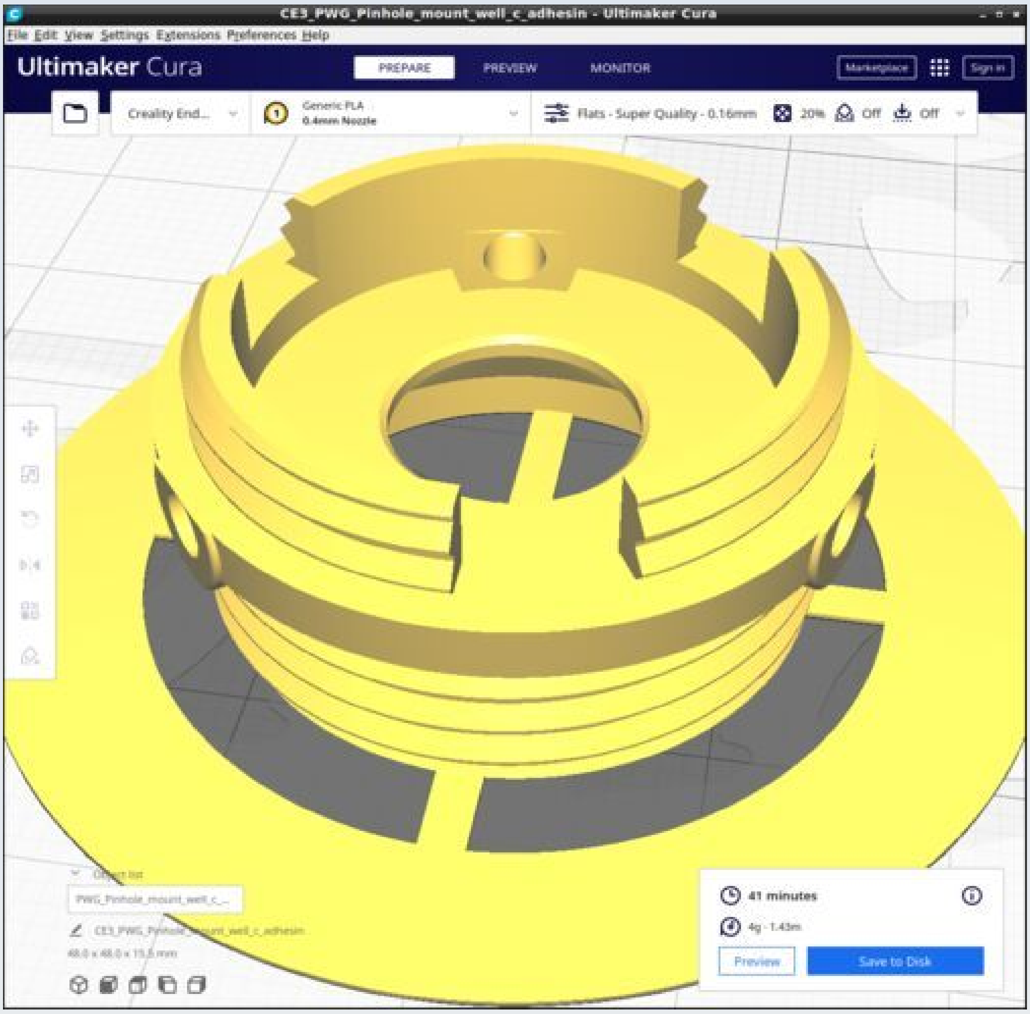
DI_PWG_Pinhole_mount



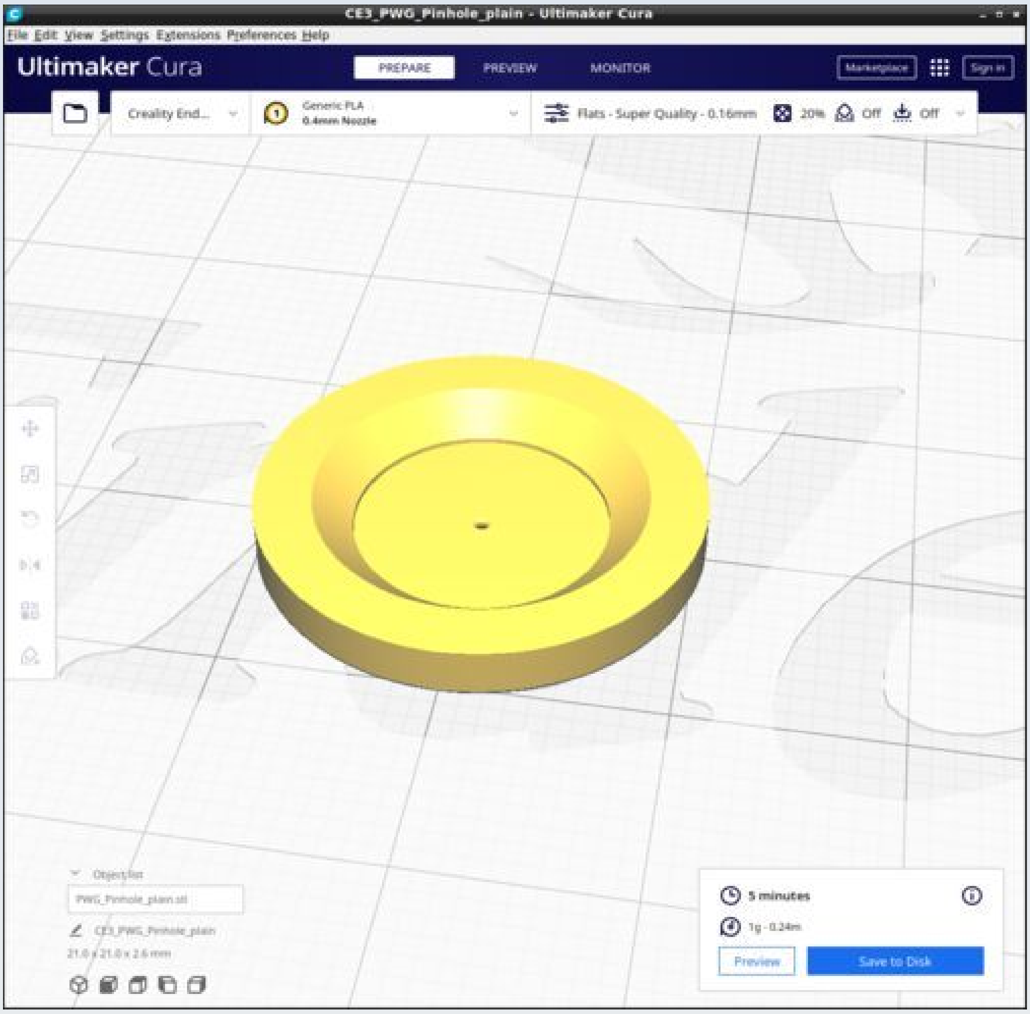
DI_PWG_Pinhole_mount_washer



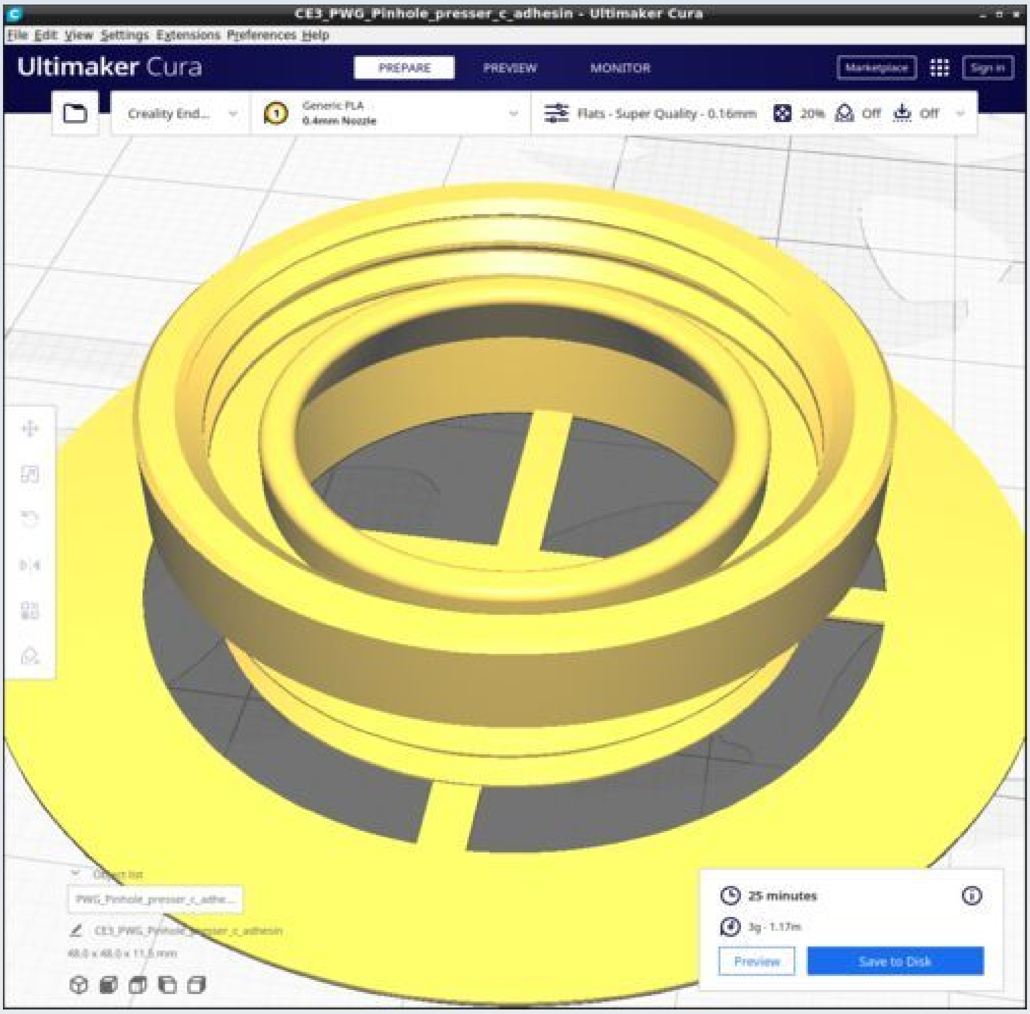
DI_PWG_Pinhole_mount_well



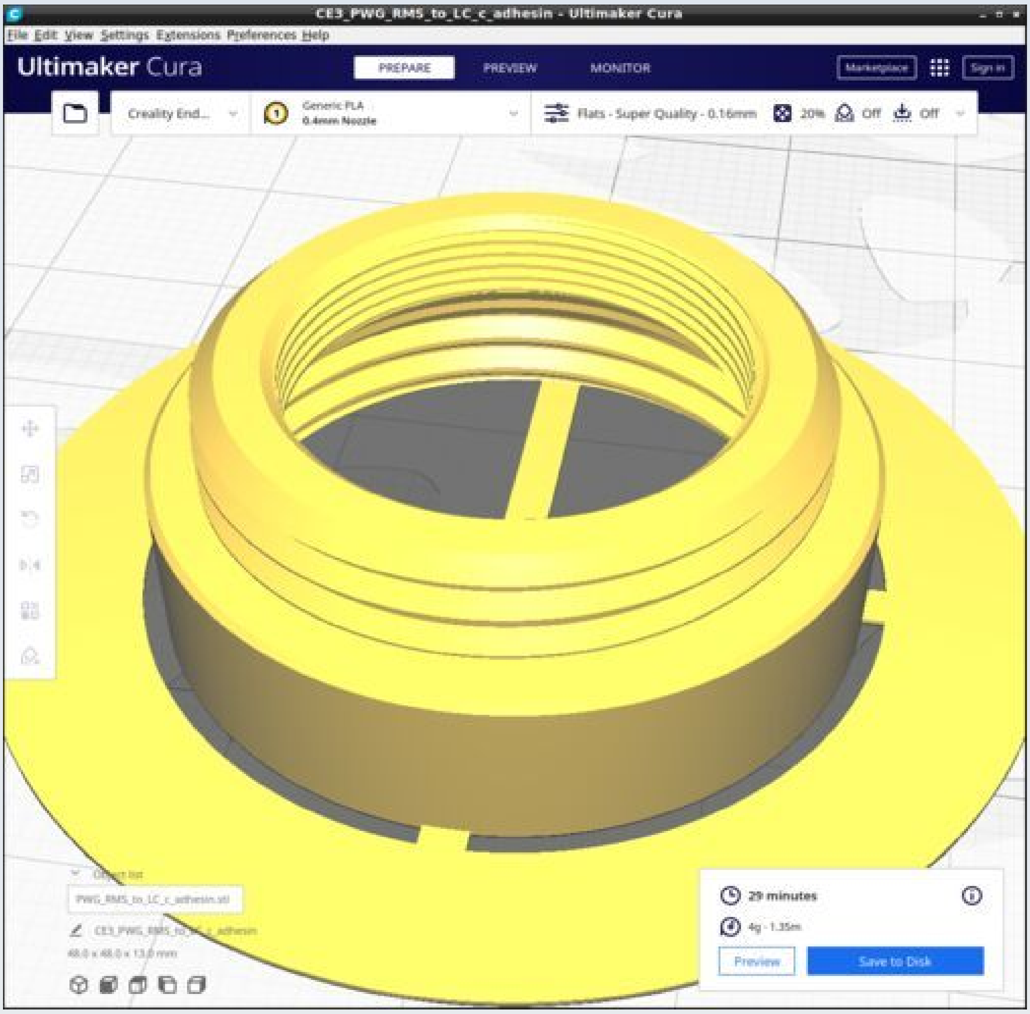
DI_PWG_Pinhole_plain



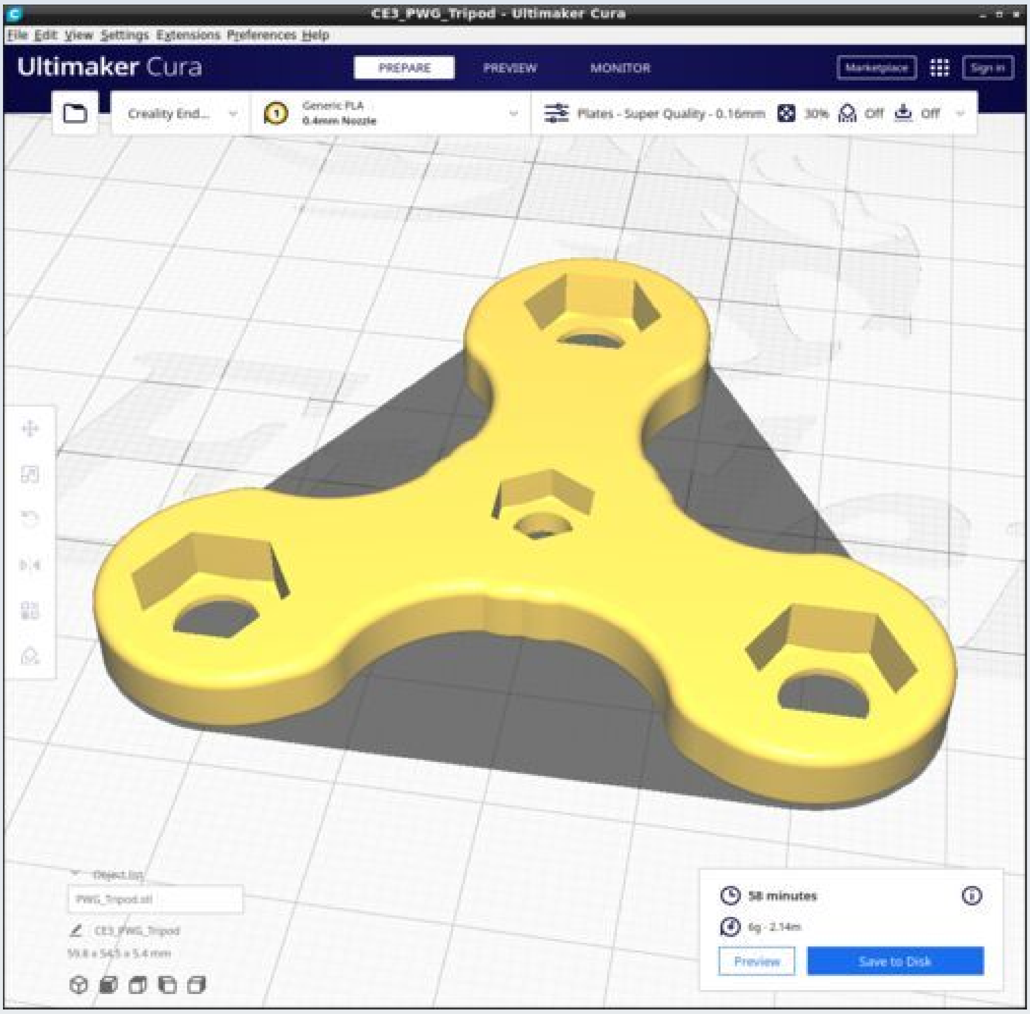
DI_PWG_Pinhole_presser



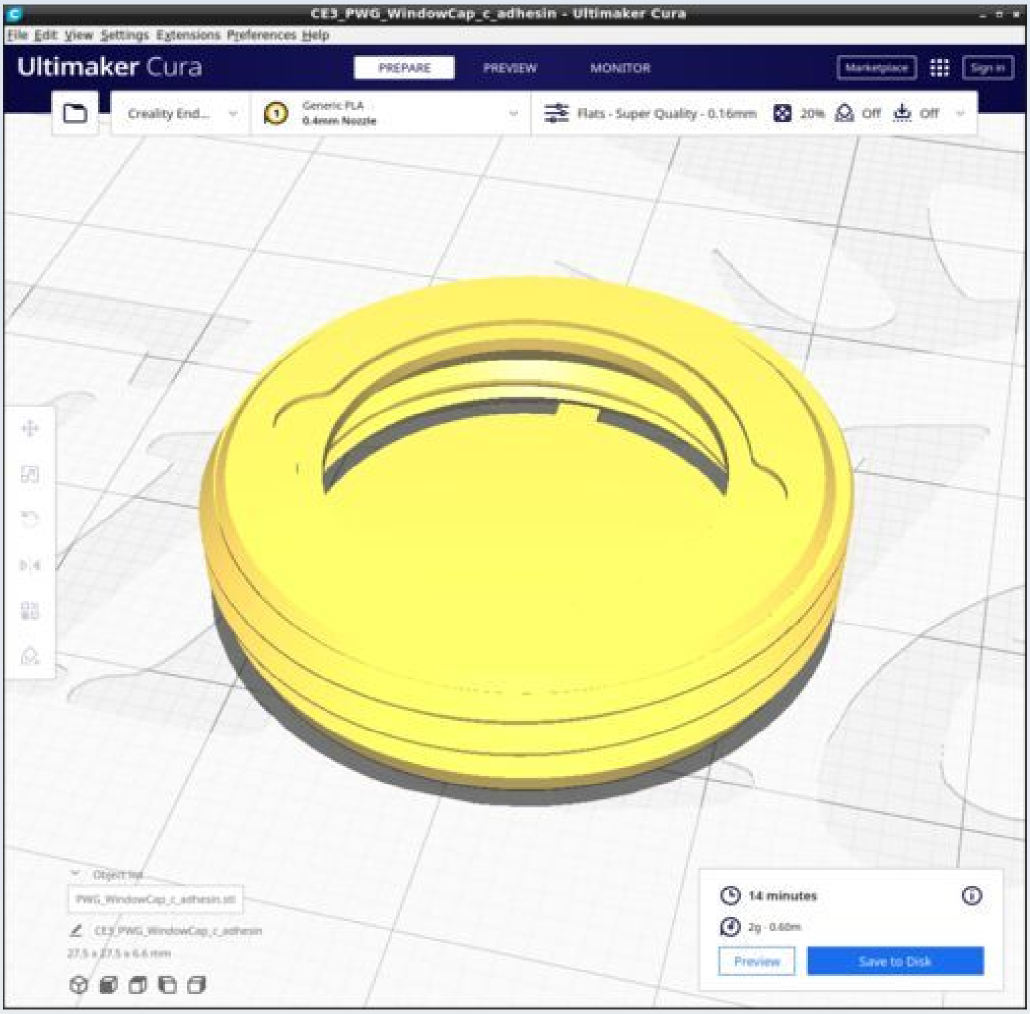
DI_PWG_RMS_to_LC



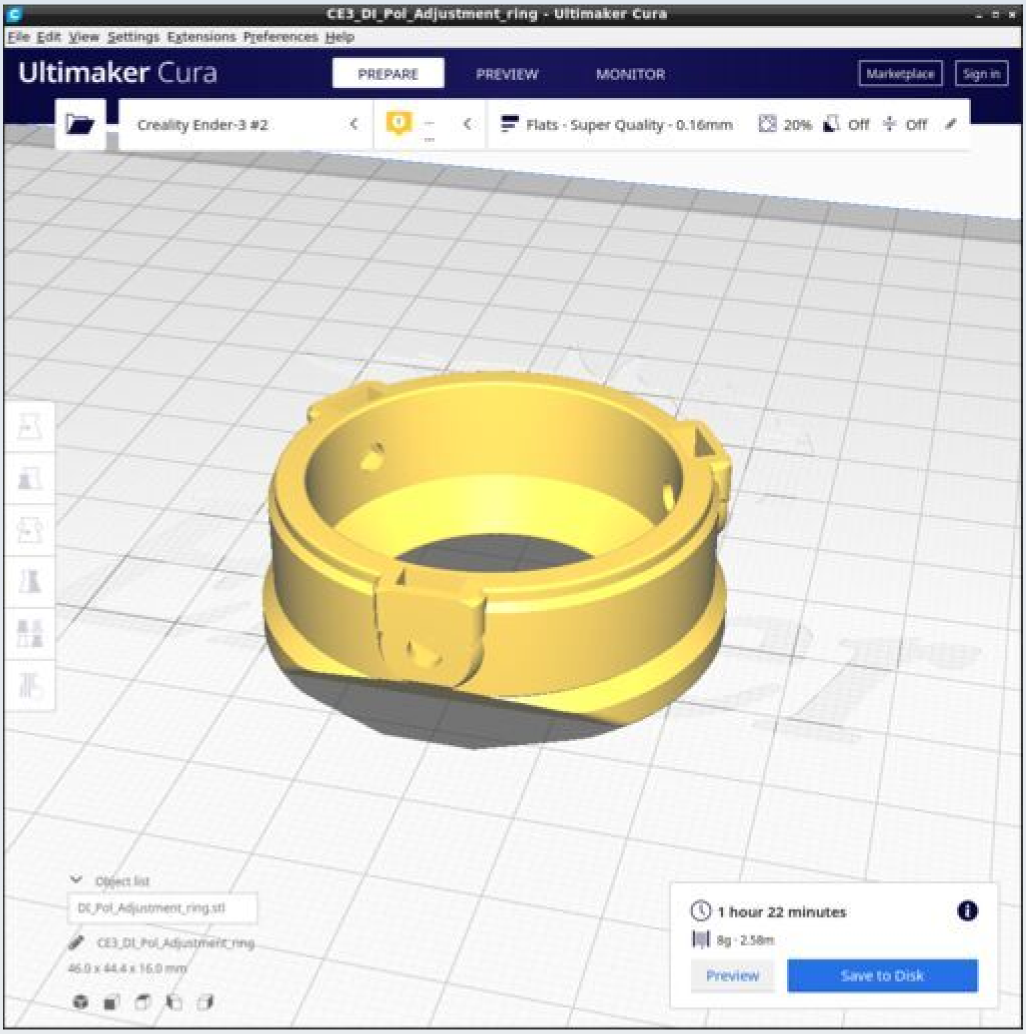
DI_PWG_Tripod



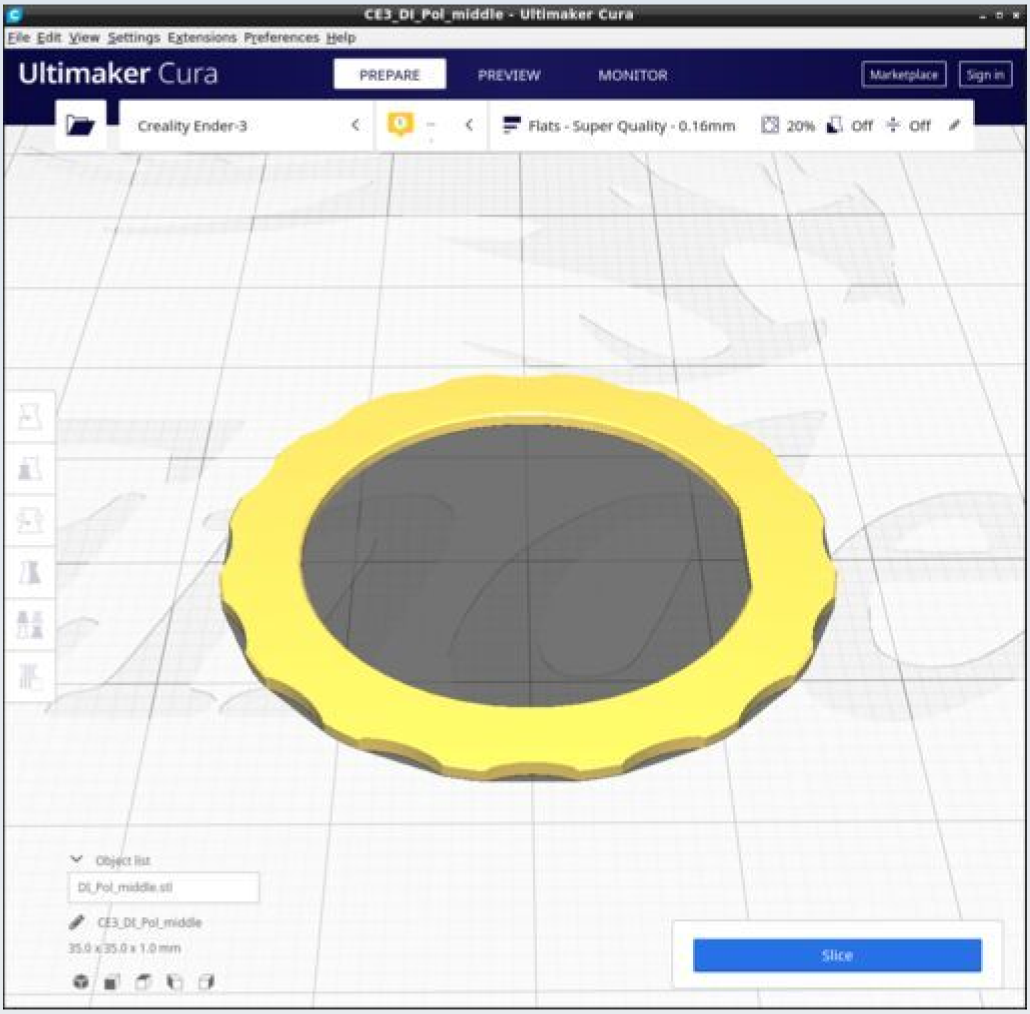
DI_PWG_WindowCap



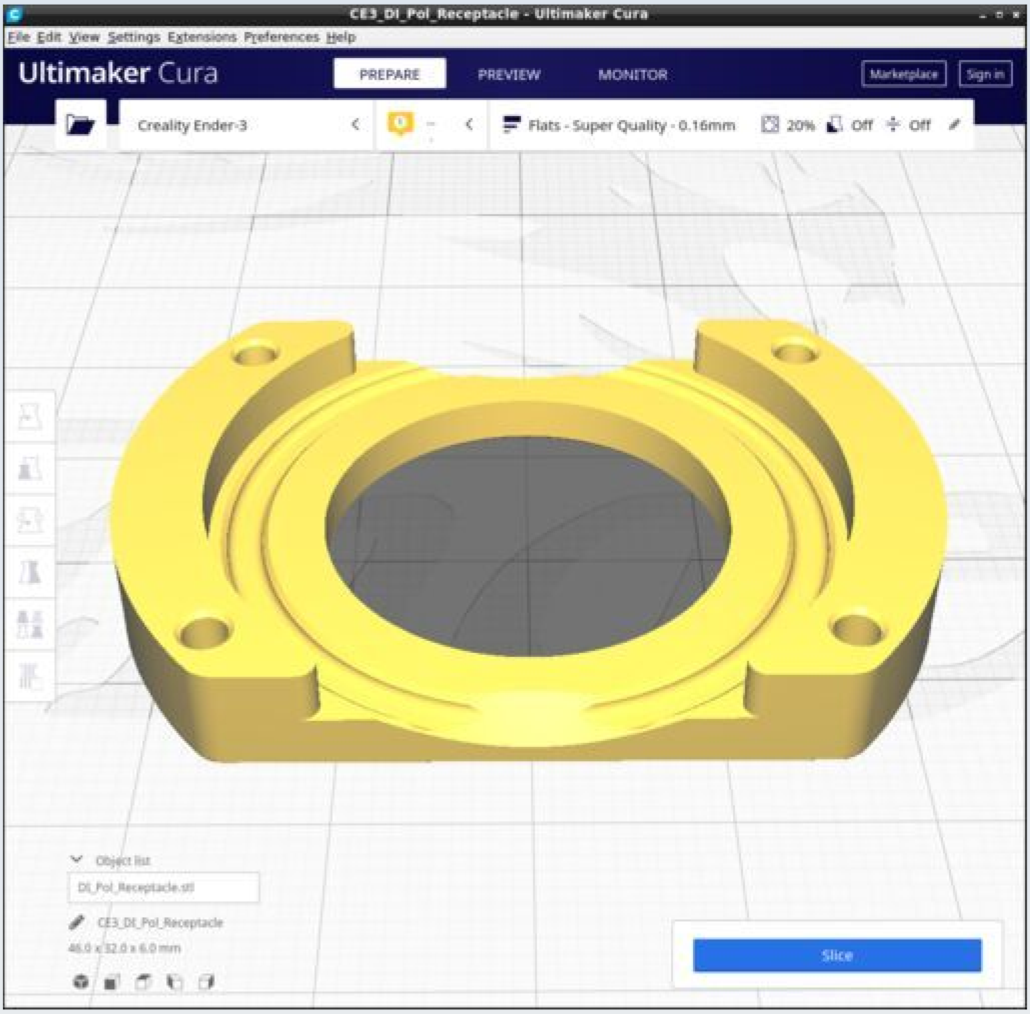
DI_Pol_Adjustment_ring



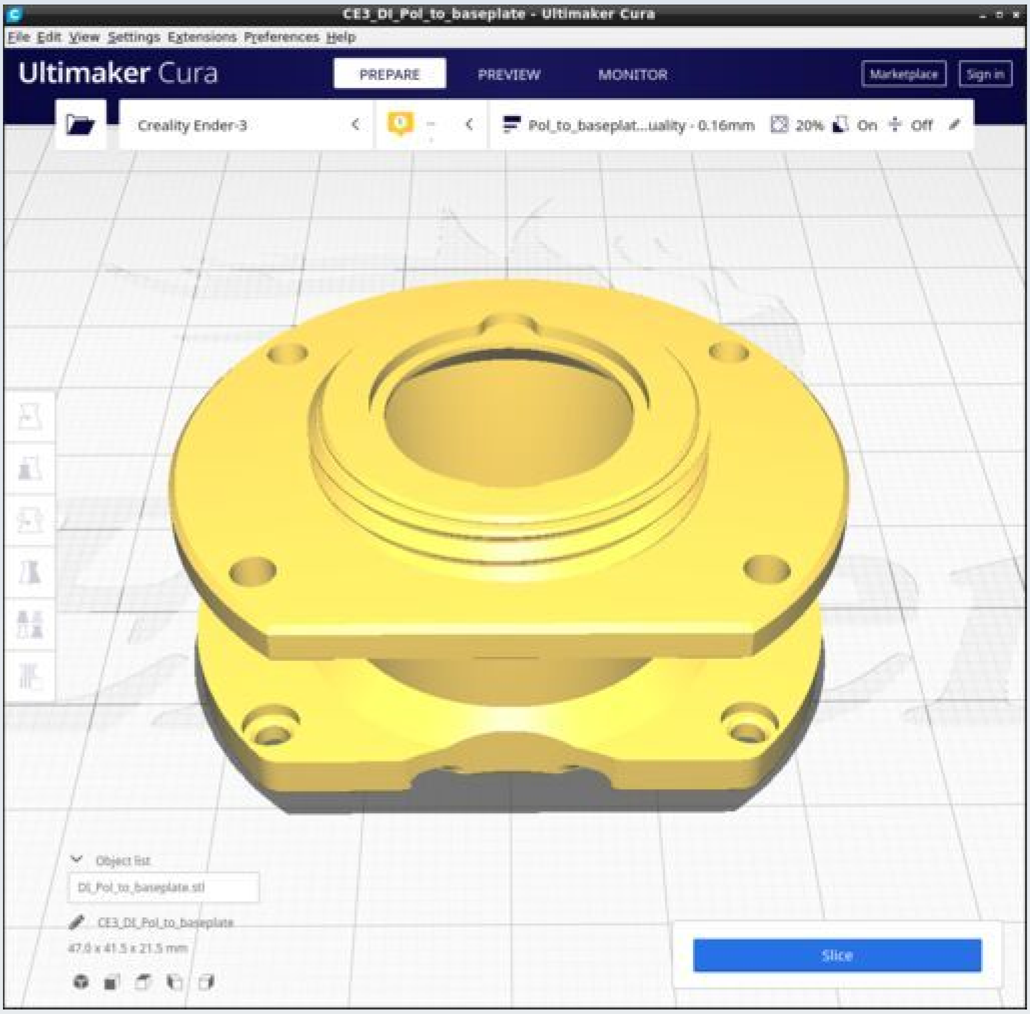
DI_Pol_middle



DI_Pol_Receptacle

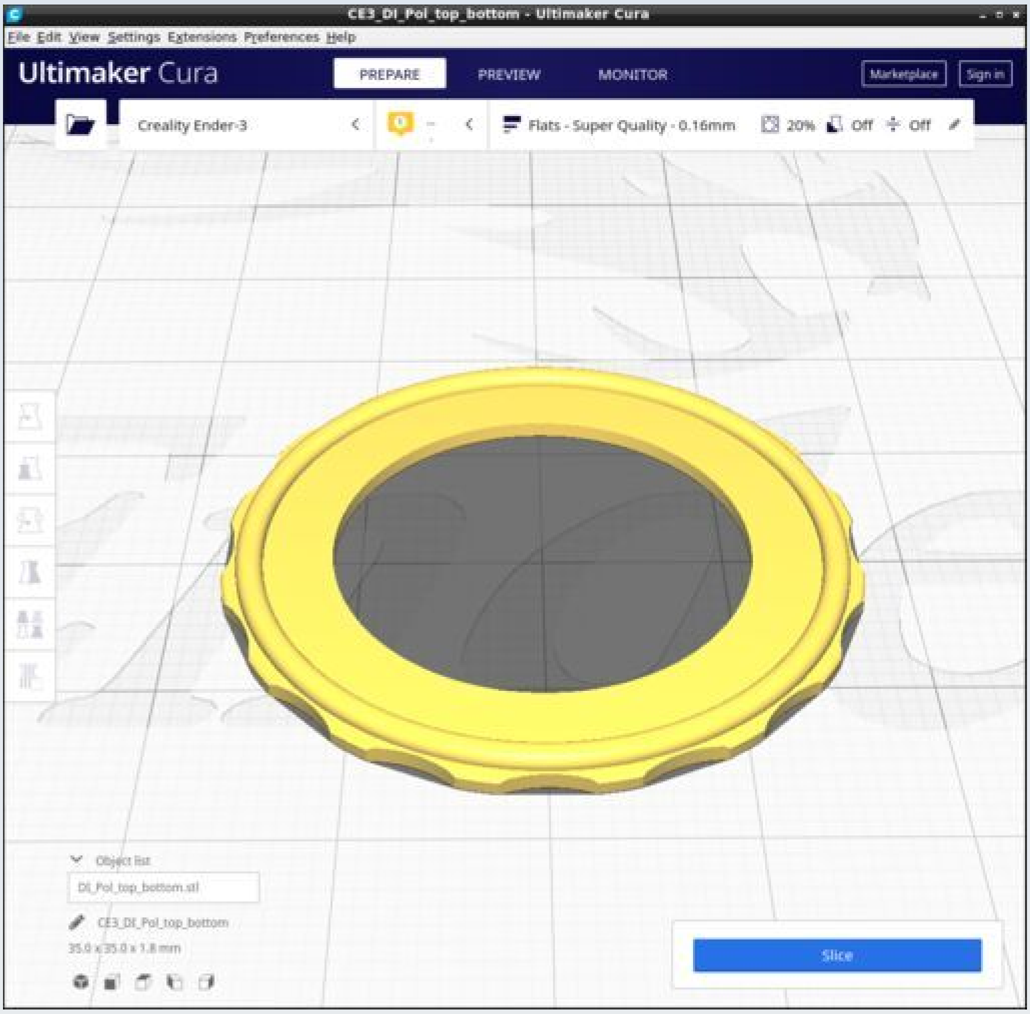


DI_Pol_to_baseplate

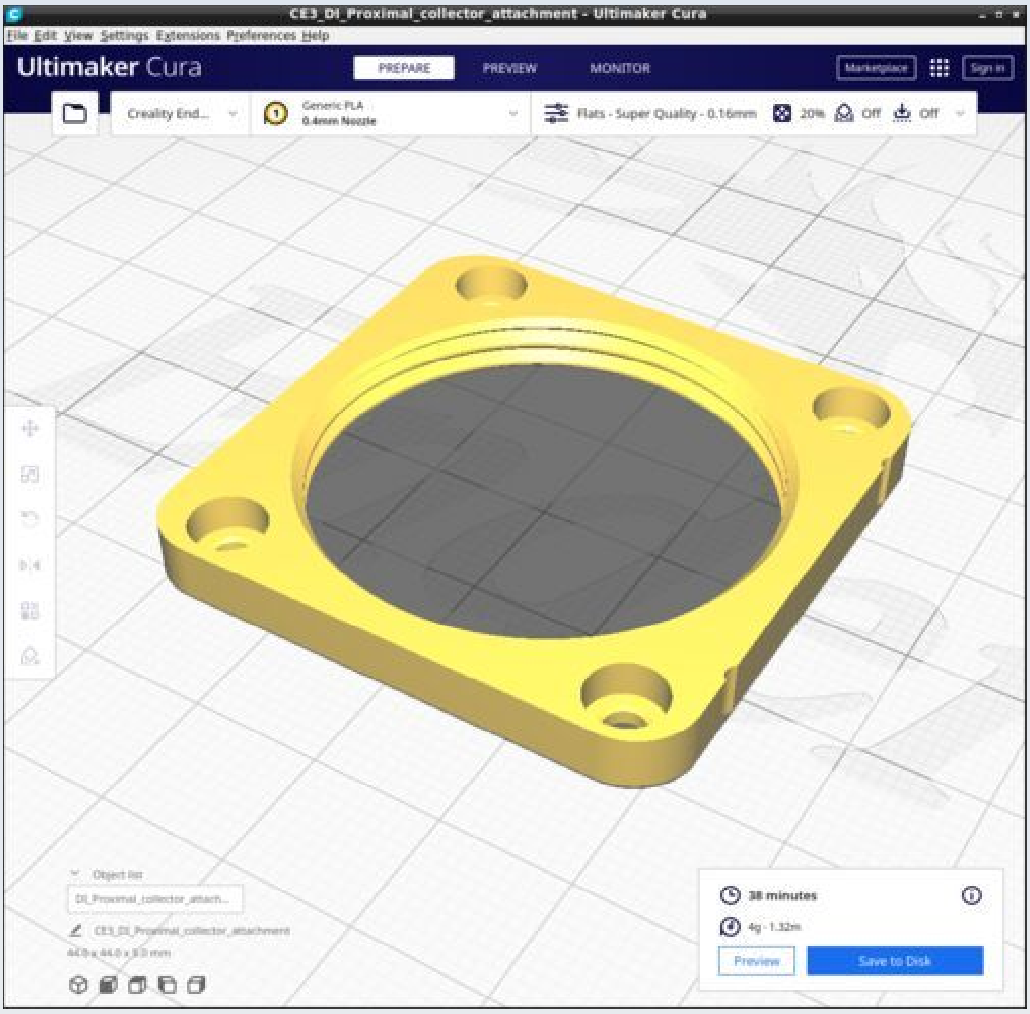


Pol_to_baseplate has its own Cura profile with tree supports. This is similar to the 'Condenser' profile but uses an infill density of 20% (not 30%) and has a greater tree angle to avoid making supports on the base of the model.

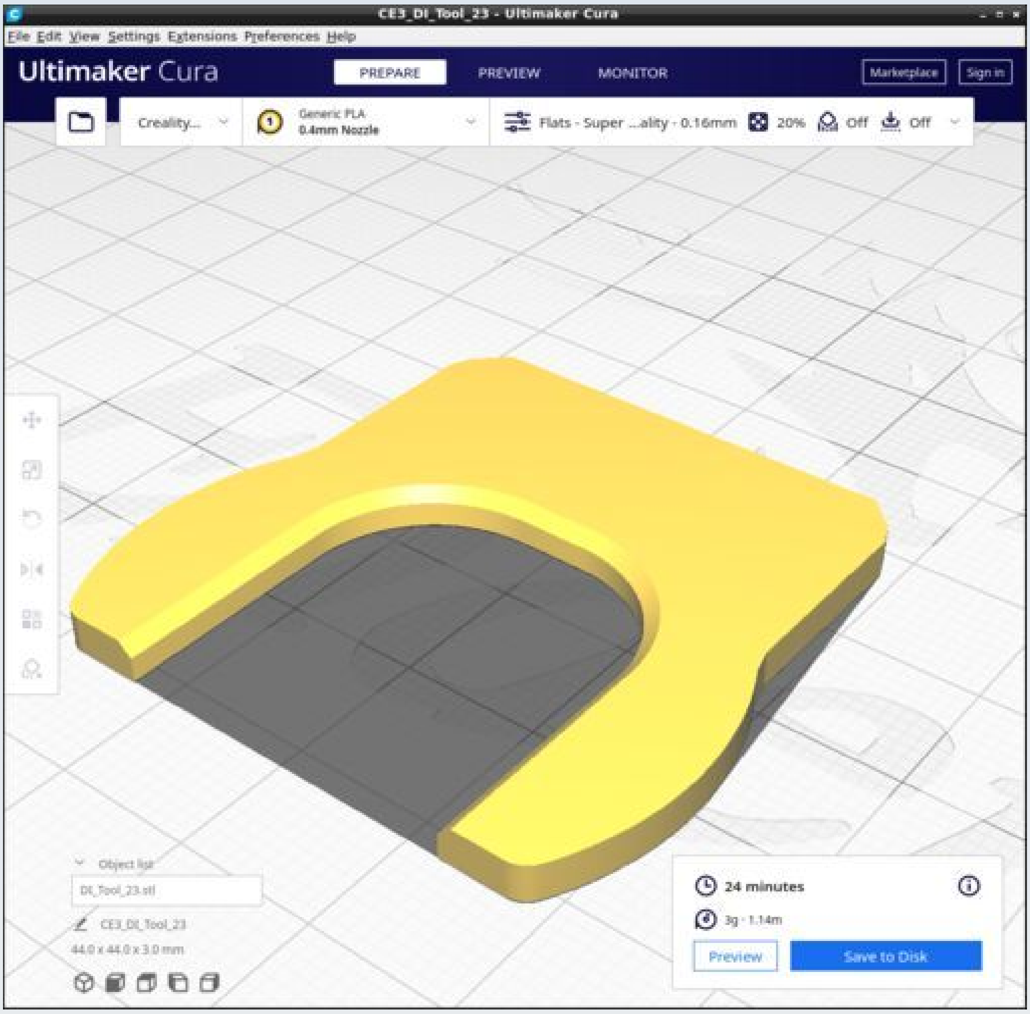
DI_Pol_top_bottom



DI_Proximal_collector_attachment

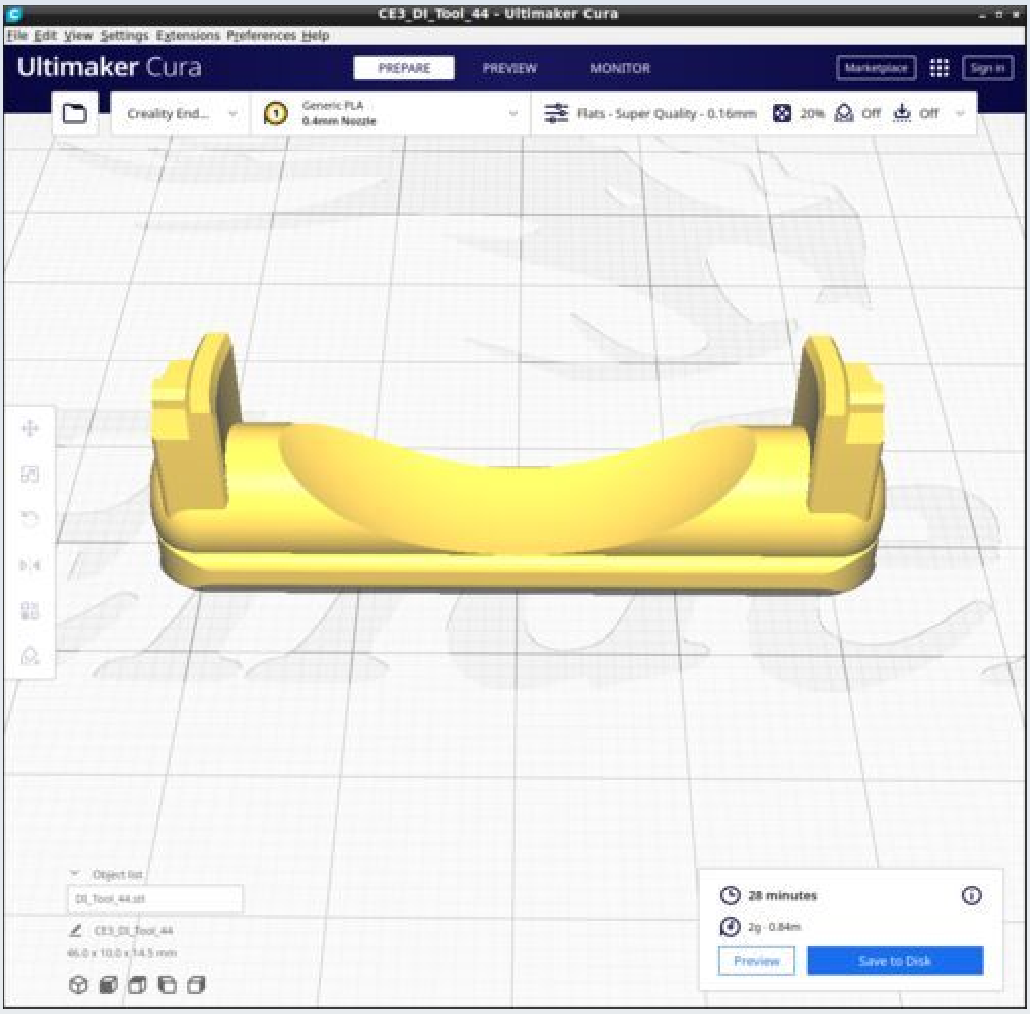


DI_Tool_23

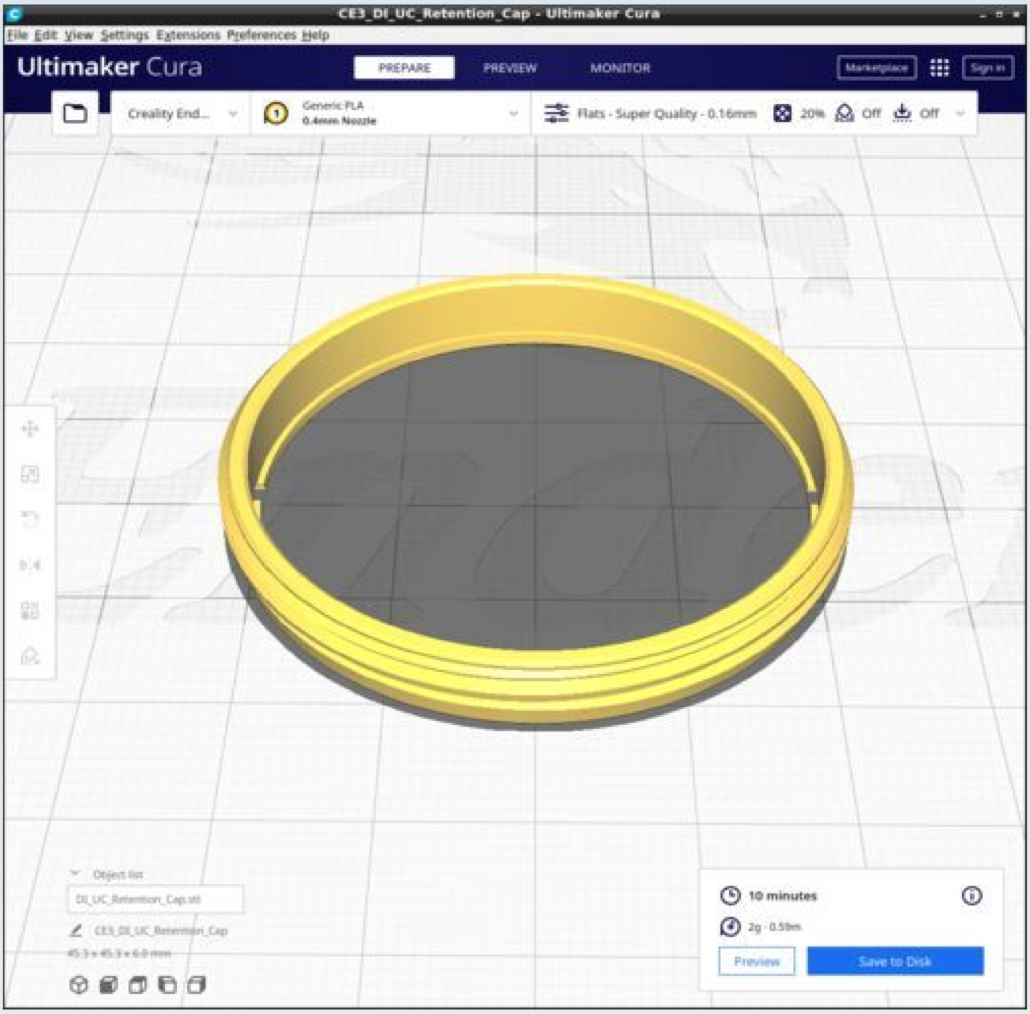


Although shown here with profile ‘flats’ you may want to print this with a higher density infill for added strength.

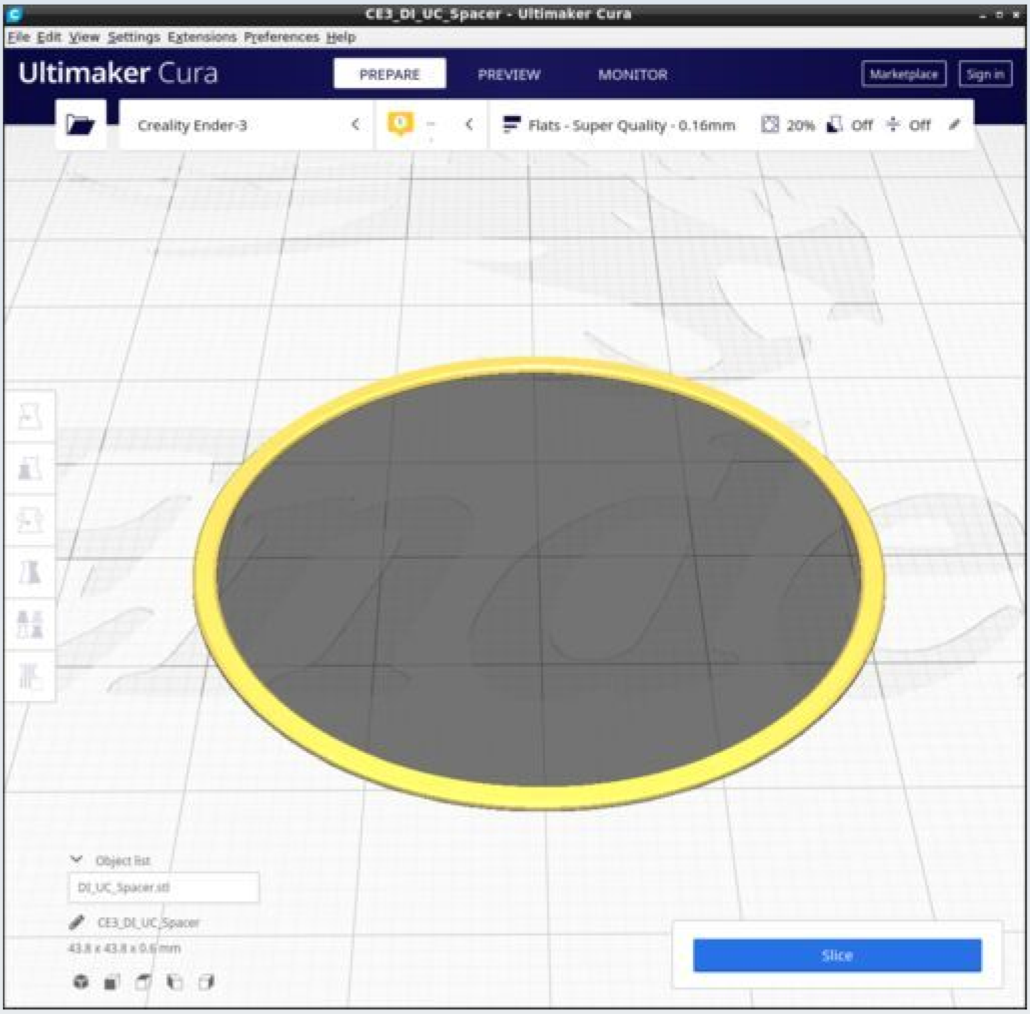
DI_Tool_44


CE3_DI_Tool_44 - Ultimaker Cura
File Edit View Settings Extensions Preferences Help
Ultimaker Cura
PREPARE
PREVIEW
MONITOR
Marketplace
Sign in
Creality End...
Generic PLA
0.4mm Nozzle
Flats - Super Quality - 0.16mm
20%
Off
Off
Object list
DI_Tool_44.stl
CE3_DI_Tool_44
46.0 x 10.0 x 14.5 mm
28 minutes
2g · 0.84m
Preview
Save to Disk

DI_UC_Retention_Cap

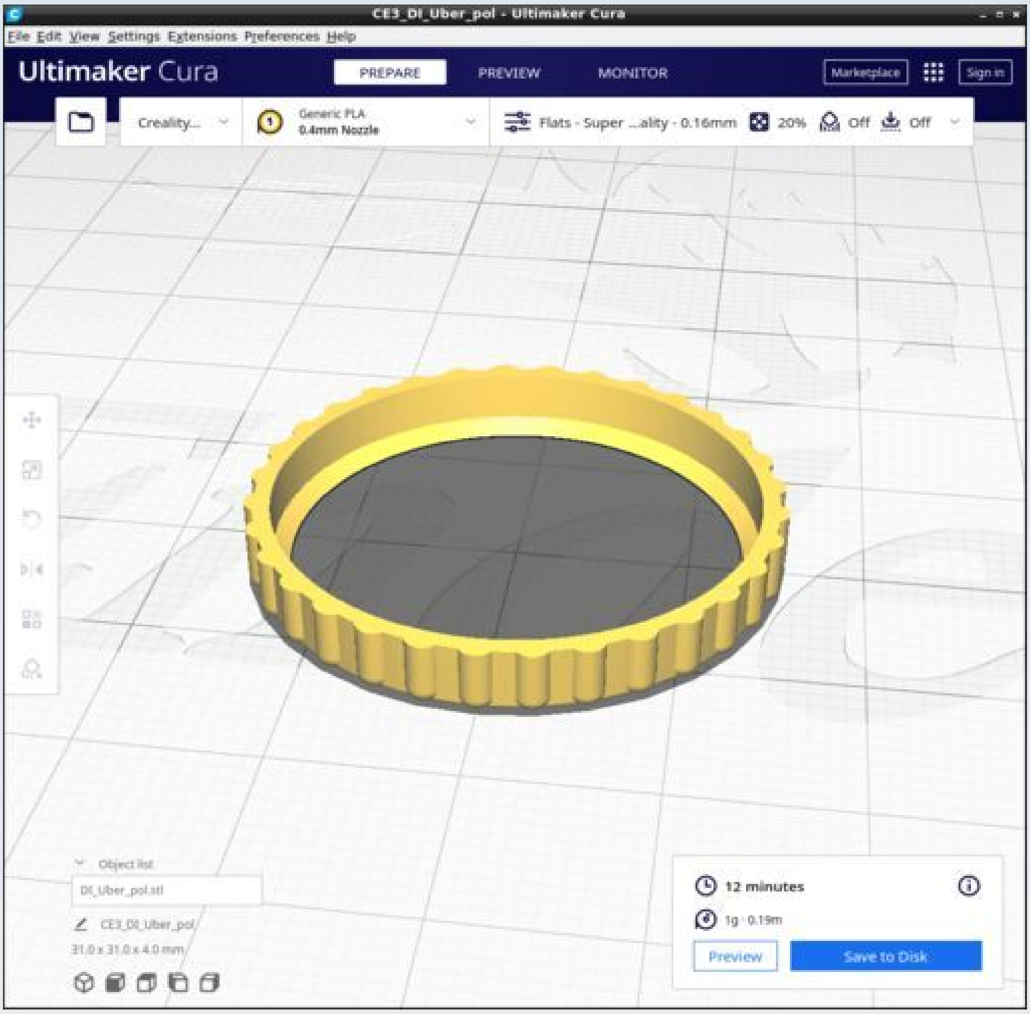


DI_UC_Spacer



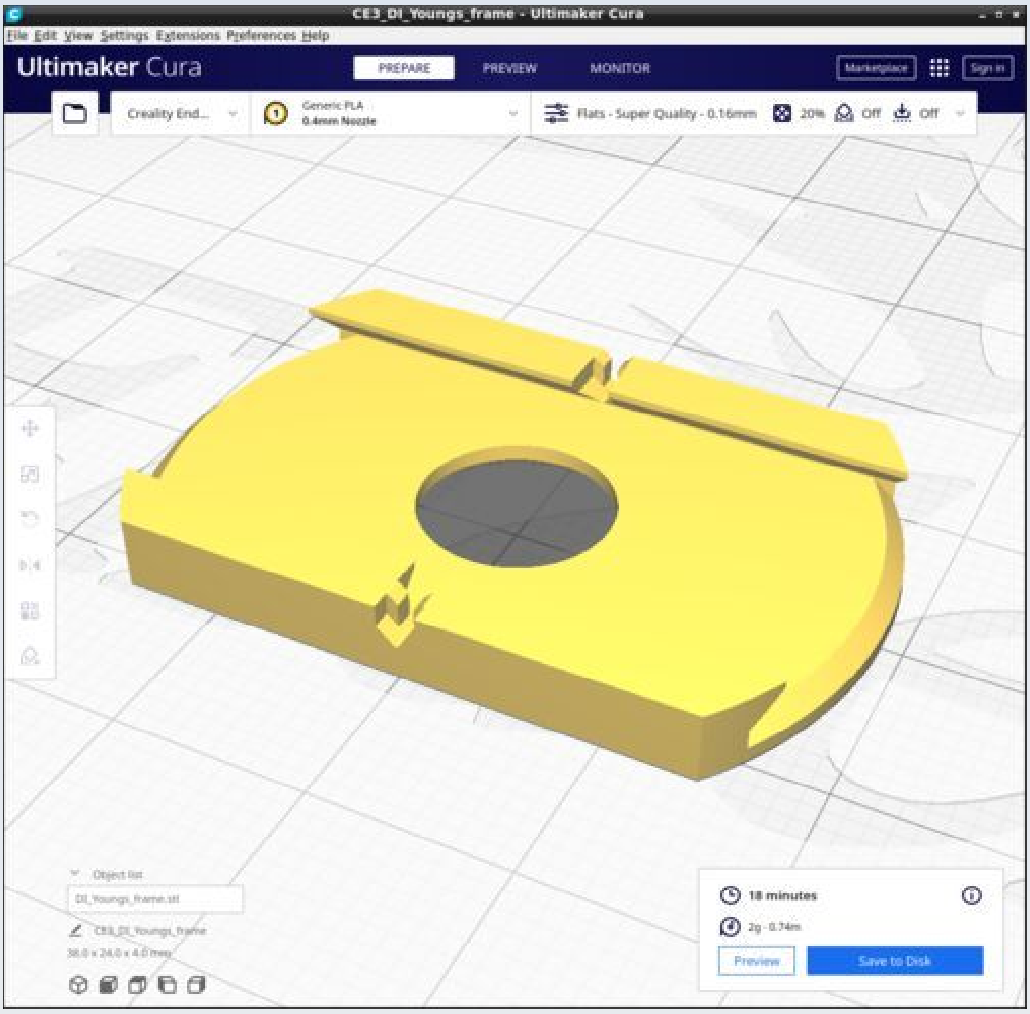
You may find the custom Cura profile ‘WashersSpacers’ more useful when printing this.

DI_Uber_pol

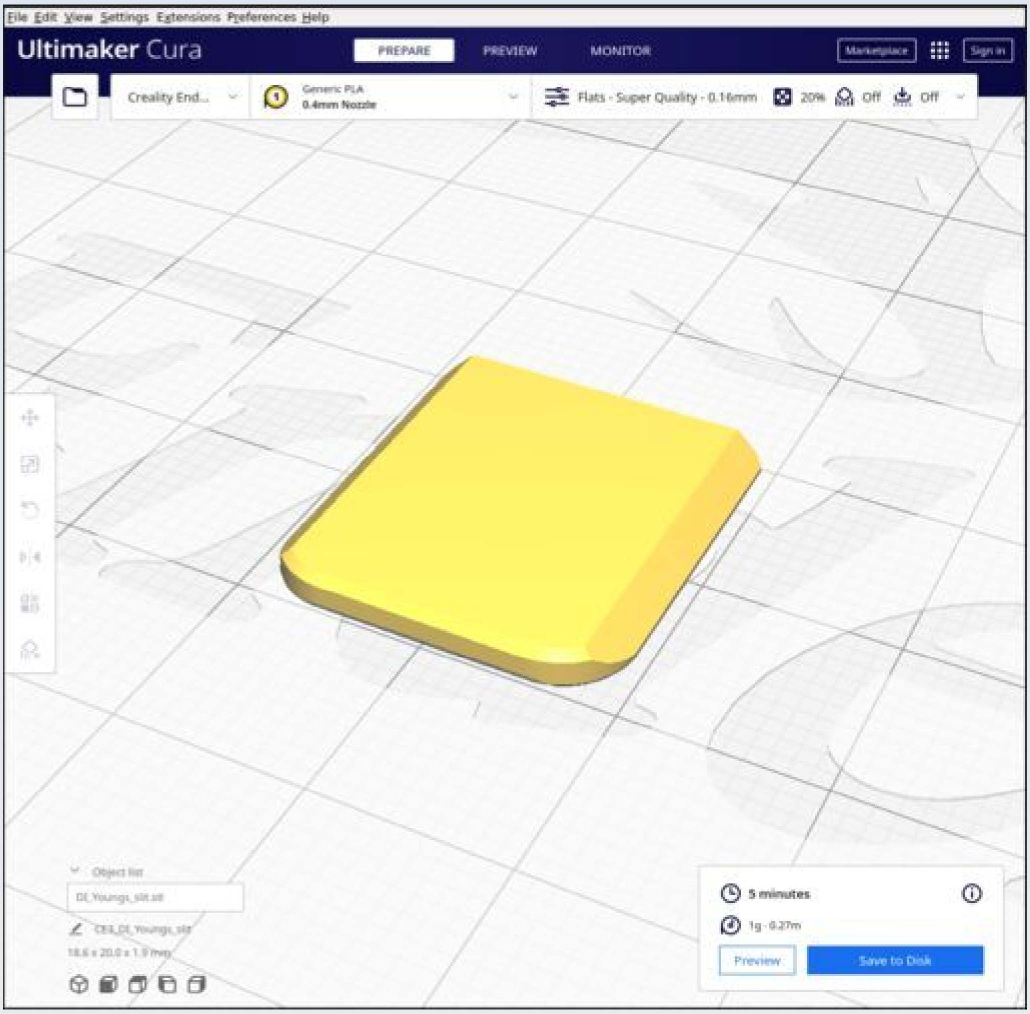


CE3_DI_Uber_pol - Ultimaker Cura
File Edit View Settings Extensions Preferences Help
Ultimaker Cura
PREPARE
PREVIEW
MONITOR
Marketplace
Sign in
Creality...
Generic PLA
0.4mm Nozzle
Flats - Super ...ality - 0.16mm
20%
Off
Off
Object list
DI_Uber_pol.stl
CE3_DI_Uber_pol
31.0 x 31.0 x 4.0 mm
12 minutes
1g · 0.19m
Preview
Save to Disk

DI_Youngs_frame



DI_Youngs_slit



Note the orientation of the part is important, not only to ensure a good straight optical edge by motion along the X-gantry only but also to avoid Z-seam lines at the optical flat edge.

Filterblock

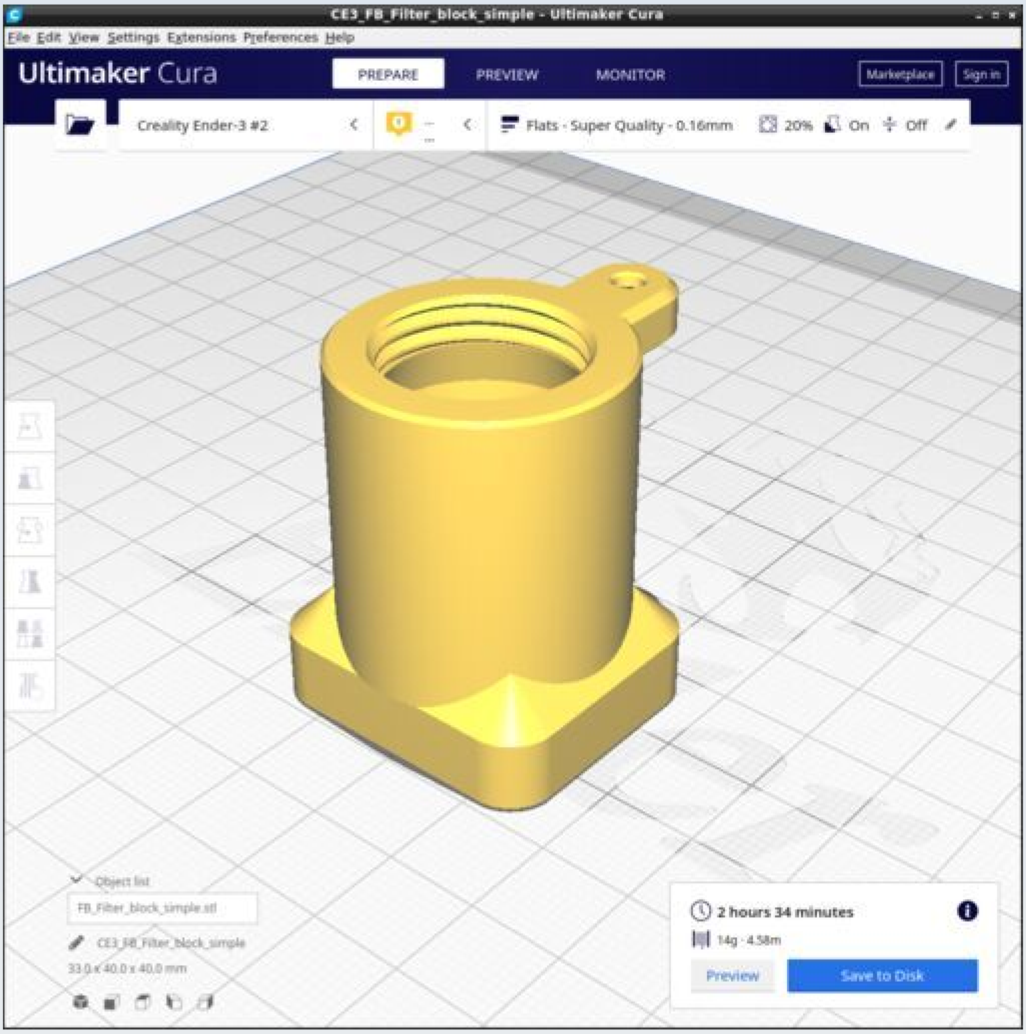
This shows the parts for the filter block segment of the optical tube, the part that goes between the objective holder and the ocular head. The models for these files are found in the FreeCAD file called FilterBlock.FCStd.

Resources

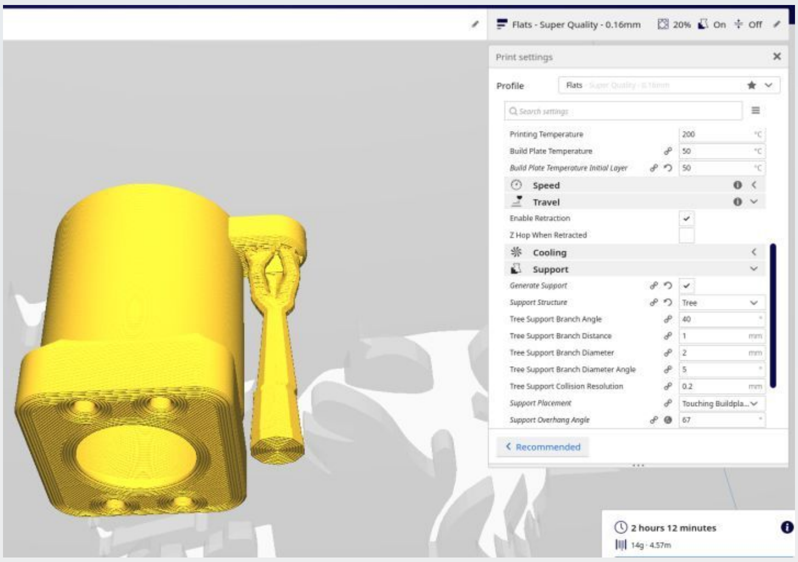
Cura calculates the following resources are required to print each model in this chapter:

Filterblock	Time_Hr	Time_ Min	PLA_Length(m)
FB_Filter_block_simple	2	34	4.58
FB_Filter_collar_compression_tool	0	6	0.26
FB_Filter_collar	0	1	0.03
FB_Filter_F17_slider	0	21	0.58
FB_Filter_F_slider	0	12	0.47
FB_Filter_slider	0	19	0.56
FB_Filter_slot_bottom	0	19	0.38
FB_Filter_slot_stopper	0	8	0.35
FB_Filter_slot_top	0	14	0.33
FB_Infinity_adapter	0	41	0.95
FB_Side_port_separate	0	35	0.99
FB_Side_port_separate_EpiStop	0	51	1.25
FB_Splitter_case	1	32	2.58
FB_Stopper	0	24	0.73
FB_Top_connector	0	42	1.13

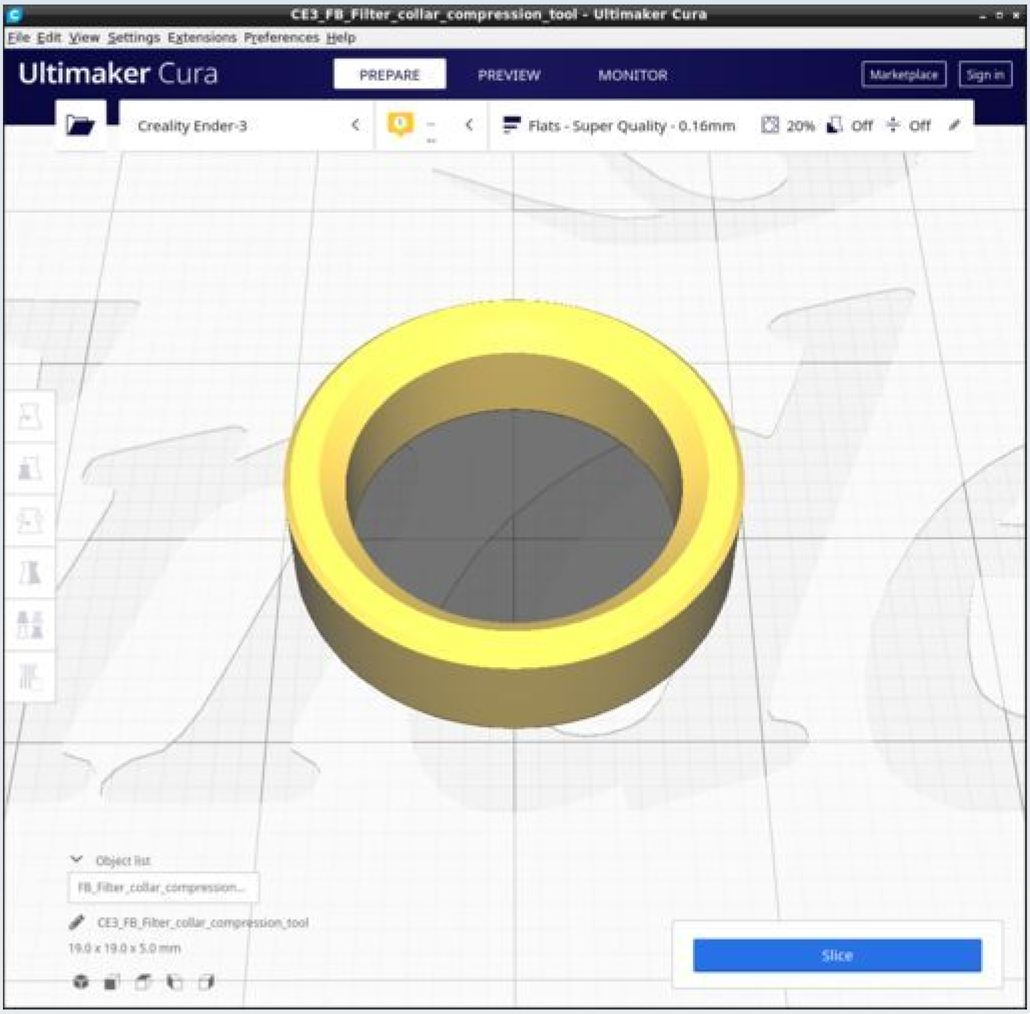
FB_Filter_block_simple



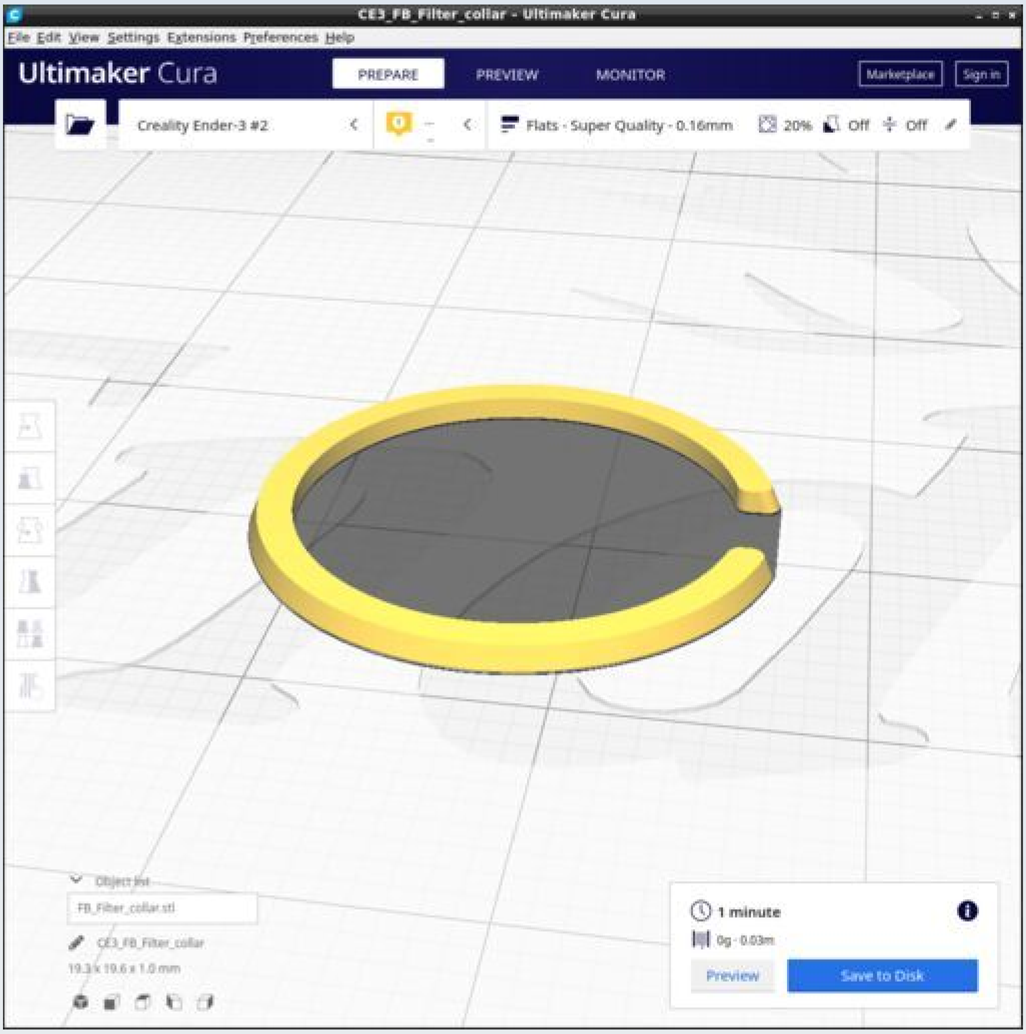
Use tree supports: Branch angle 40. touching baseplate only. Overhang 67 degrees. See picture. The tree gives a solid concentric trunk at the base (better for adhesion). Normal support will result in a hollow square base - less contact area so risk of coming off).



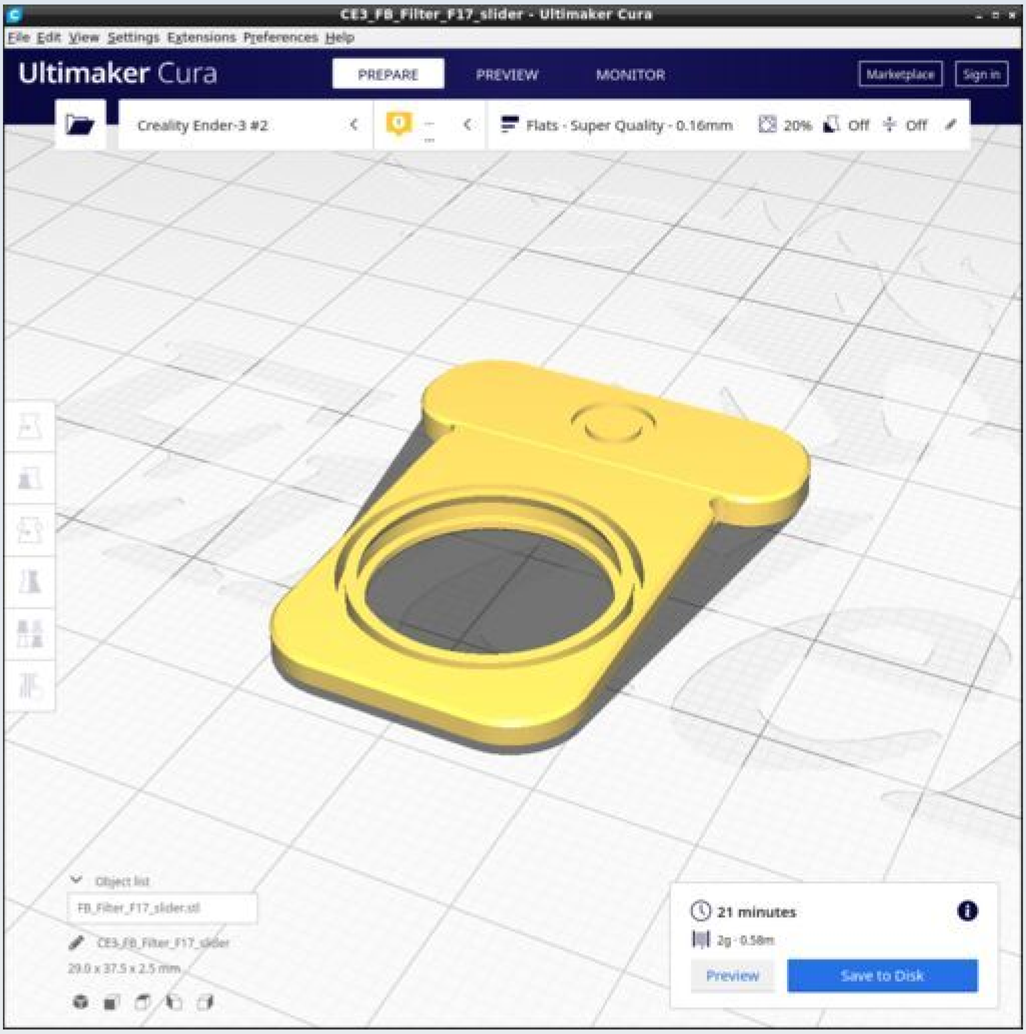
FB_Filter_collar_compression_tool



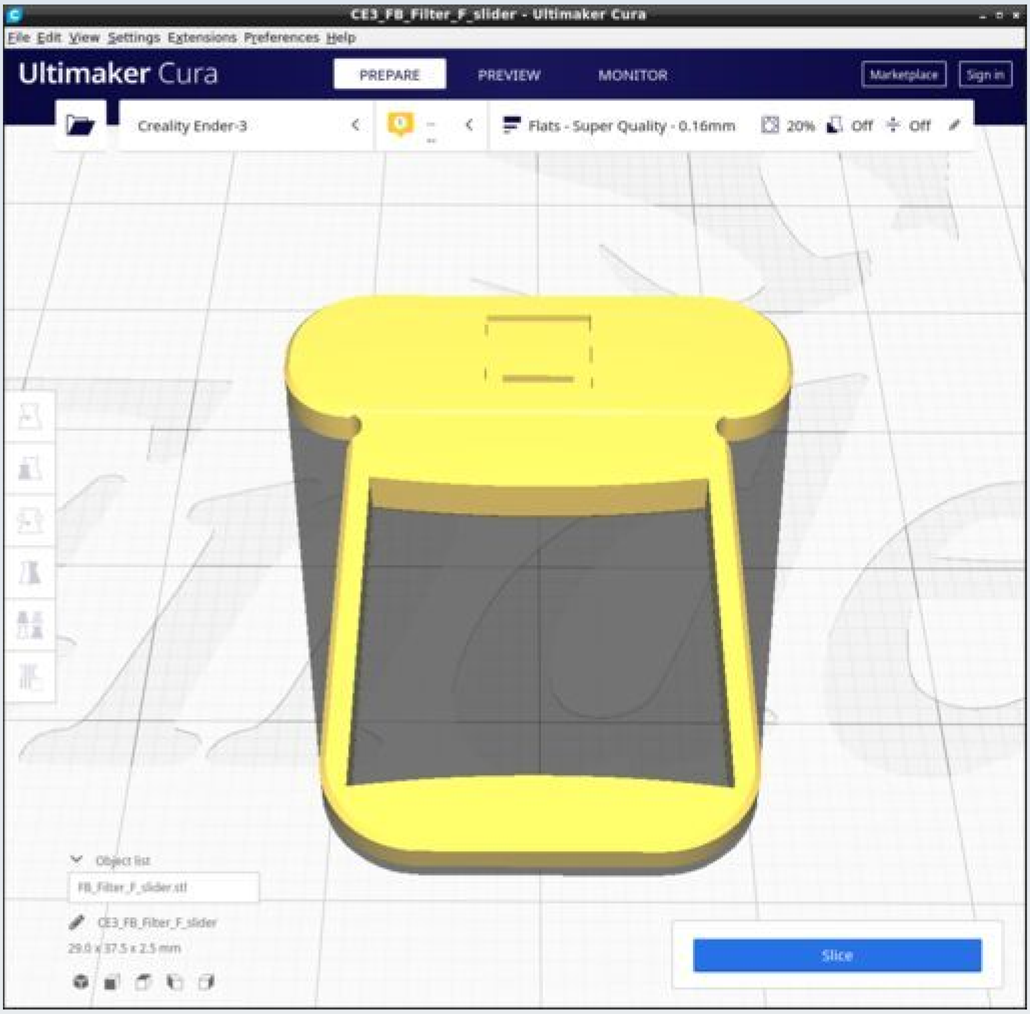
FB_Filter_collar



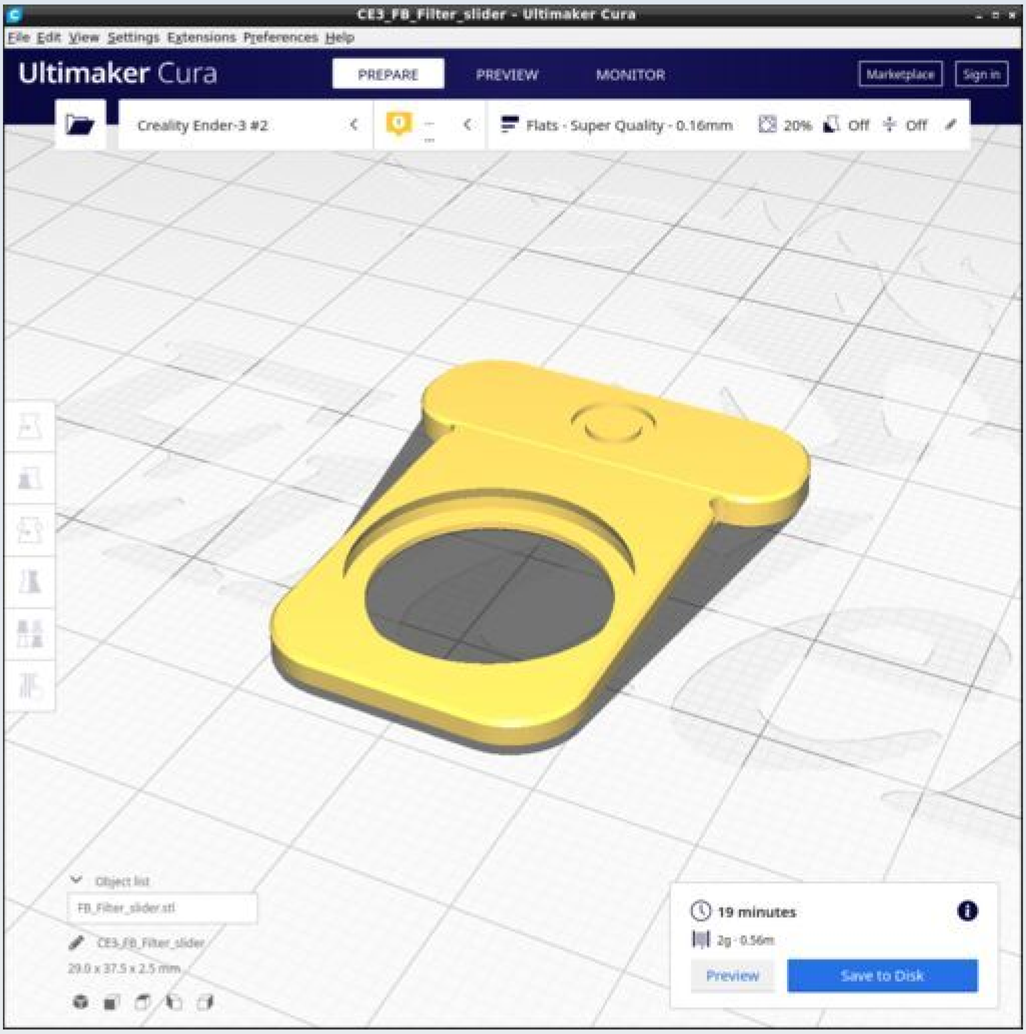
FB_Filter_F17_slider



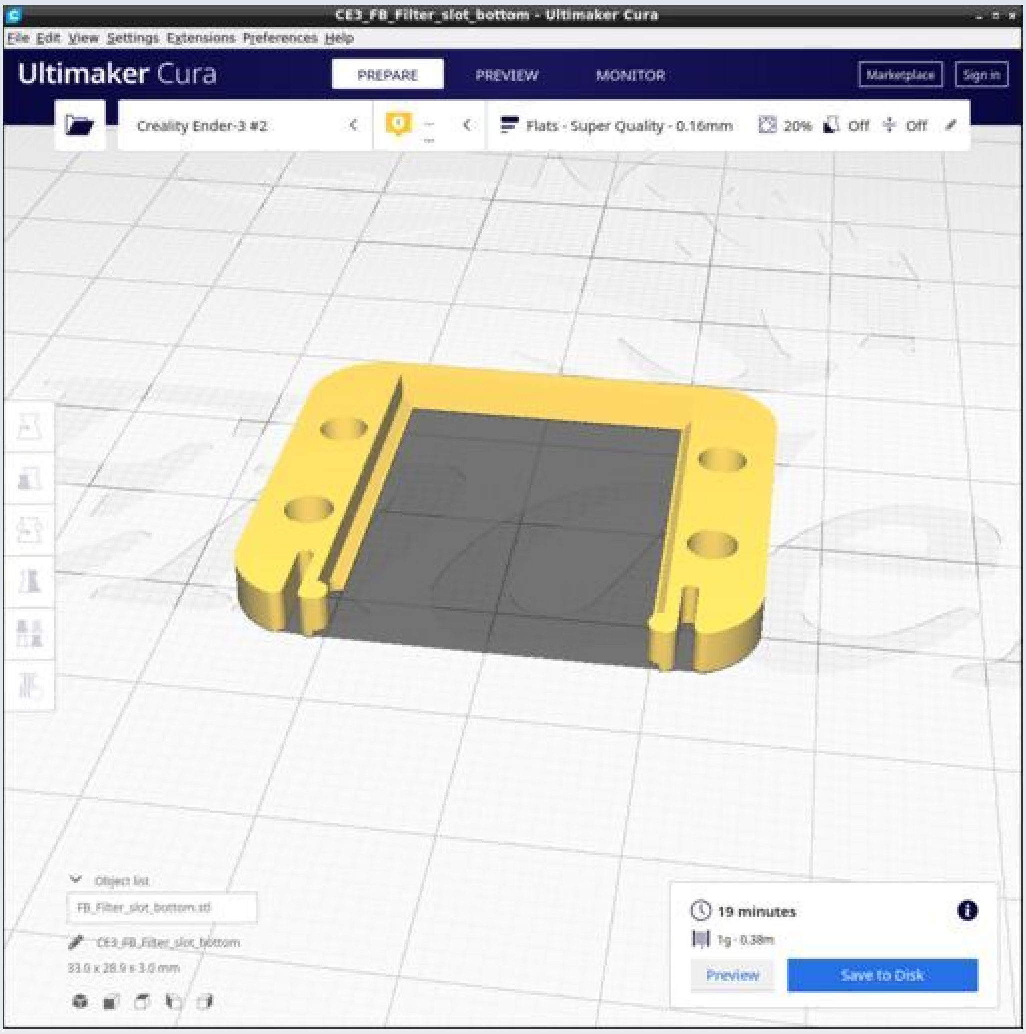
FB_Filter_F_slider



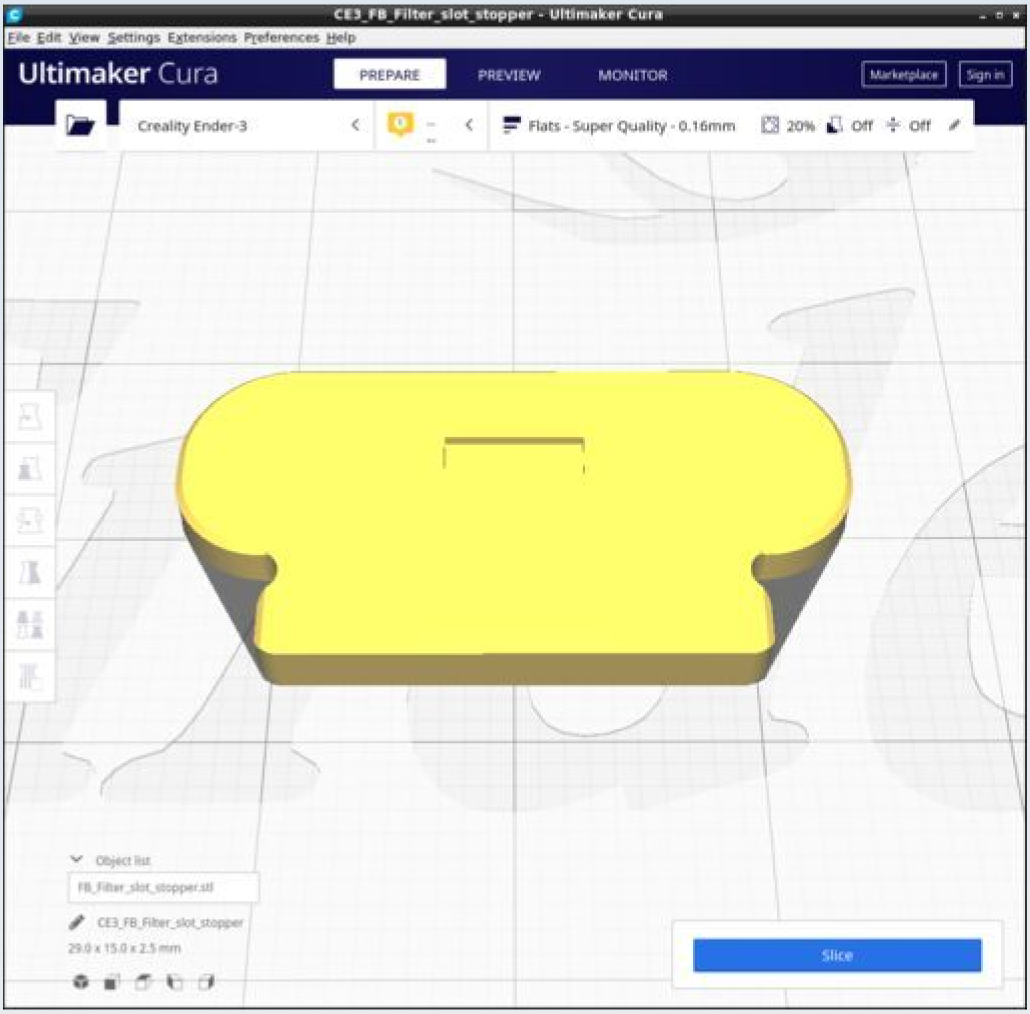
FB_Filter_slider



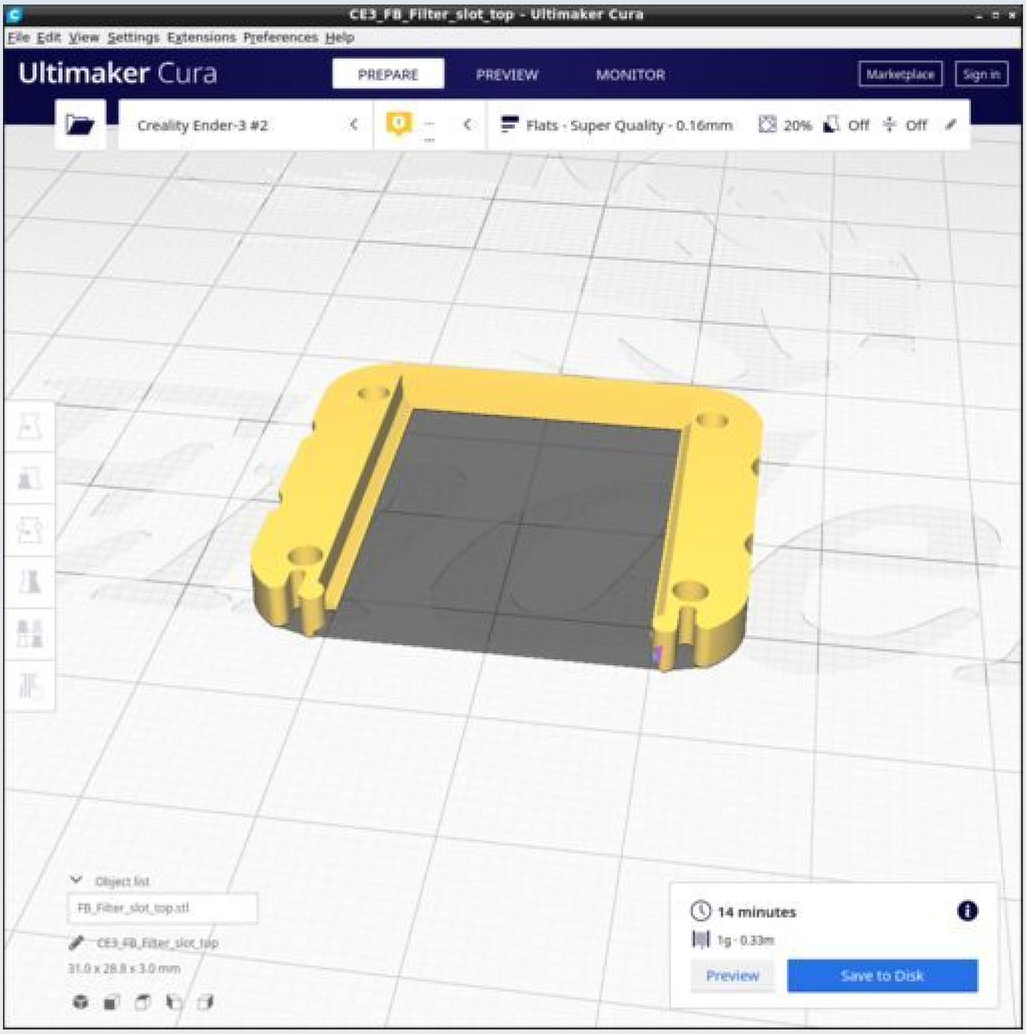
FB_Filter_Slot_bottom



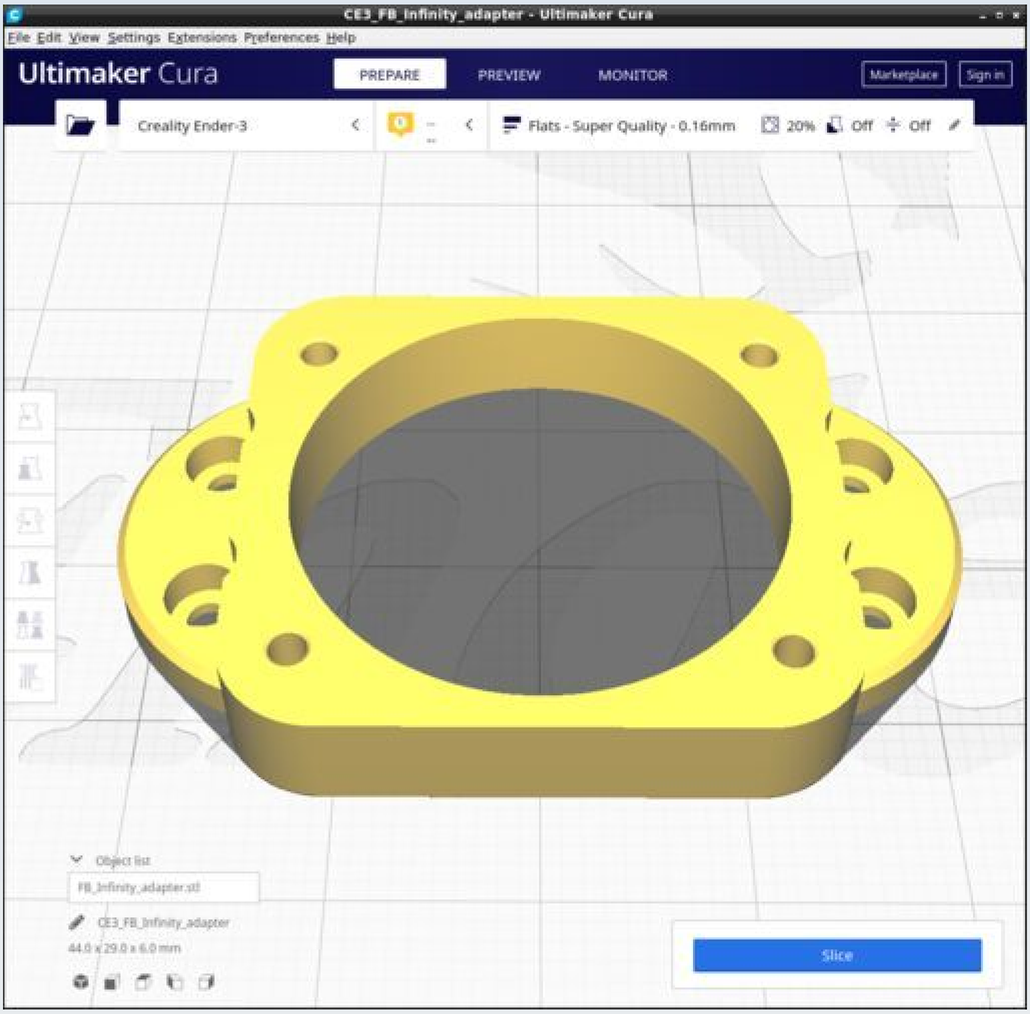
FB_Filter_slot_stopper



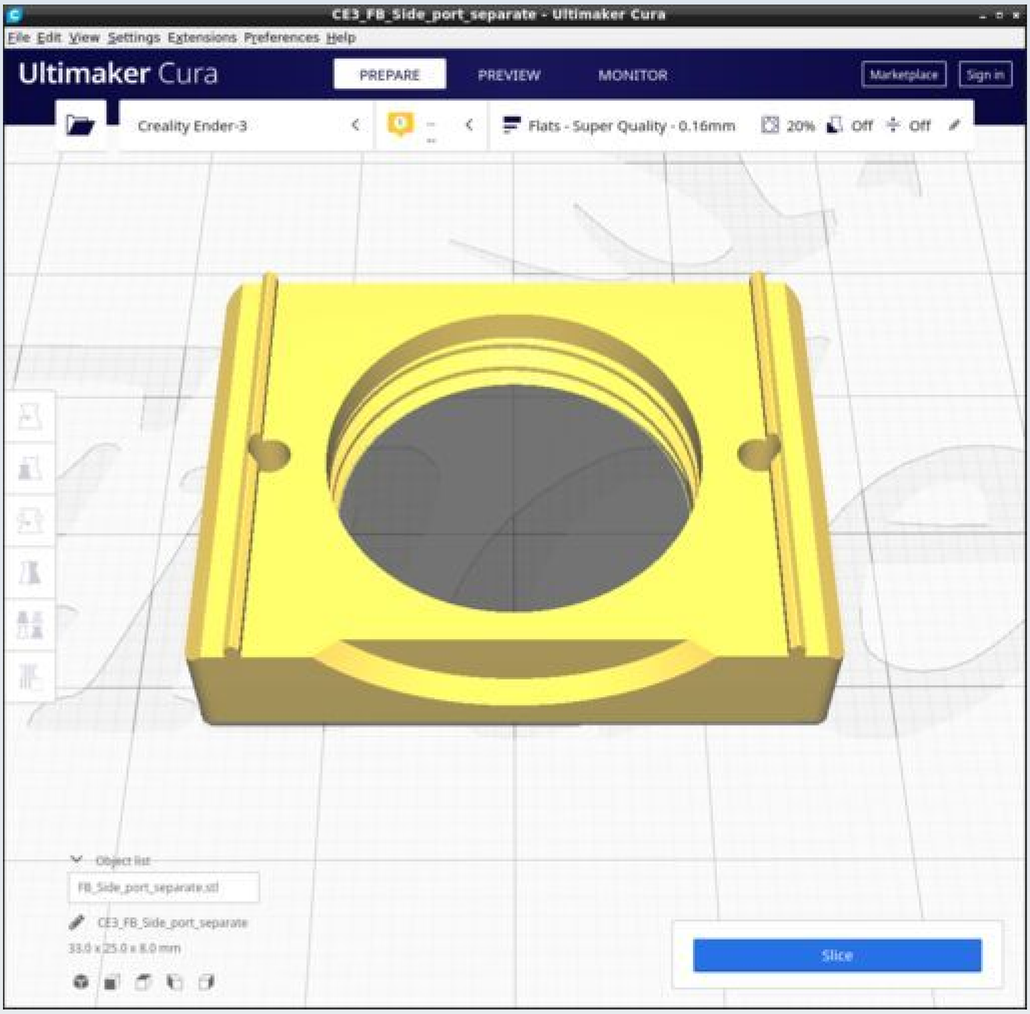
FB_Filter_slot_top



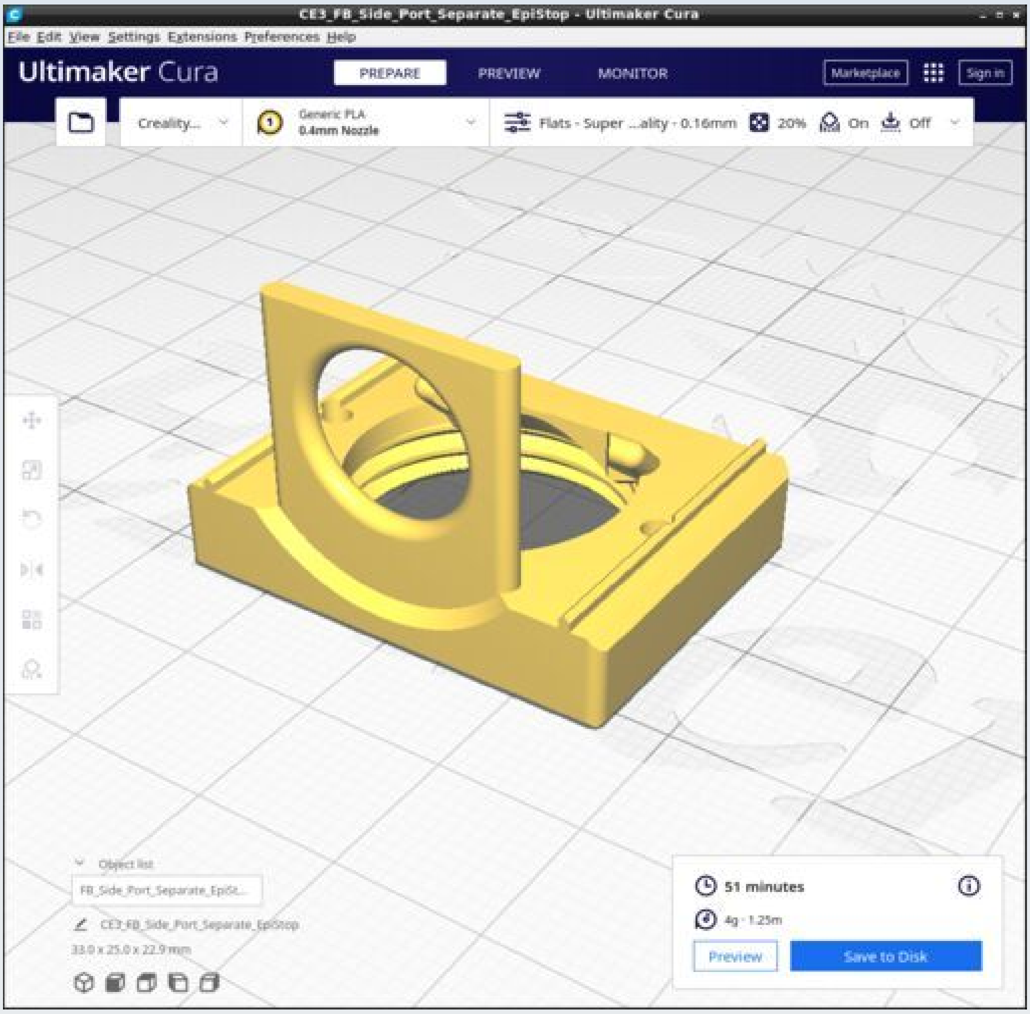
FB_Infinity_adapter



FB_Side_port_separate

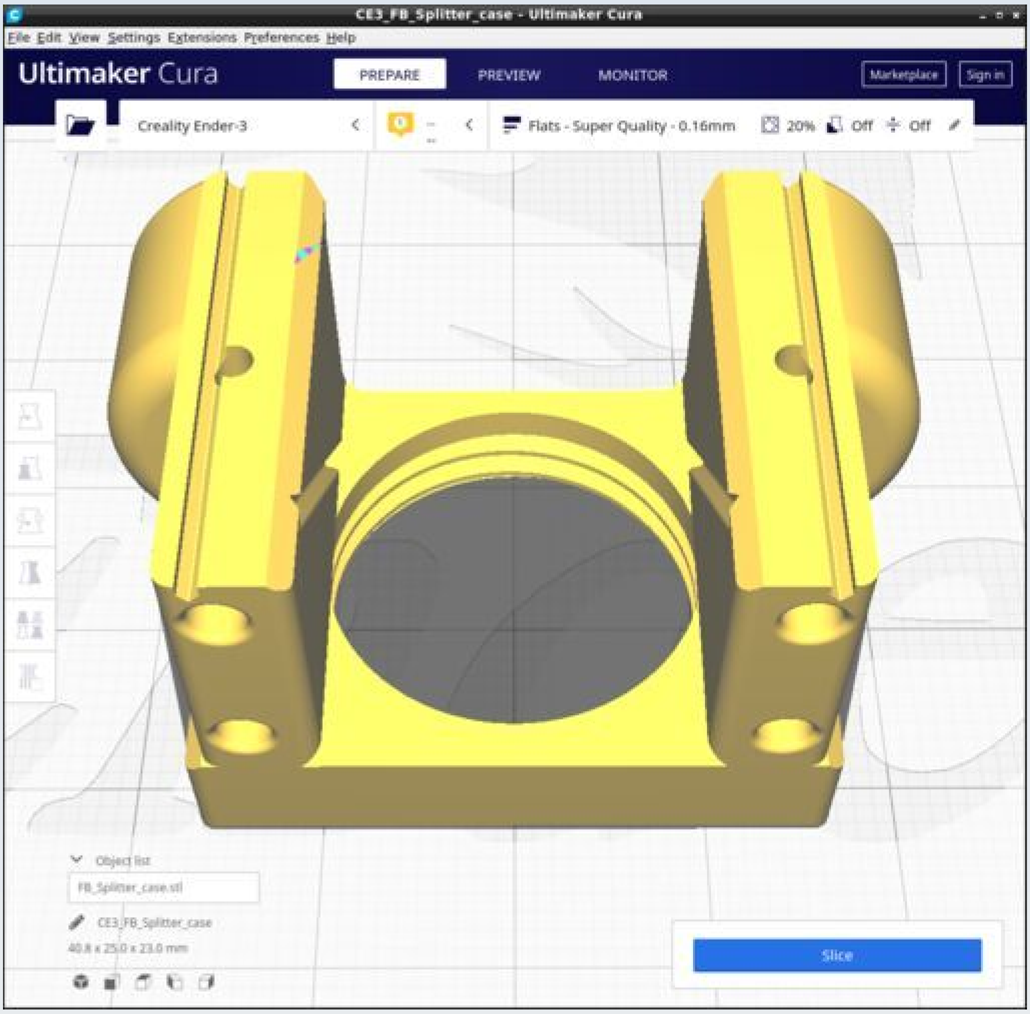


FB_Side_port_separate_EpiStop



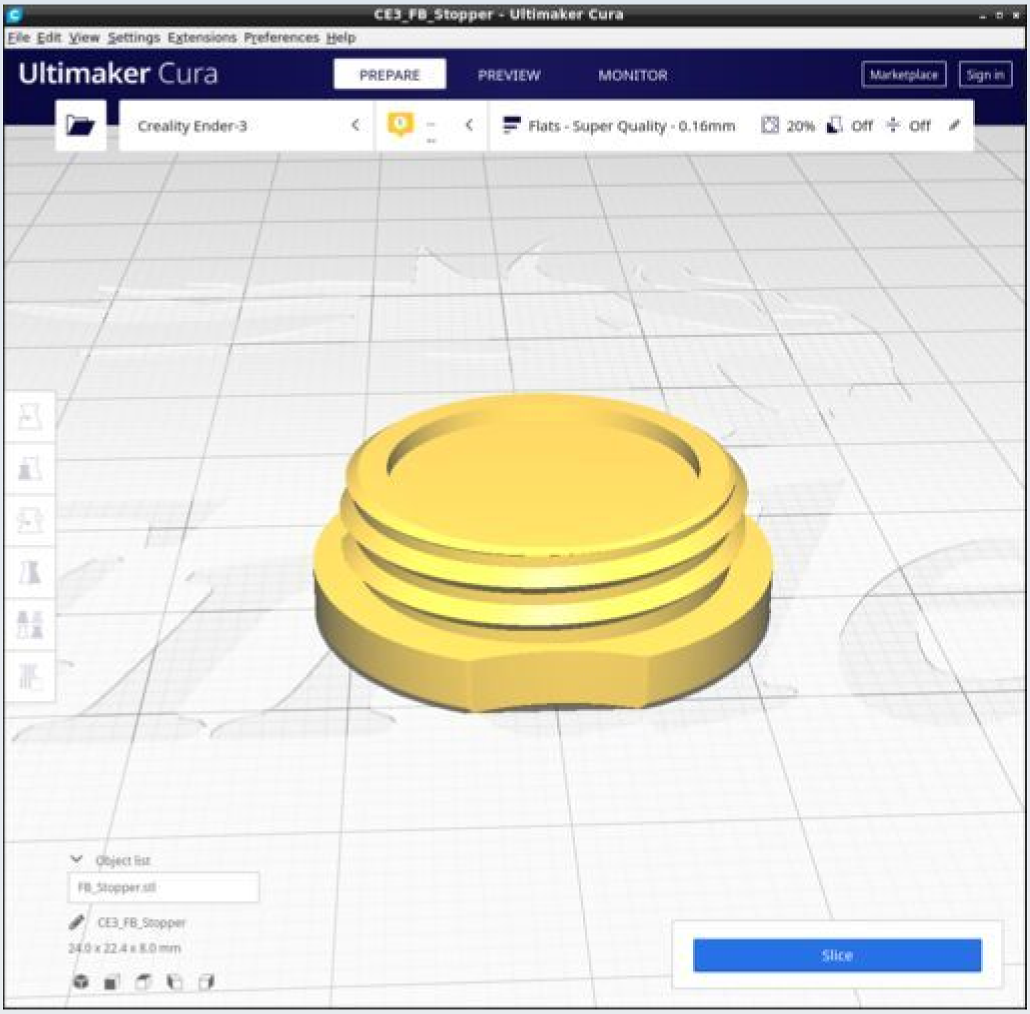
Print with supports on: General (not tree) support, overhang 67 degrees, supports enabled ‘everywhere’.

FB_Splitter_case



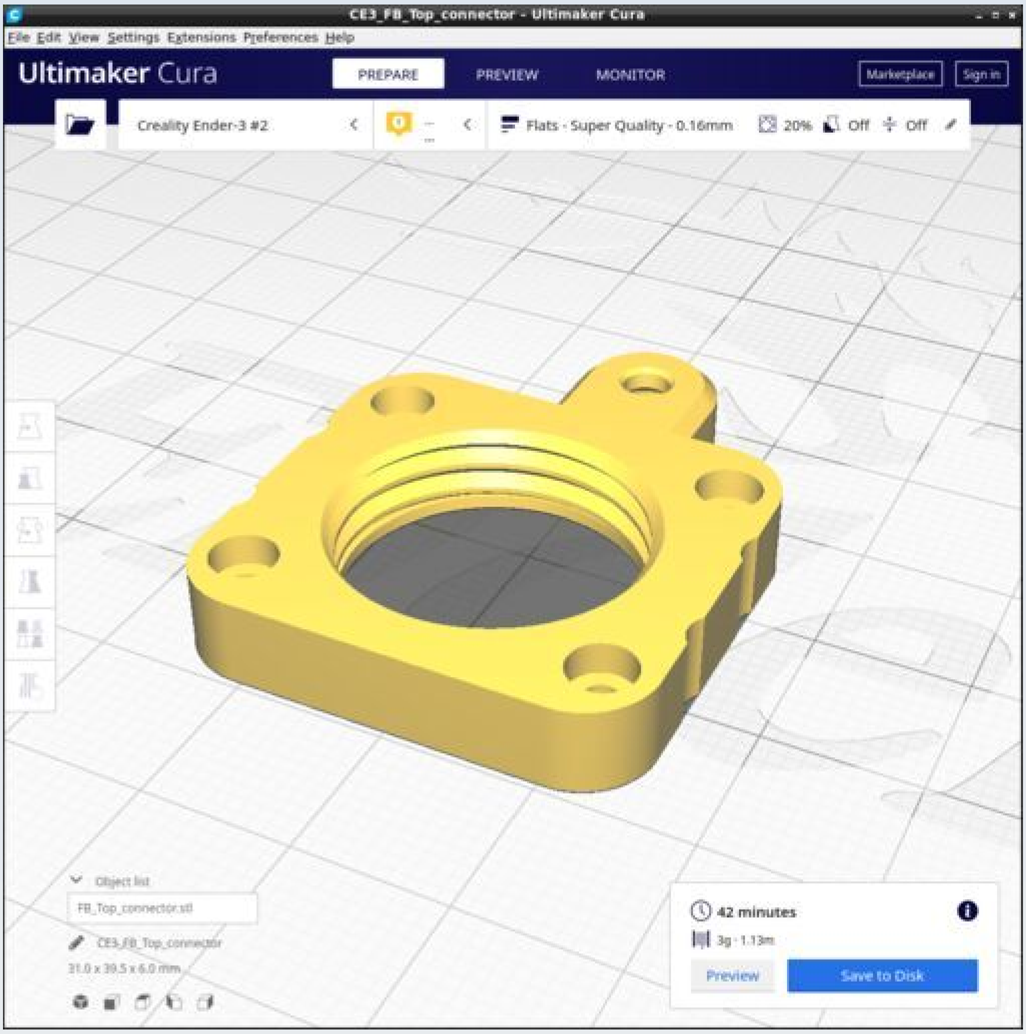
Ensure all supports are off.

FB_Stopper



Ensure all supports are off.

FB_Top_connector



Focus Gears

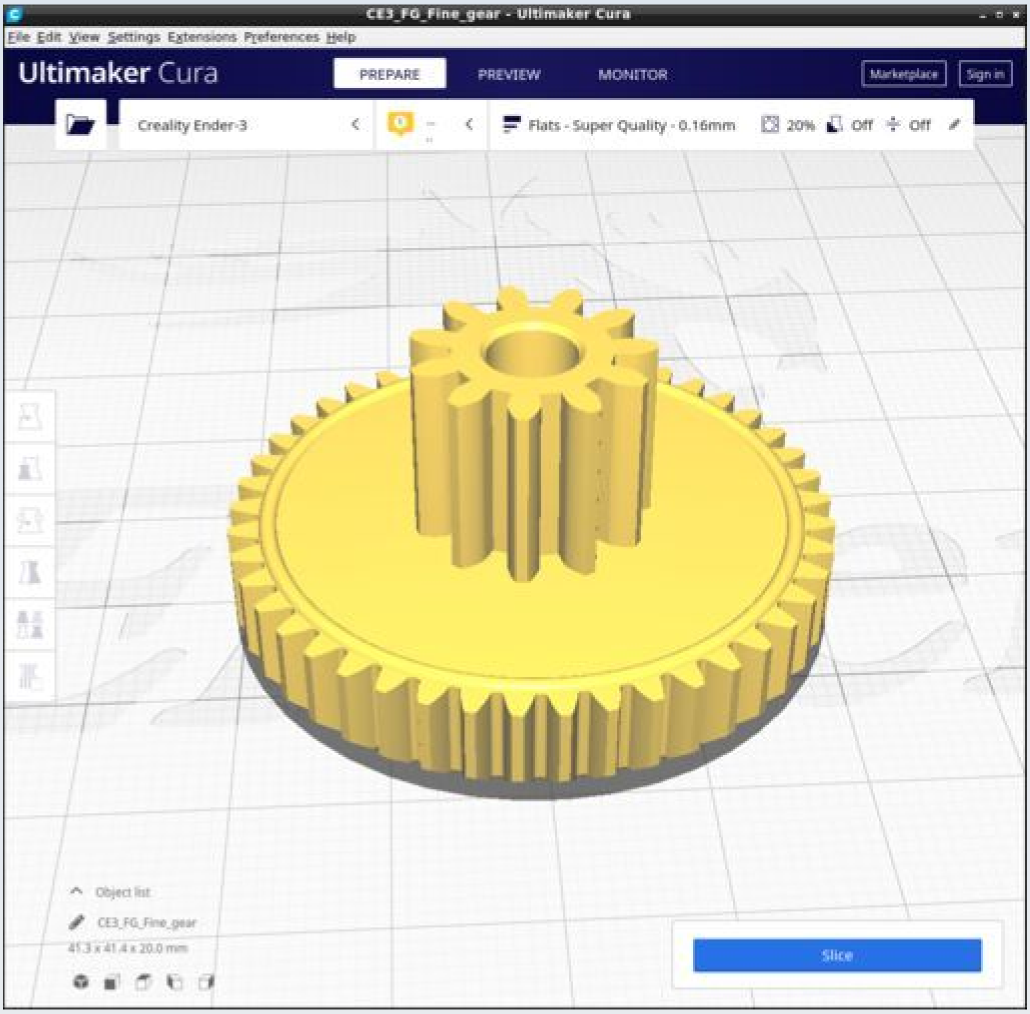
These are the parts for the stage focus mechansim. The CAD source models for these files are found in the file Focus_Gears.FCStd.

Resources

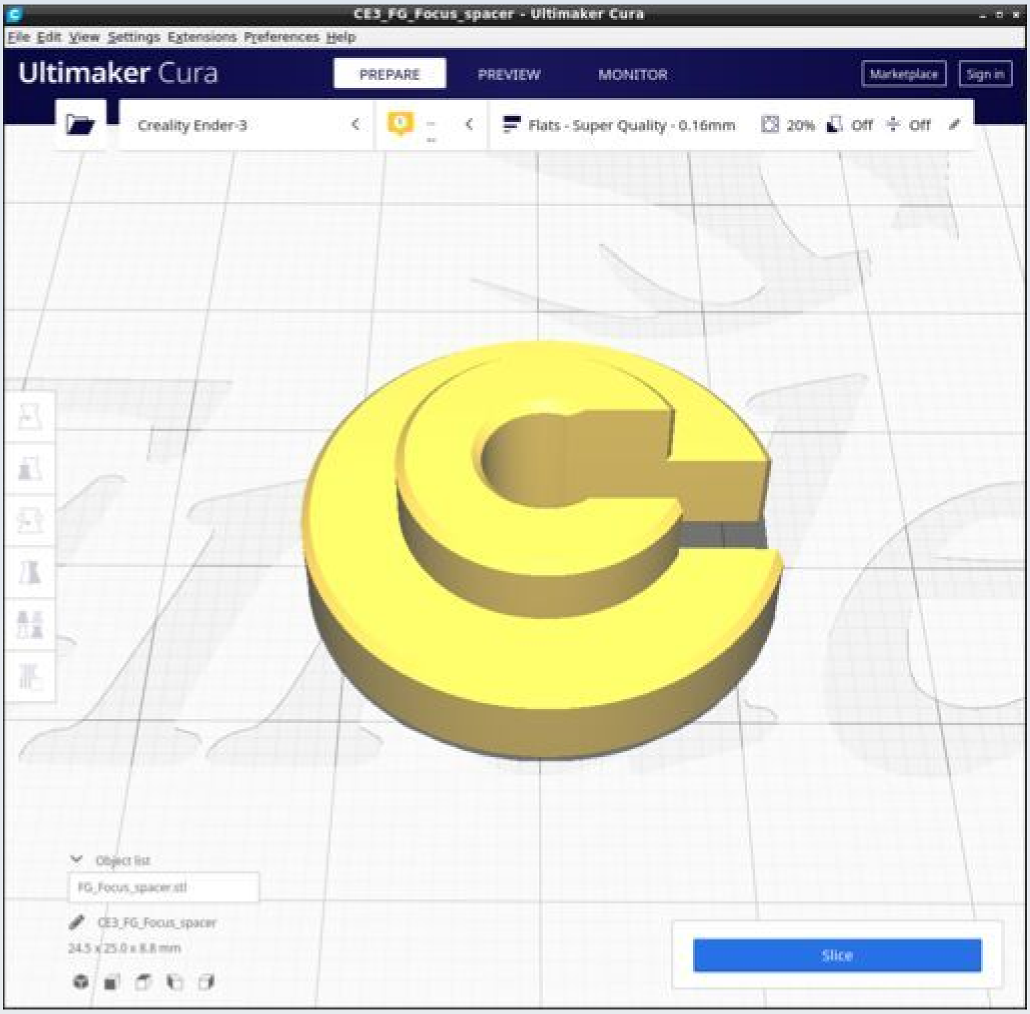
Cura calculates the following resources are required to print each model in this chapter:

Focus Gears	Time_Hr	Time_Min	PLA_Length(m)
FG_Fine_gear	1	38	2.65
FG_Focus_spacer	0	20	0.7
FG_Intermedius	1	7	1.75
FG_Pulley_coarse	1	18	2.03
FG_Pulley	0	21	0.33
FG_Eccentric_Tensioner_Top	0	24	0.69
FG_Eccentric_Tensioner_Bottom	0	19	0.44
FG_Eccentric_Tensioner_Pulley_c_adhesin	0	17	0.22

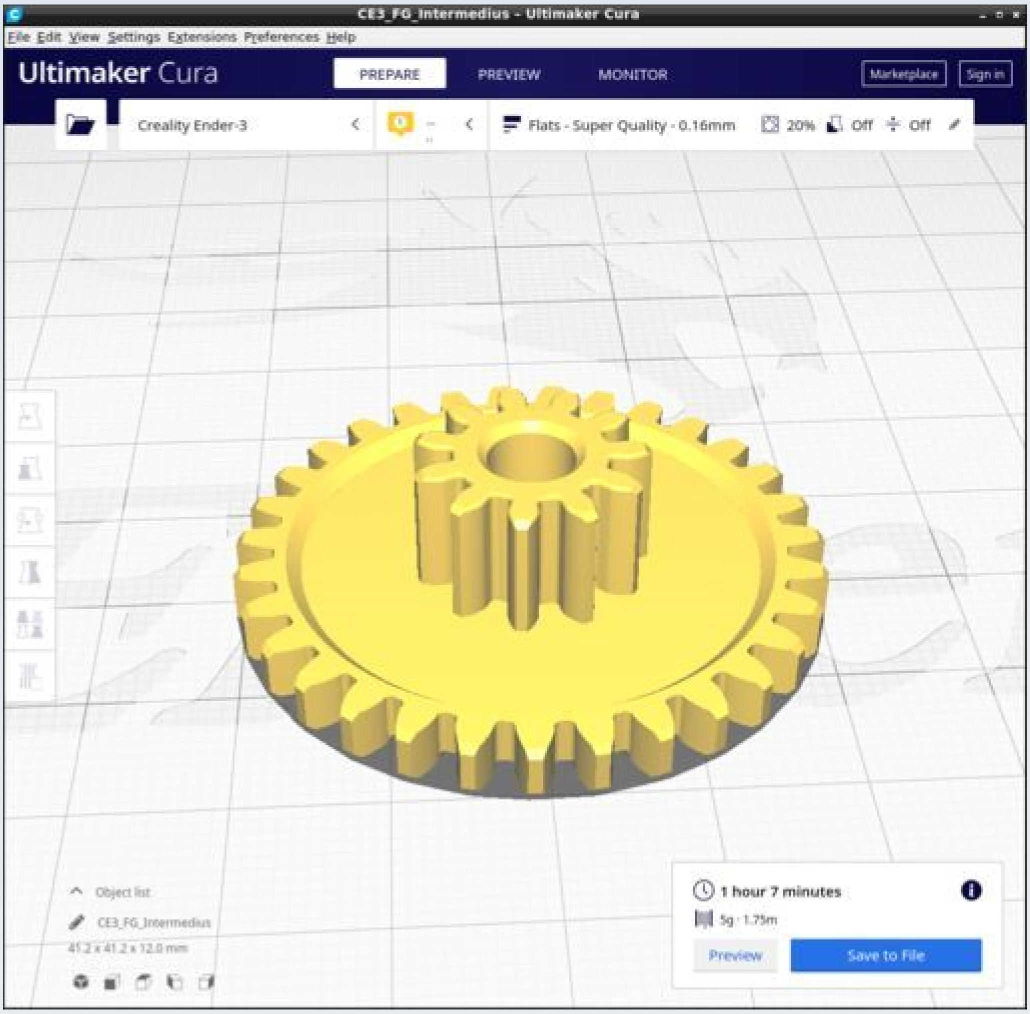
FG_Fine_gear


CE3_FG_Fine_gear - Ultimaker Cura
File Edit View Settings Extensions Preferences Help
Ultimaker Cura
PREPARE
PREVIEW
MONITOR
Marketplace
Sign in
Creality Ender-3
Flats - Super Quality - 0.16mm
20%
Off
Off
Object list
CE3_FG_Fine_gear
41.3 x 41.4 x 20.0 mm
Slice

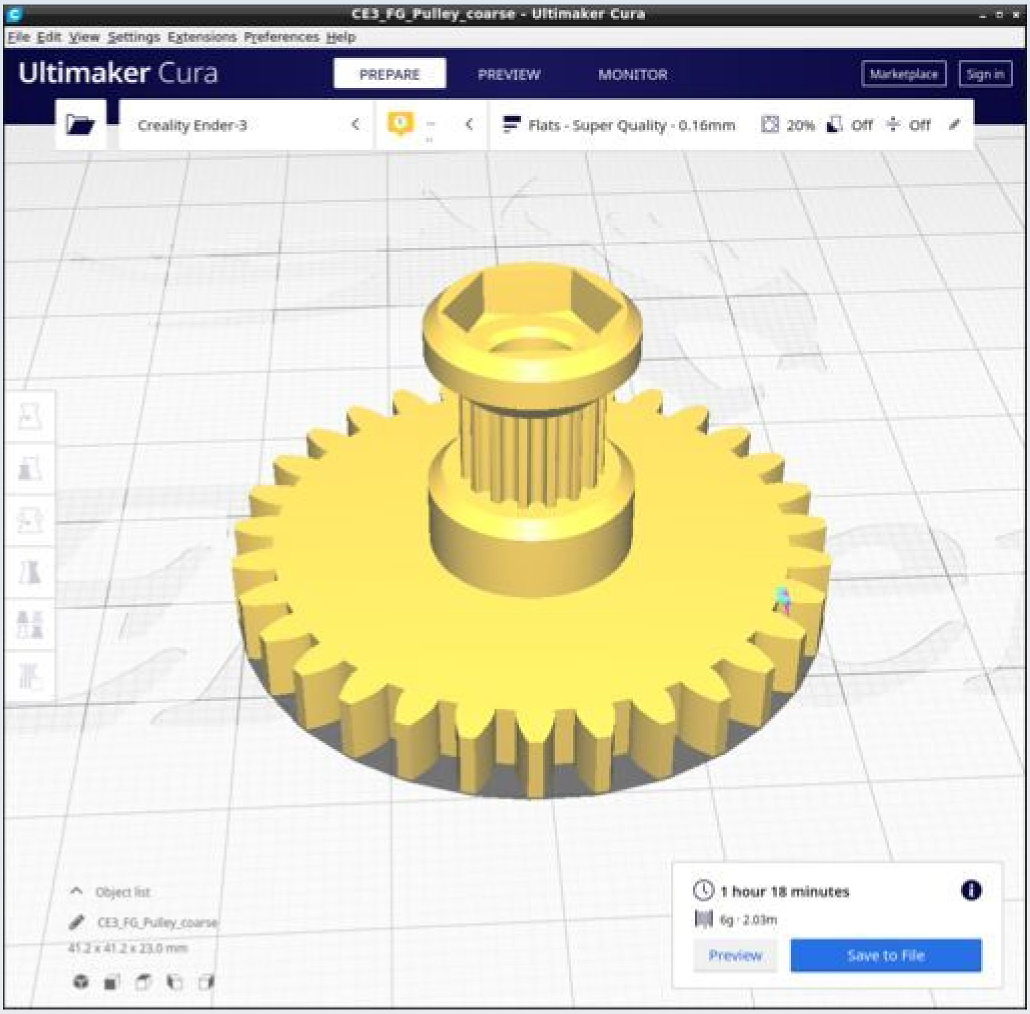
FG_Focus_spacer



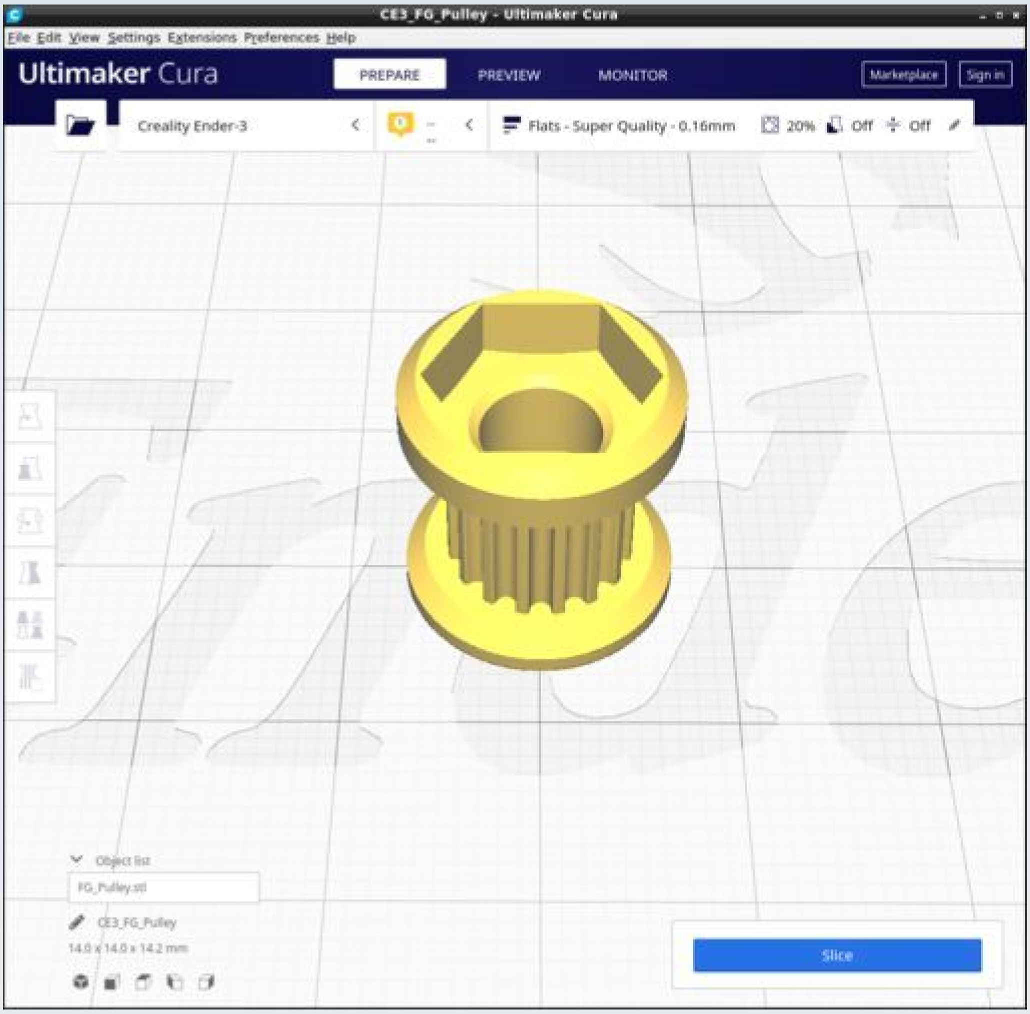
FG_Intermedius



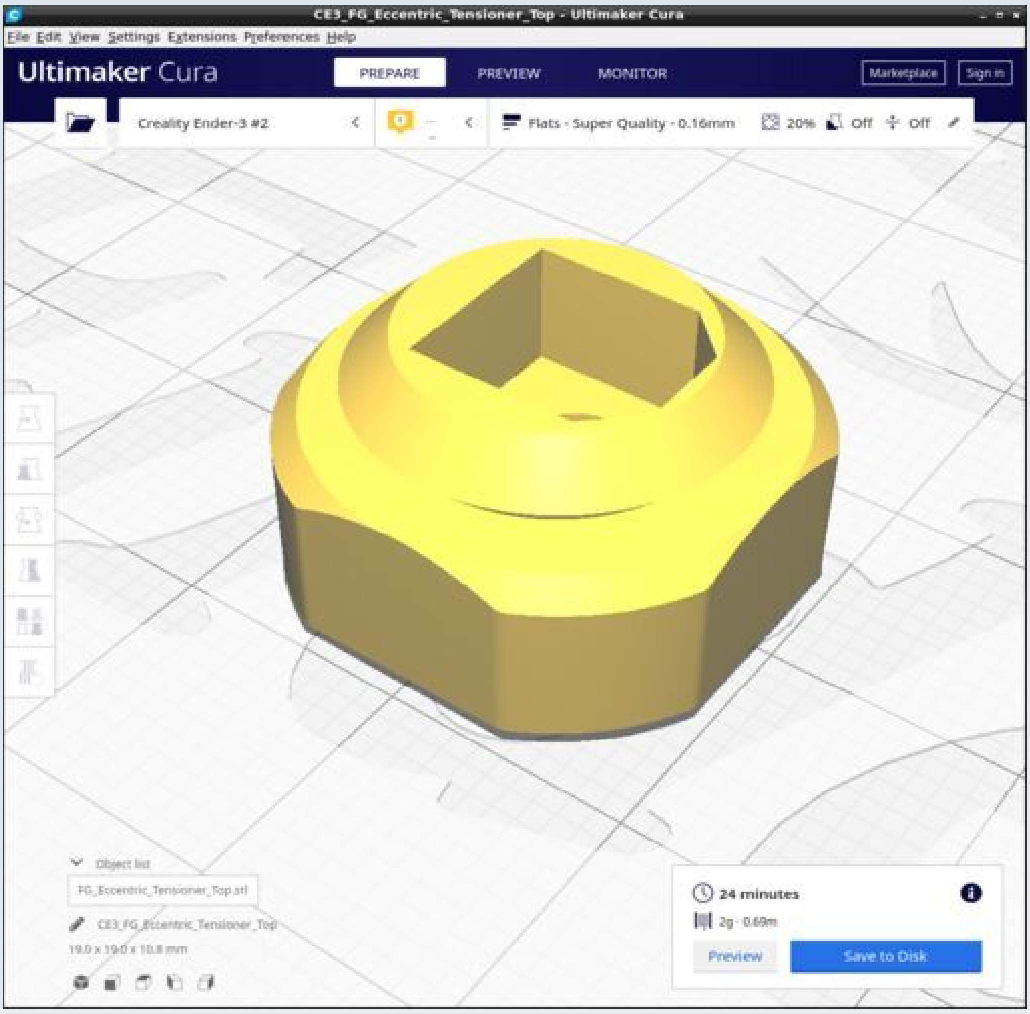
FG_Pulley_coarse



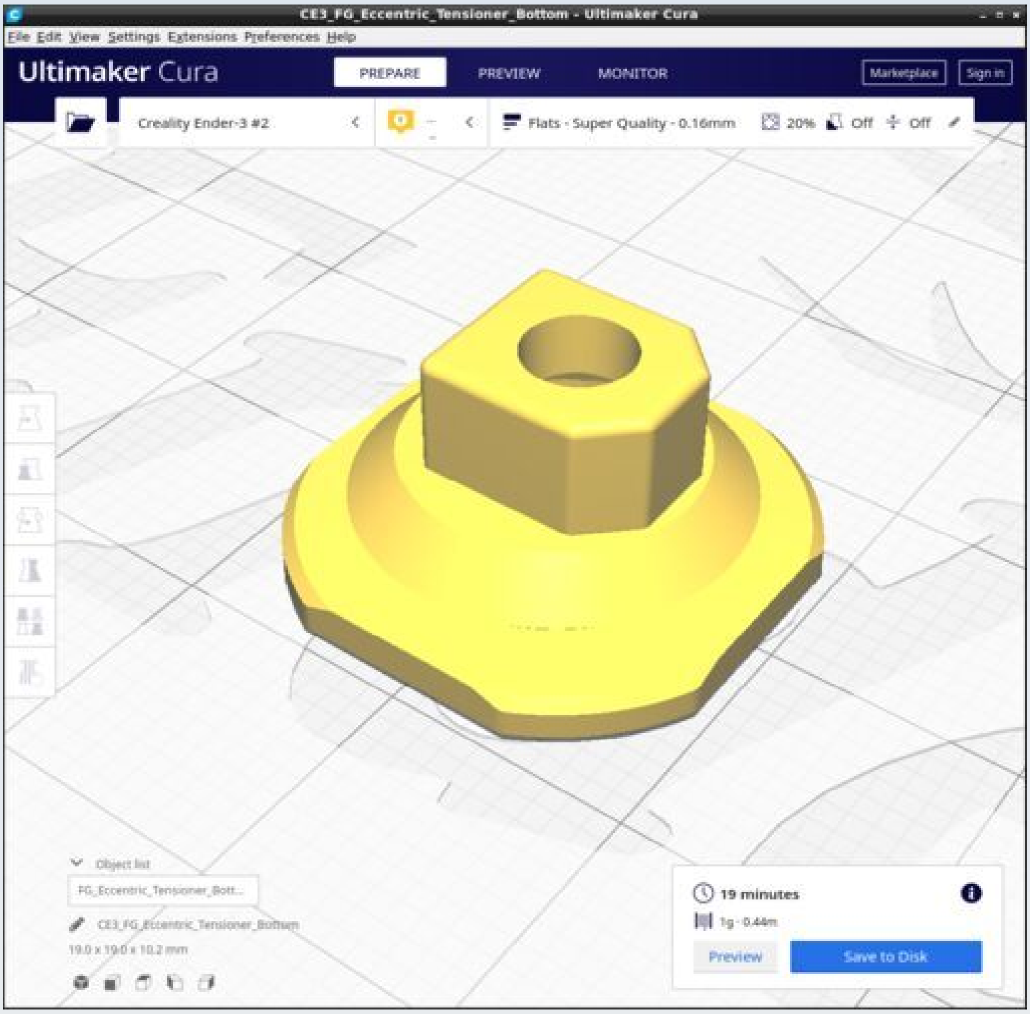
FG_Pulley


CE3_FG_Pulley - Ultimaker Cura
File Edit View Settings Extensions Preferences Help
Ultimaker Cura
PREPARE
PREVIEW
MONITOR
Marketplace
Sign in
Creality Ender-3
Flats - Super Quality - 0.16mm
20%
Off
Off
Object list
FG_Pulley.stl
CE3_FG_Pulley
14.0 x 14.0 x 14.2 mm
Slice

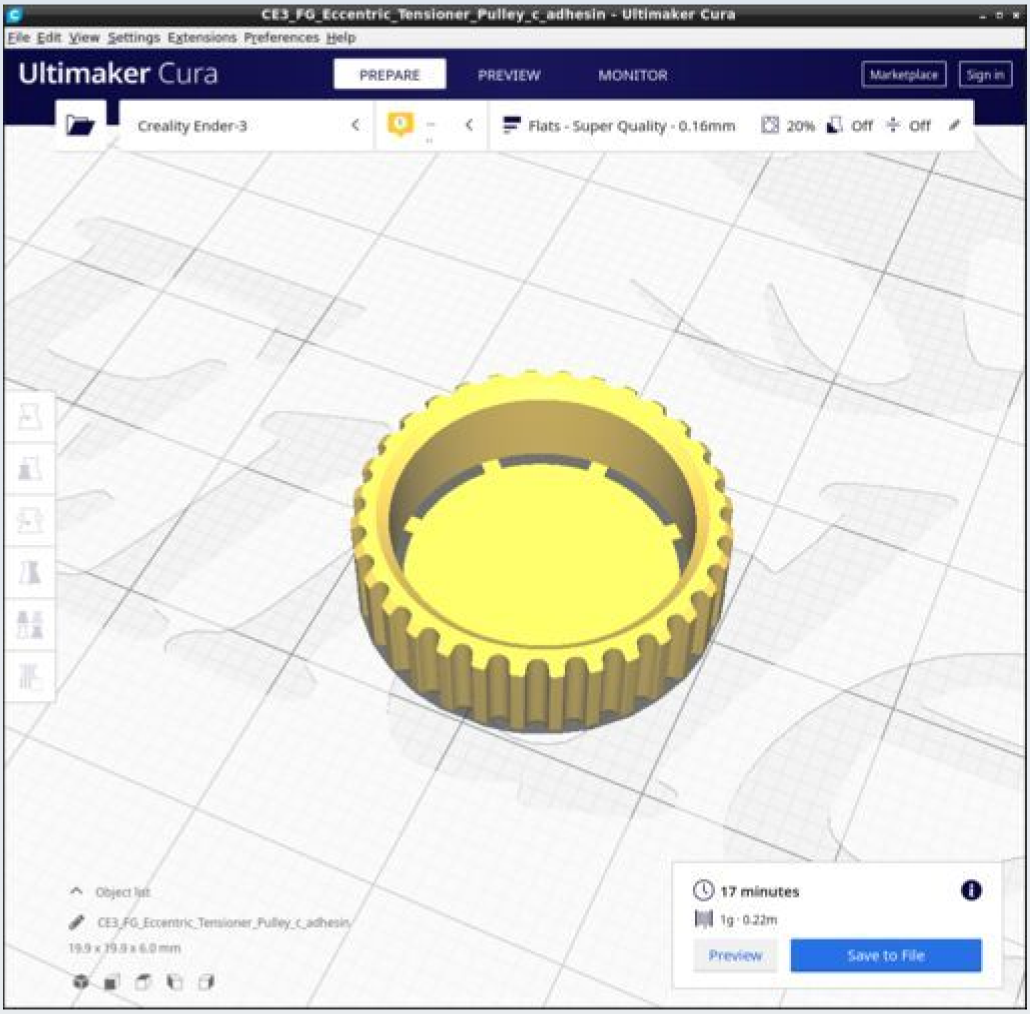
FG_Eccentric_Tensioner_Top



FG_Eccentric_Tensioner_Bottom



FG_Eccentric_Tensioner_Pulley_c_adhesin



Legs

These are the parts for the various legs / stands options for the microscope. The CAD source models for these files are found in the file Legs.FCStd.

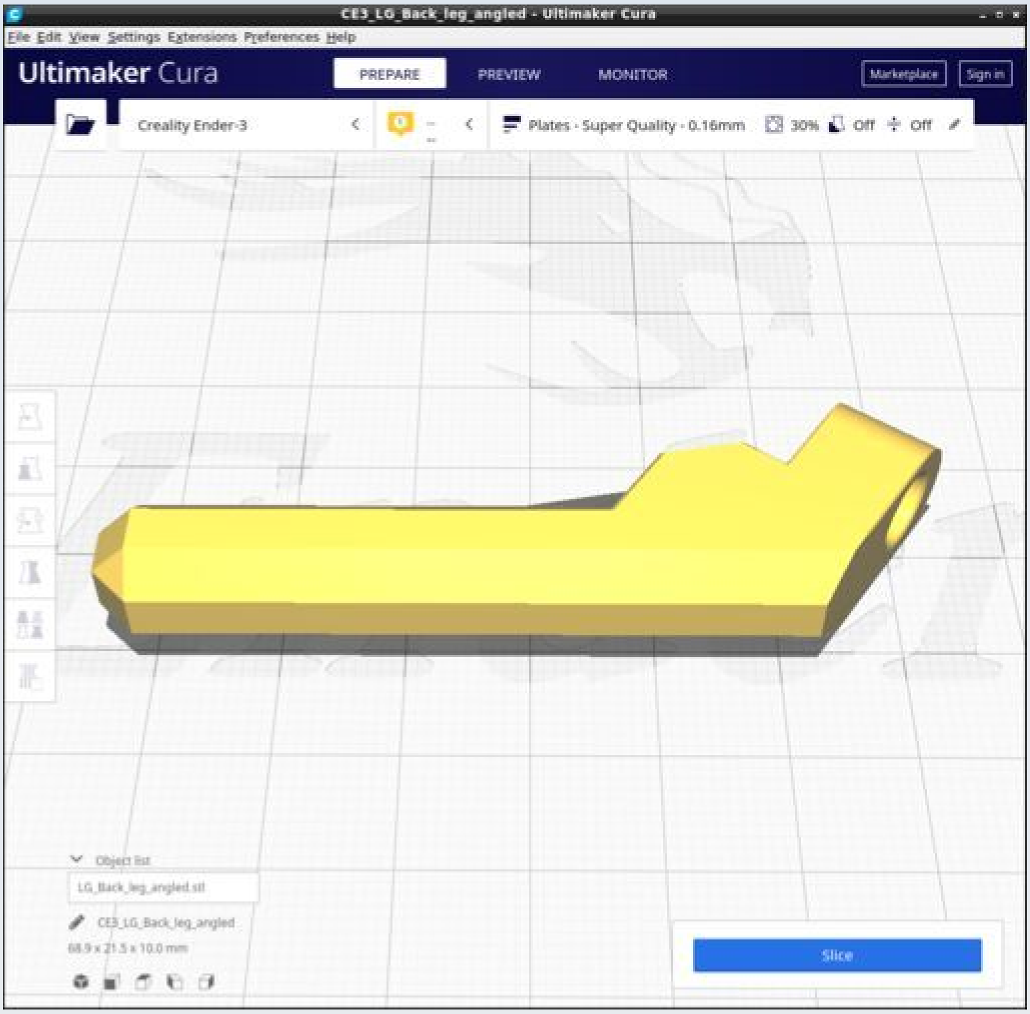
All these should be printed with the ‘Plates’ custom Cura profile. Only the ‘LG_Feet_linker’ requires supports and special instructions (see below).

Resources

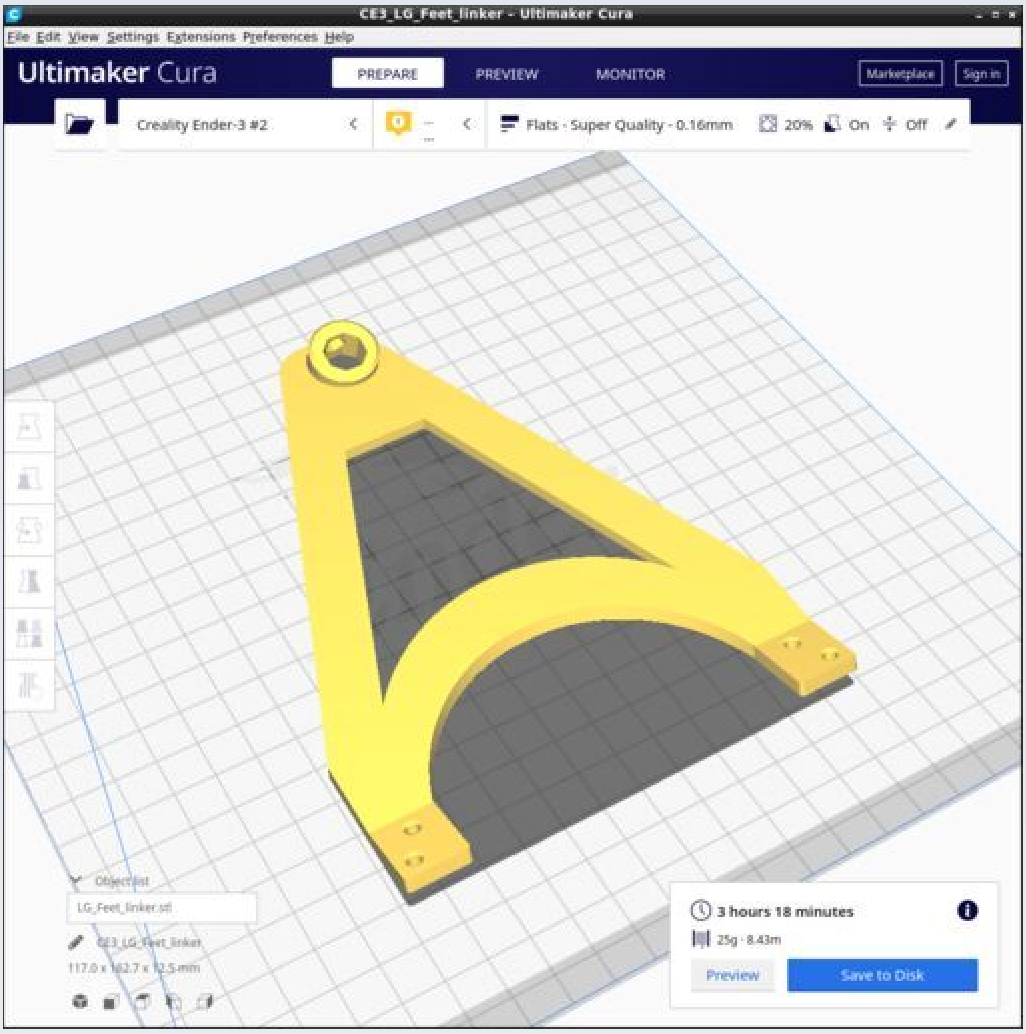
Cura calculates the following resources are required to print each model in this chapter:

Legs	Time_Hr	Time_Min	PLA_Length(m)
LG_Back_leg_angled	0	36	1.68
LG_Feet_linker	3	18	8.43
LG_Front_legs	3	21	9.34
LG_Hind_extension	0	46	1.64
LG_Short_leg	0	16	0.54

LG_Back_leg_angled



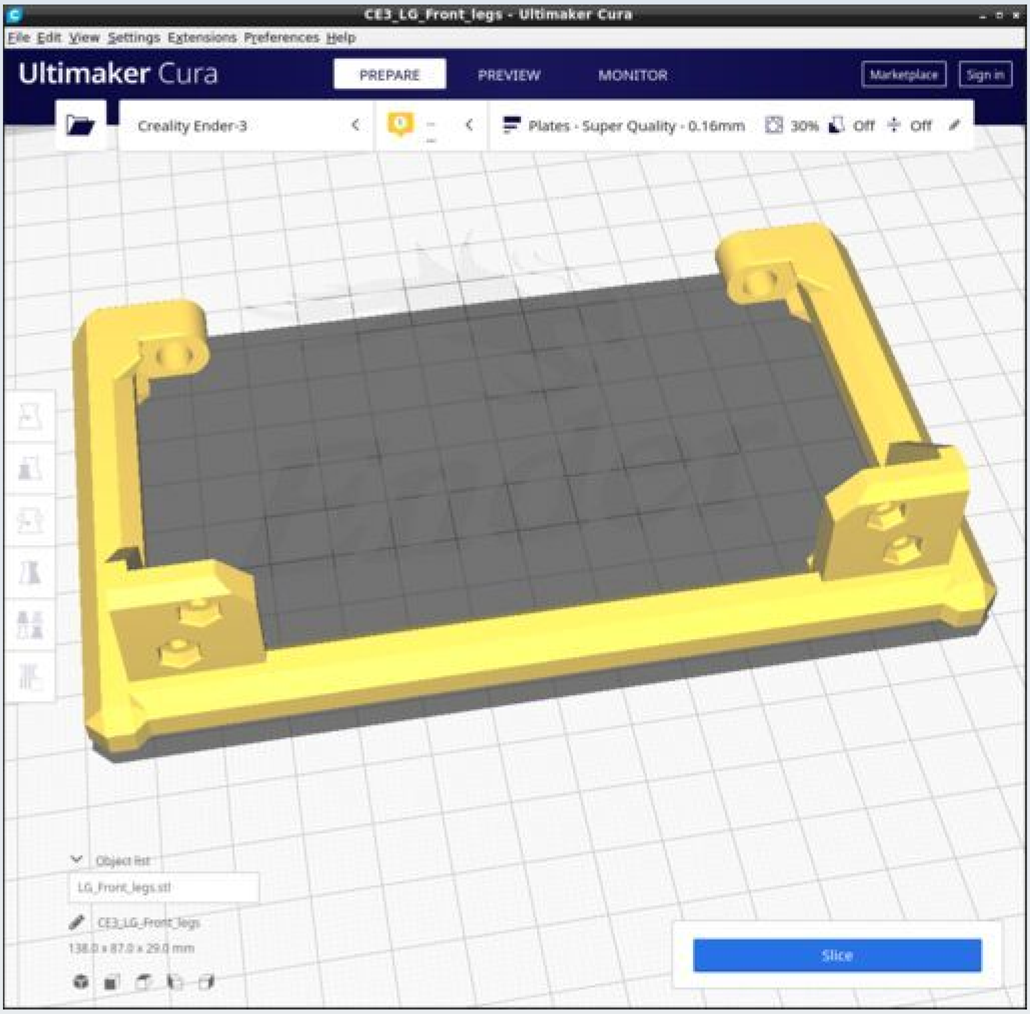
LG_Feet_linker



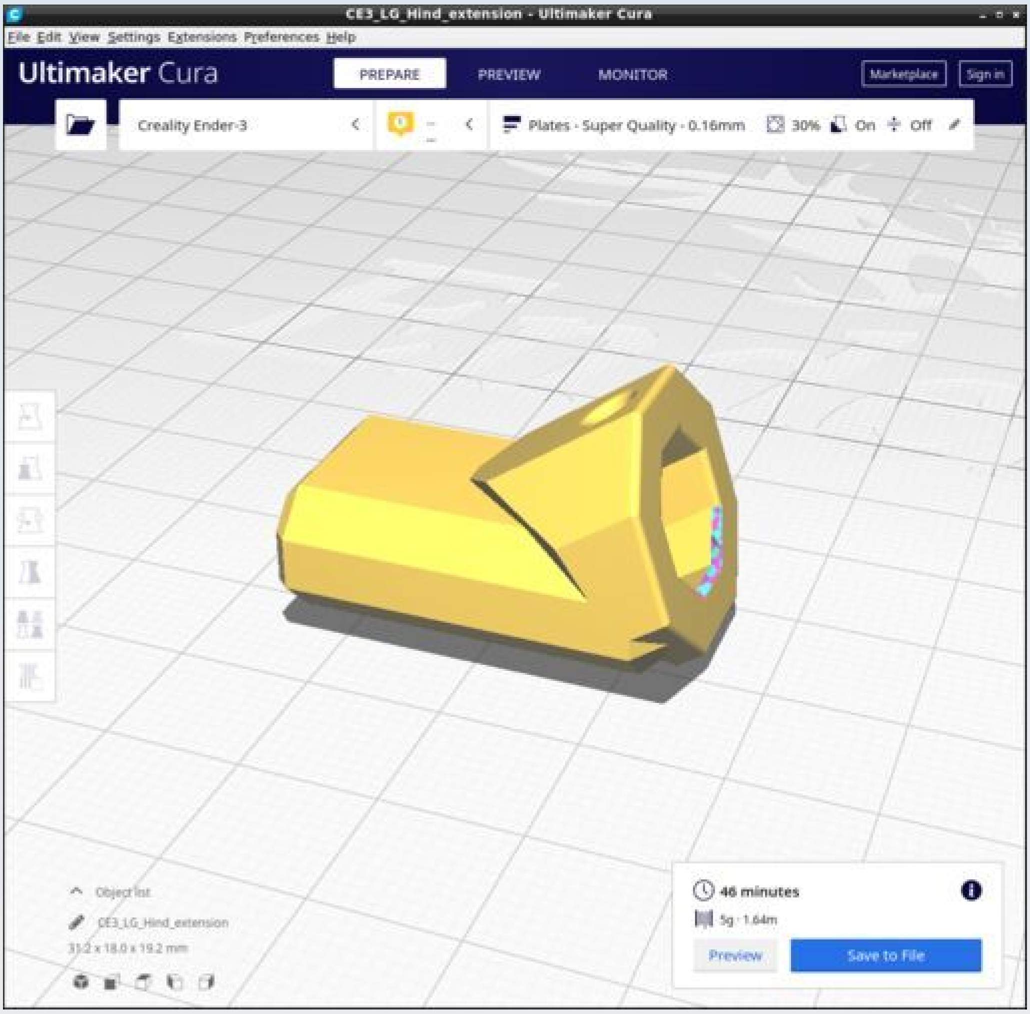
Use supports 'touching baseplate only' with 67 degree overhang angle.

Also, you must rotate it in Cura by 90 degrees to the position shown in the figure and ensure it is lain flat agains the build plate because there is a slight angle to it when first loaded (this may be imperceptible by eye but it can cause print failure if not corrected). Both the rotation by 90 degrees and the laying flat can be achieved in one step by selecting the model, going to the rotations menu and click the ‘Lay flat’ icon – this will do both things for you automatically (tested and works with Cura 4.8 and Cura 4.10.0).

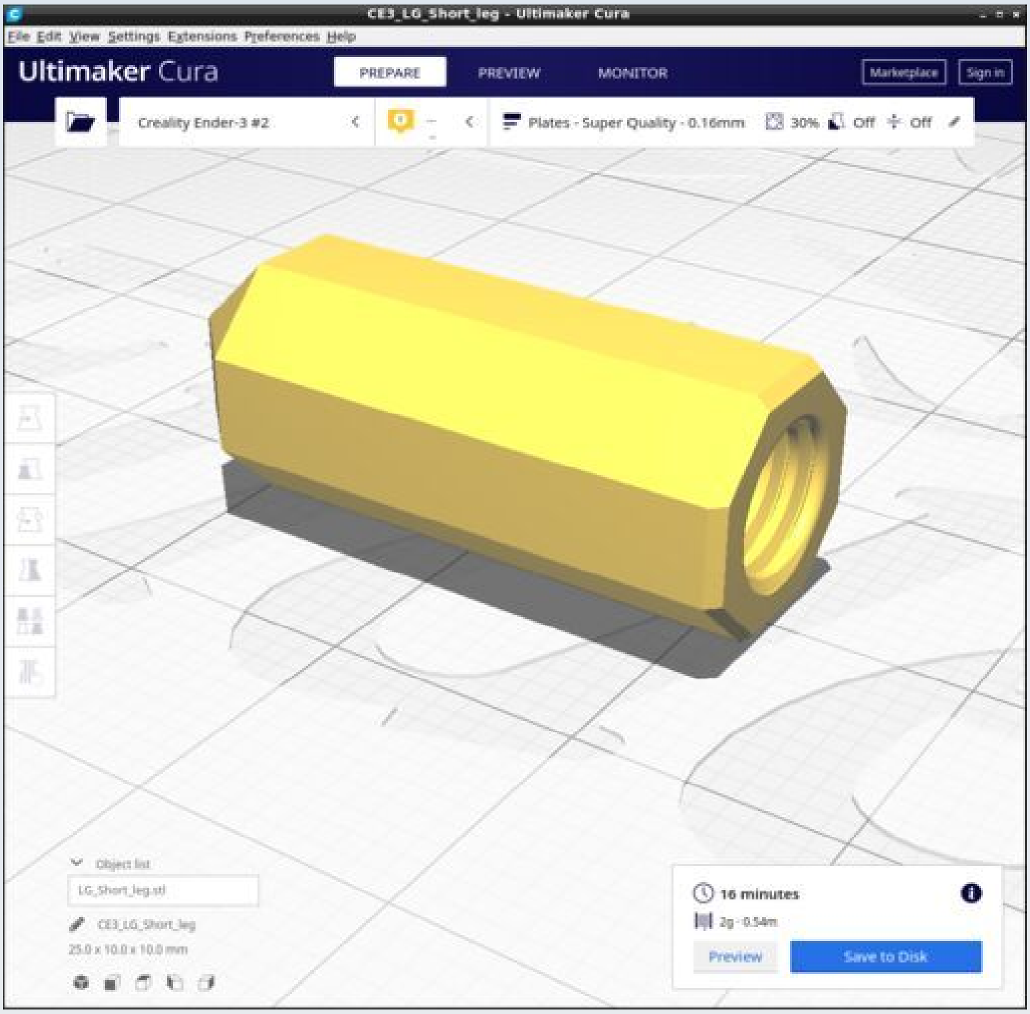
LG_Front_legs



LG_Hind_extension



LG_Short_leg


CE3_LG_Short_leg - Ultimaker Cura
File Edit View Settings Extensions Preferences Help
Ultimaker Cura
PREPARE
PREVIEW
MONITOR
Marketplace
Sign in
Creality Ender-3 #2
Plates - Super Quality - 0.16mm
30%
Off
Off
Object list
LG_Short_leg.stl
CE3_LG_Short_leg
25.0 x 10.0 x 10.0 mm
16 minutes
2g · 0.54m
Preview
Save to Disk

Monocular Head

These are the parts for the monocular viewing head of the microscope. Some of the parts here are also used for the binocular and trinocular head modules. The CAD source models for these files are found in the file Monocular.FCStd.

For tubular structures (including the monocular tubes and projection cone) use the ‘Flats’ profile but modify it thus: use a 'Zig-Zag' infill pattern - it is quicker due to fewer stop-start retracts on the nozzle (16% of total time spent on retractions compared to 40% for the default cubic infill pattern, for the monocular tube model). Also use the 'concentric' 'Top/bottom' pattern.

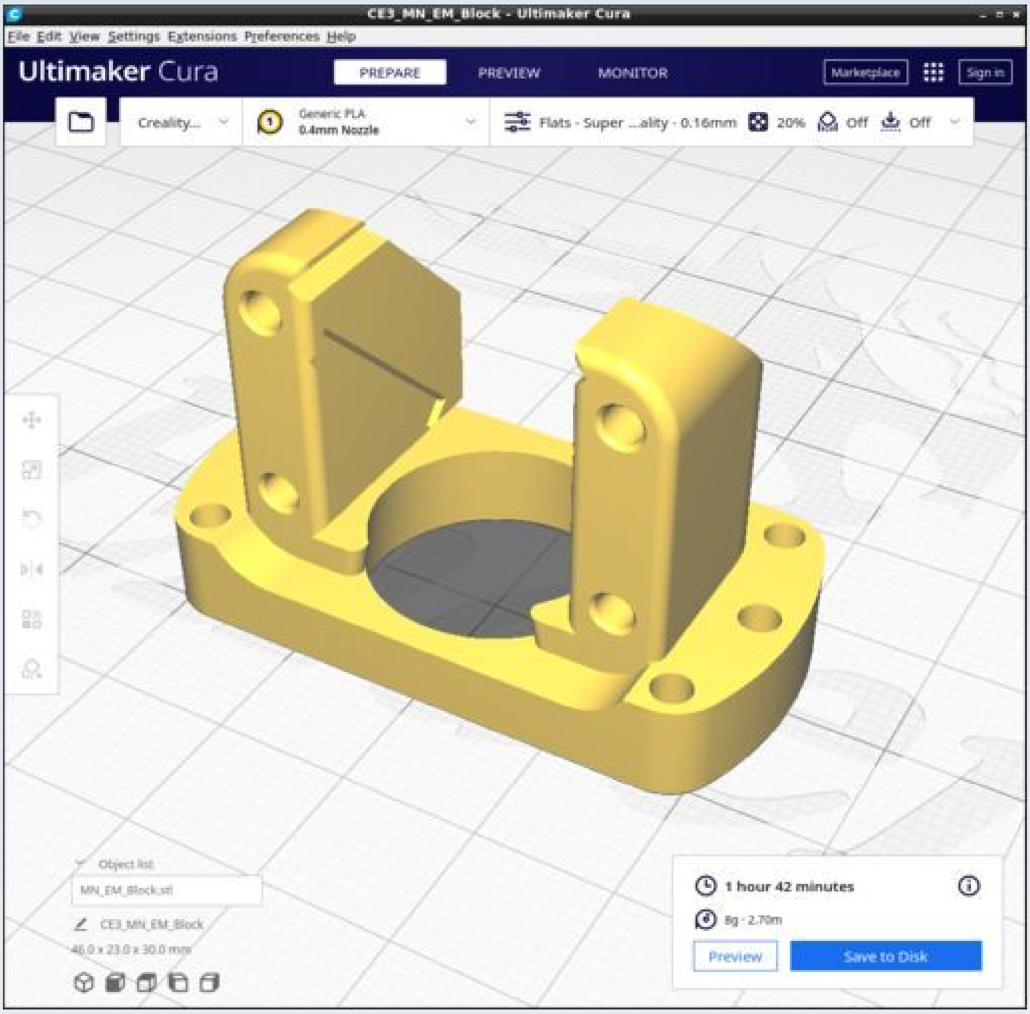
For other models just use the default ‘Flats’ profile.

Resources

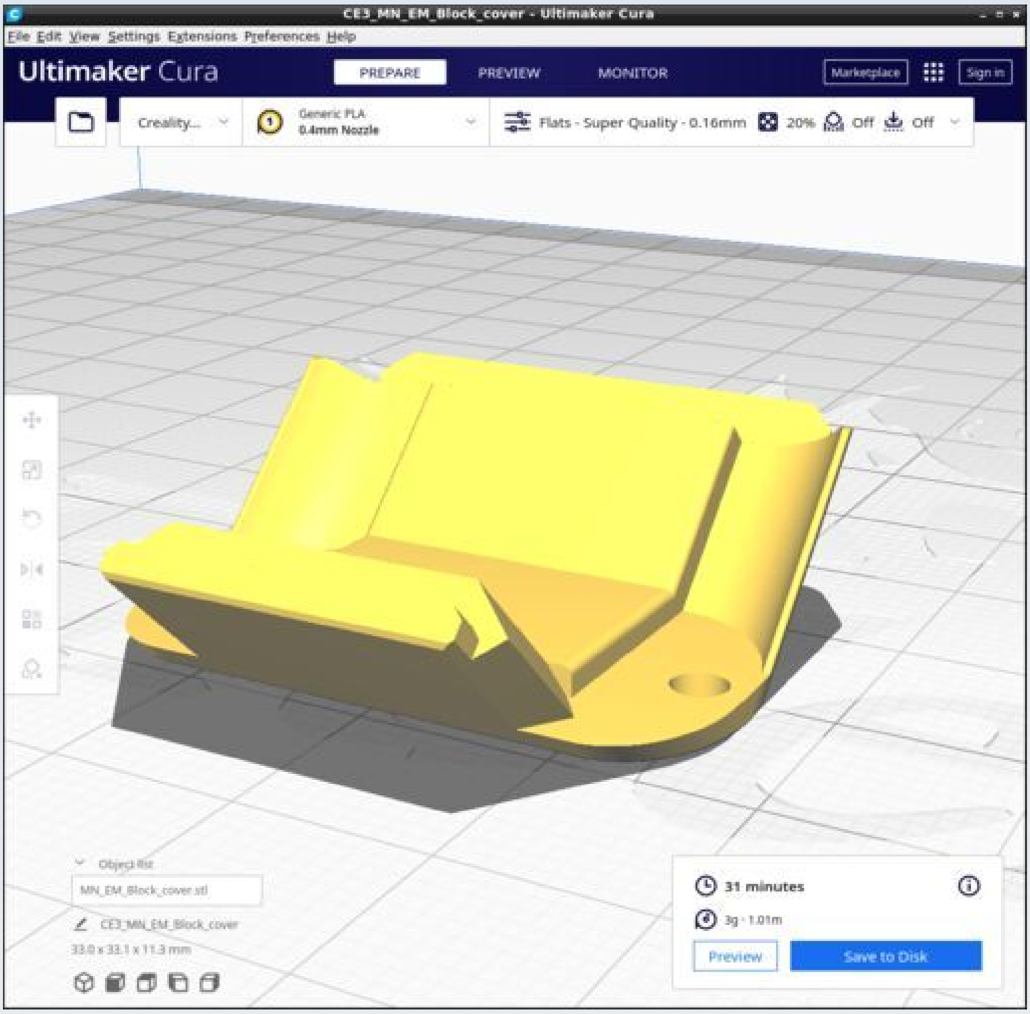
Cura calculates the following resources are required to print each model in this chapter:

Monocular Head	Time_Hr	Time_Min	PLA_Length(m)
MN_EM_Block	1	42	2.7
MN_EM_Block_cover	0	31	1.01
MN_Monocular_tube_c_adhesin	2	33	8.04
MN_Monocular_tube_CM_c_adhesin	2	7	6.56
MN_Ocular_cap_170	1	9	2.83
MN_Ocular_cap	0	42	1.65
MN_Ocular_extension_c_adhesin	0	55	2.19
MN_Ocular_extension_CM_c_adhesin	0	38	1.7
MN_Ocular_Extn_CM_170_c_adhesin	1	2	2.62
MN_Ocular_lock_nut	0	16	0.47
MN_Ocular_protective_cap	0	19	1.14
MN_Ocular_tube_protective_cap	0	26	1.14
MN_Projector_cone	2	6	7.91
MN_Aperture_20mm	0	19	0.93
MN_Aperture_46mm	0	7	0.32

MN_EM_Block


CE3_MN_EM_Block - Ultimaker Cura
File Edit View Settings Extensions Preferences Help
Ultimaker Cura
PREPARE
PREVIEW
MONITOR
Marketplace
Sign in
Creality...
Generic PLA
0.4mm Nozzle
Flats - Super ...ality - 0.16mm
20%
Off
Off
Object list
MN_EM_Block.stl
CE3_MN_EM_Block
46.0 x 23.0 x 30.0 mm
1 hour 42 minutes
8g · 2.70m
Preview
Save to Disk

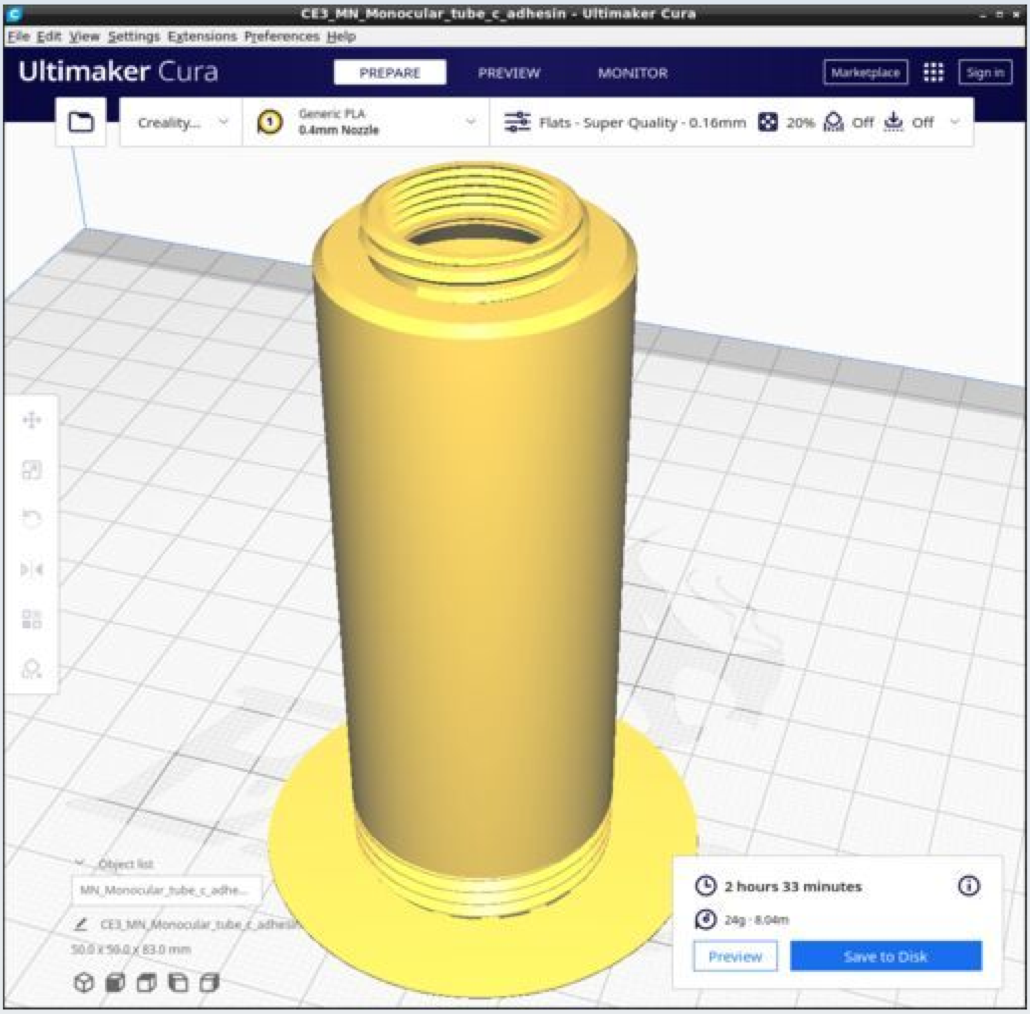
MN_EM_Block_cover



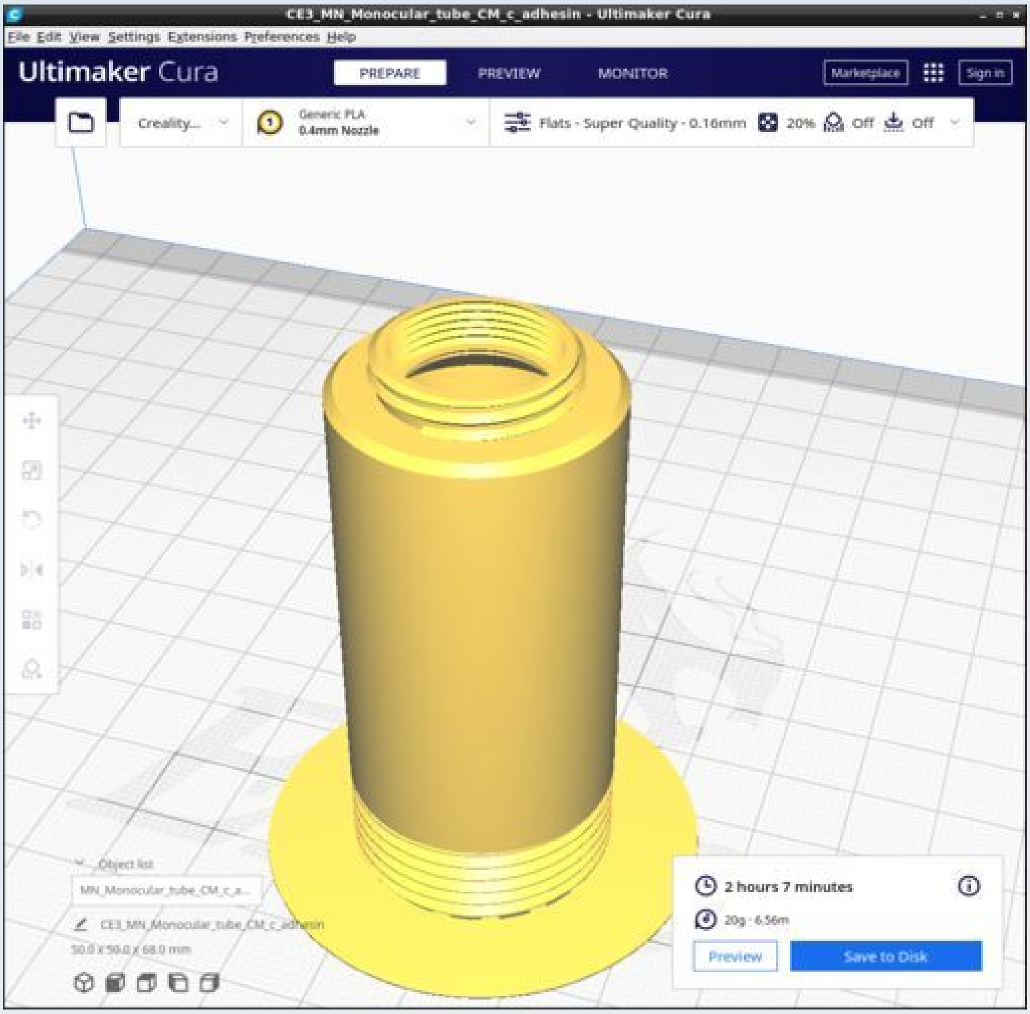
Note the orientation. For some reason, if you try to rotate the mesh by 45 degrees in FreeCAD and export the mesh, the exported mesh needs to be 'laid flat' in Cura because the 45 degree rotation doesn’t quite lay it flat.

i have found that it is best to export the mesh from FreeCAD as is, without the 45 degree rotation in FreeCAD, then do that rotation in Cura to position it as shown.

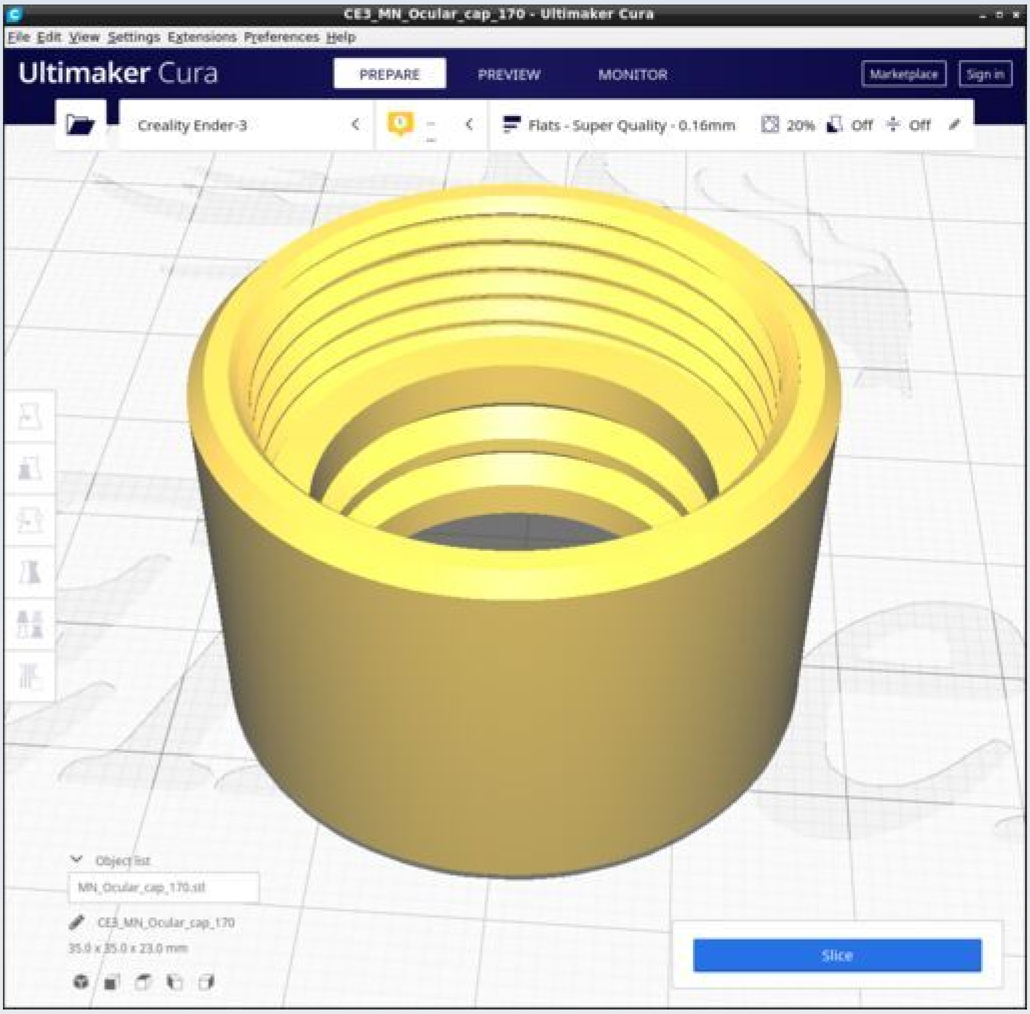
MN_Monocular_tube_c_adhesin



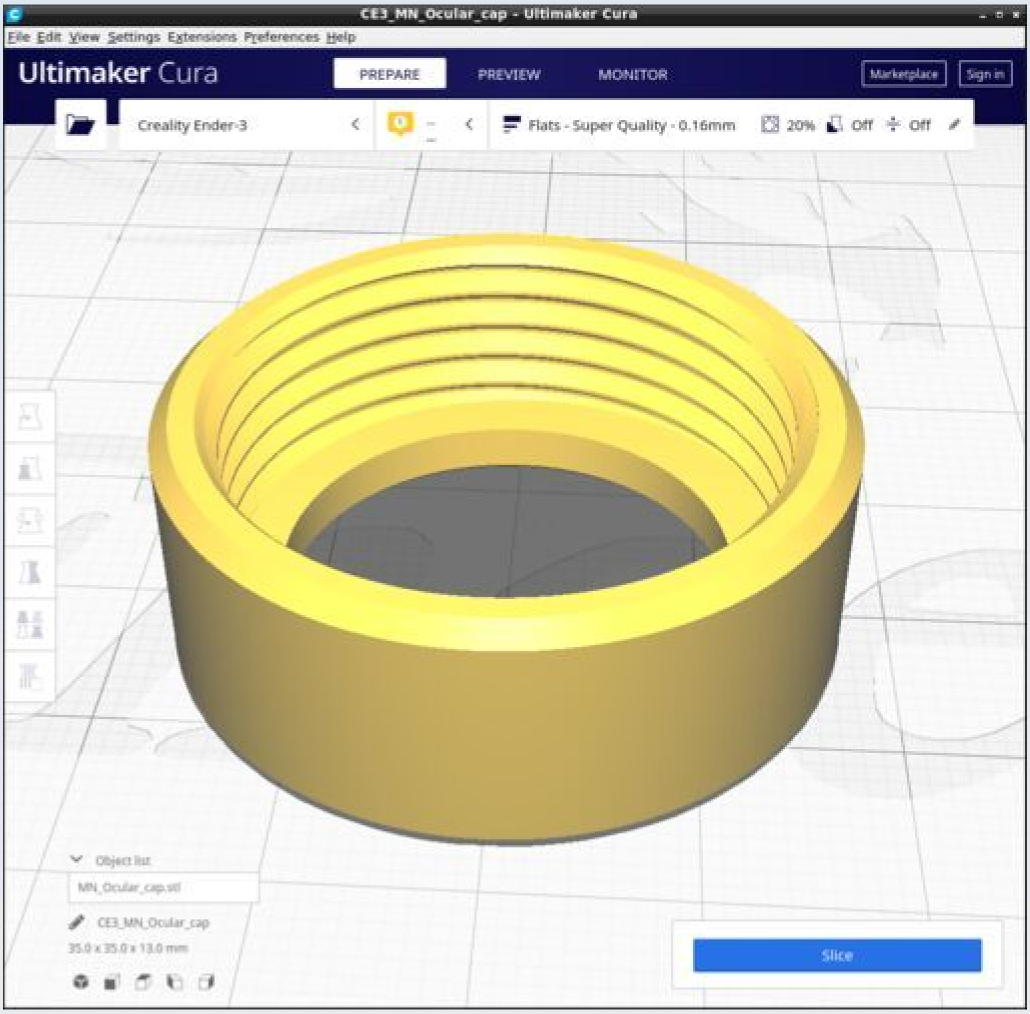
MN_Monocular_tube_CM_c_adhesin



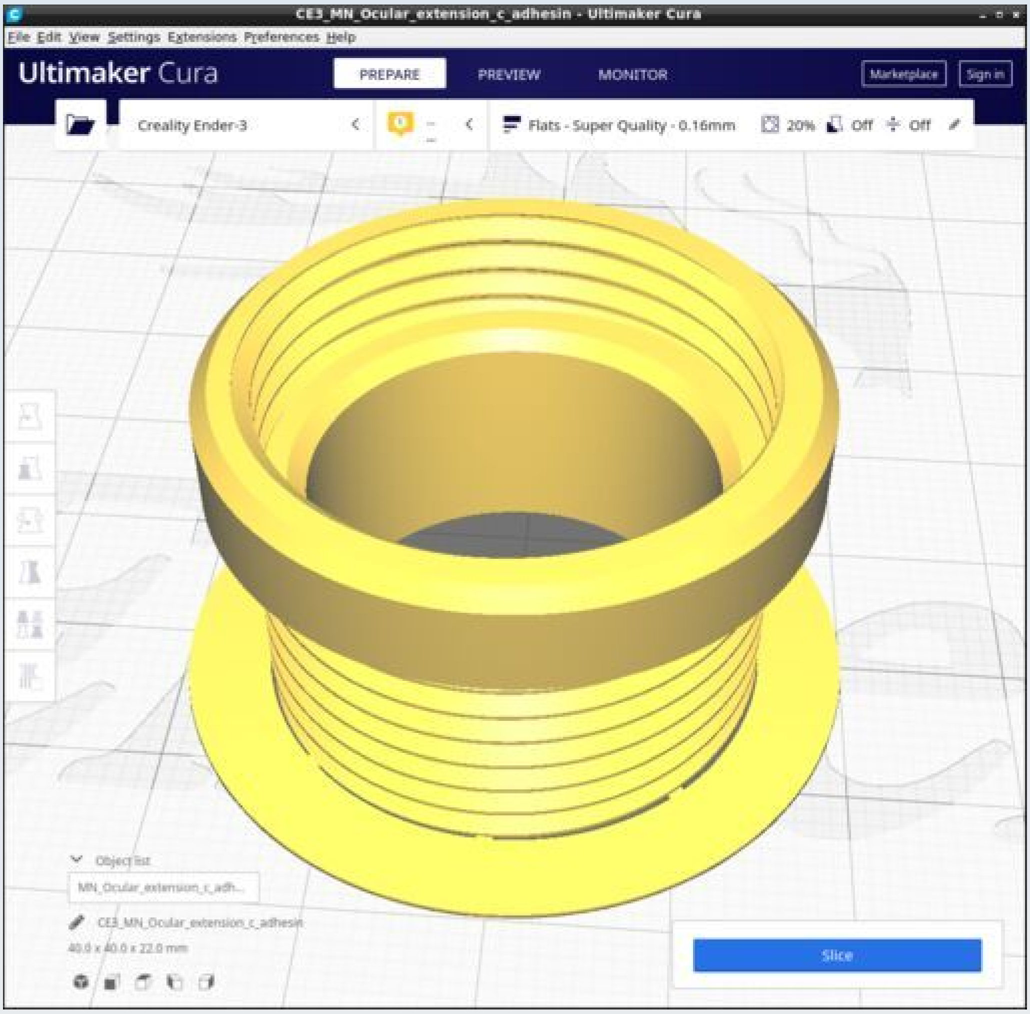
MN_Ocular_cap_170



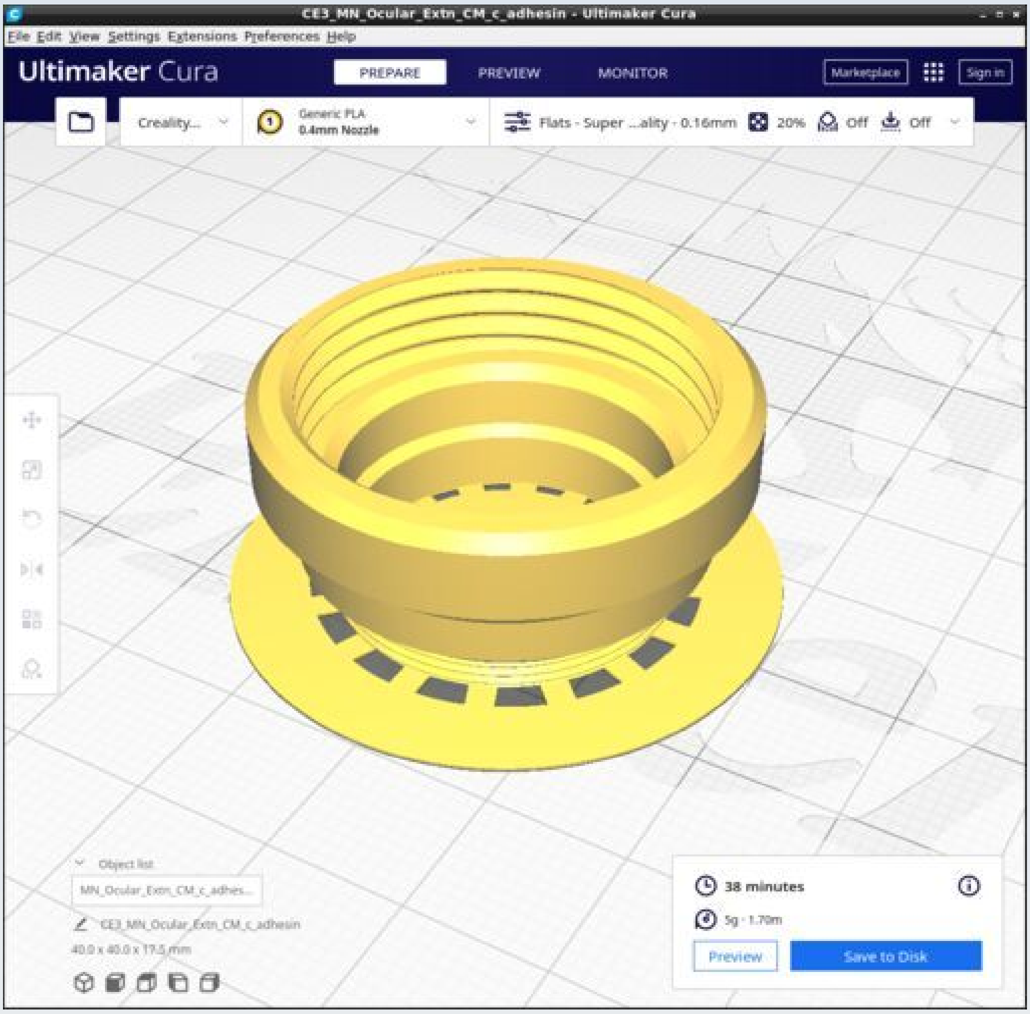
MN_Ocular_cap



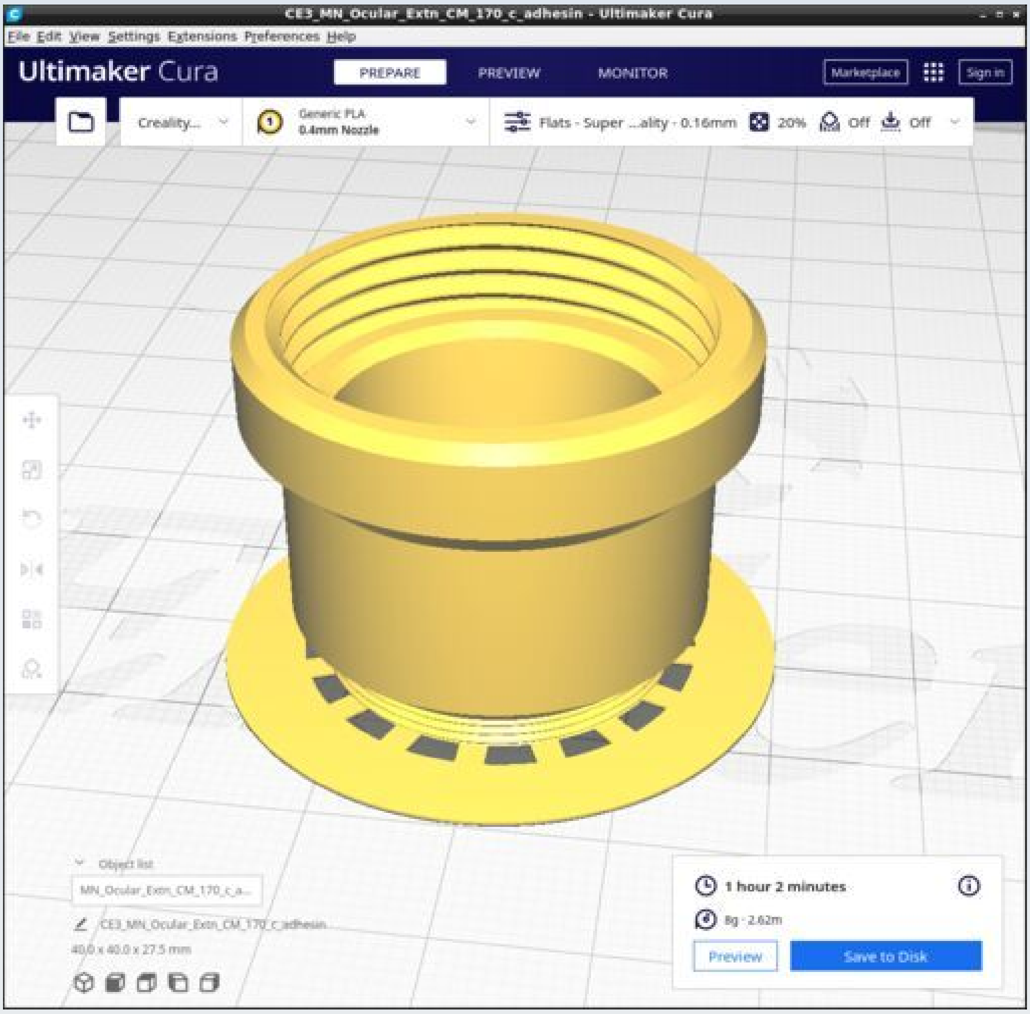
MN_Ocular_extension_c_adhesin



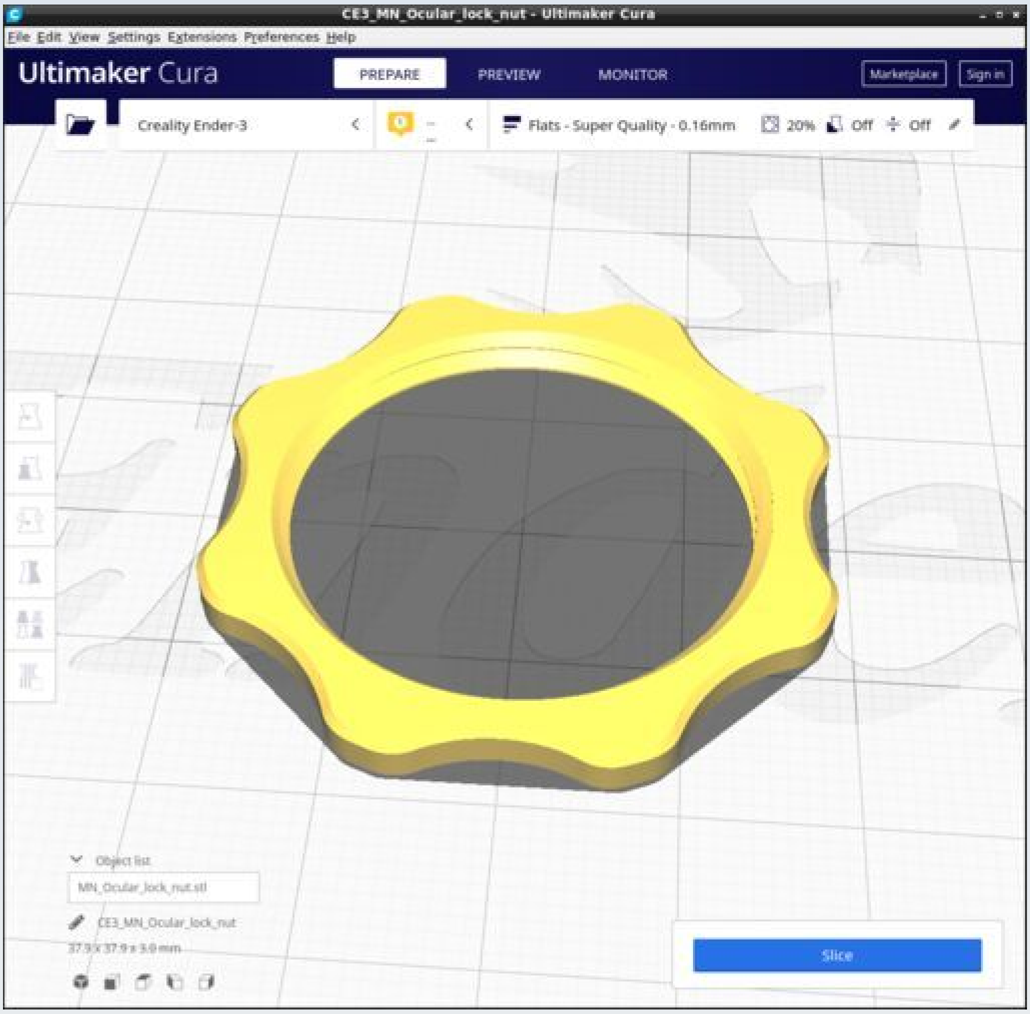
MN_Ocular_extension_CM_c_adhesin



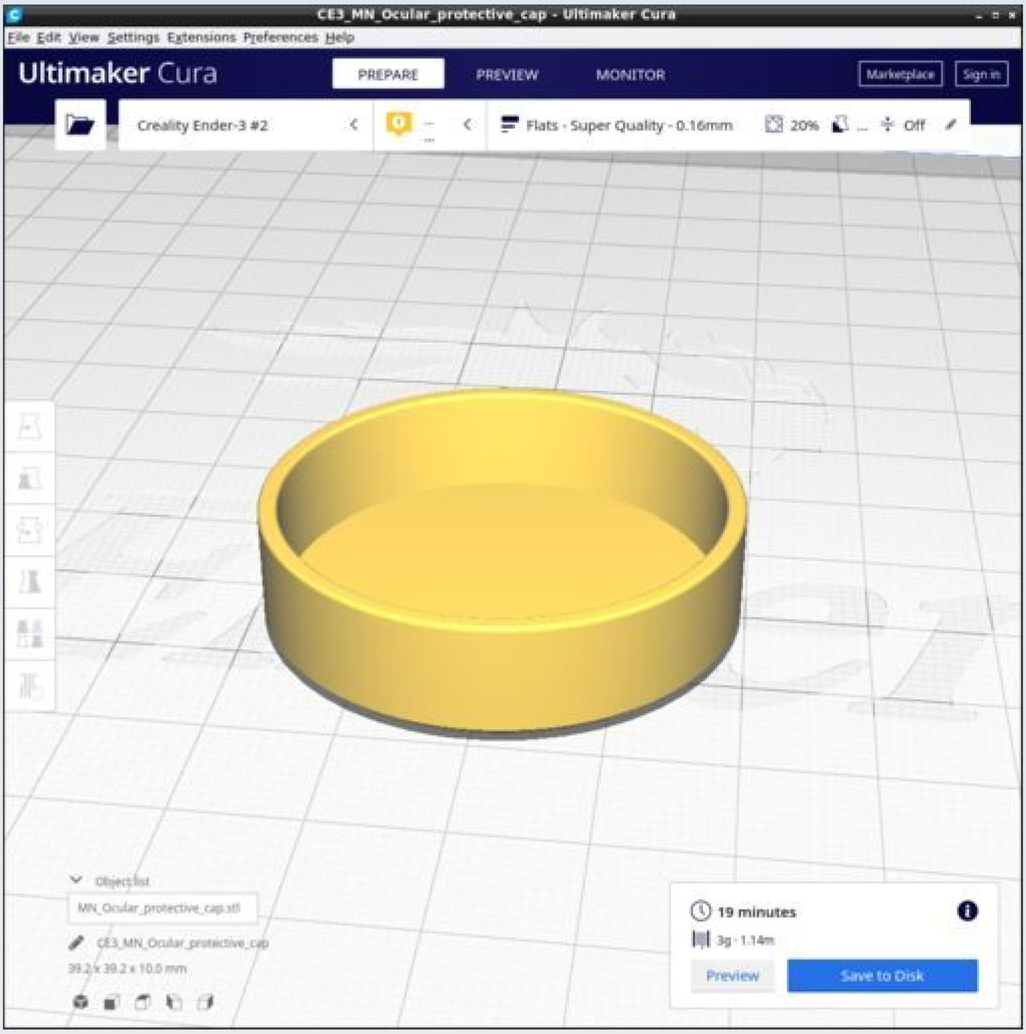
MN_Ocular_Extn_CM_170_c_adhesin



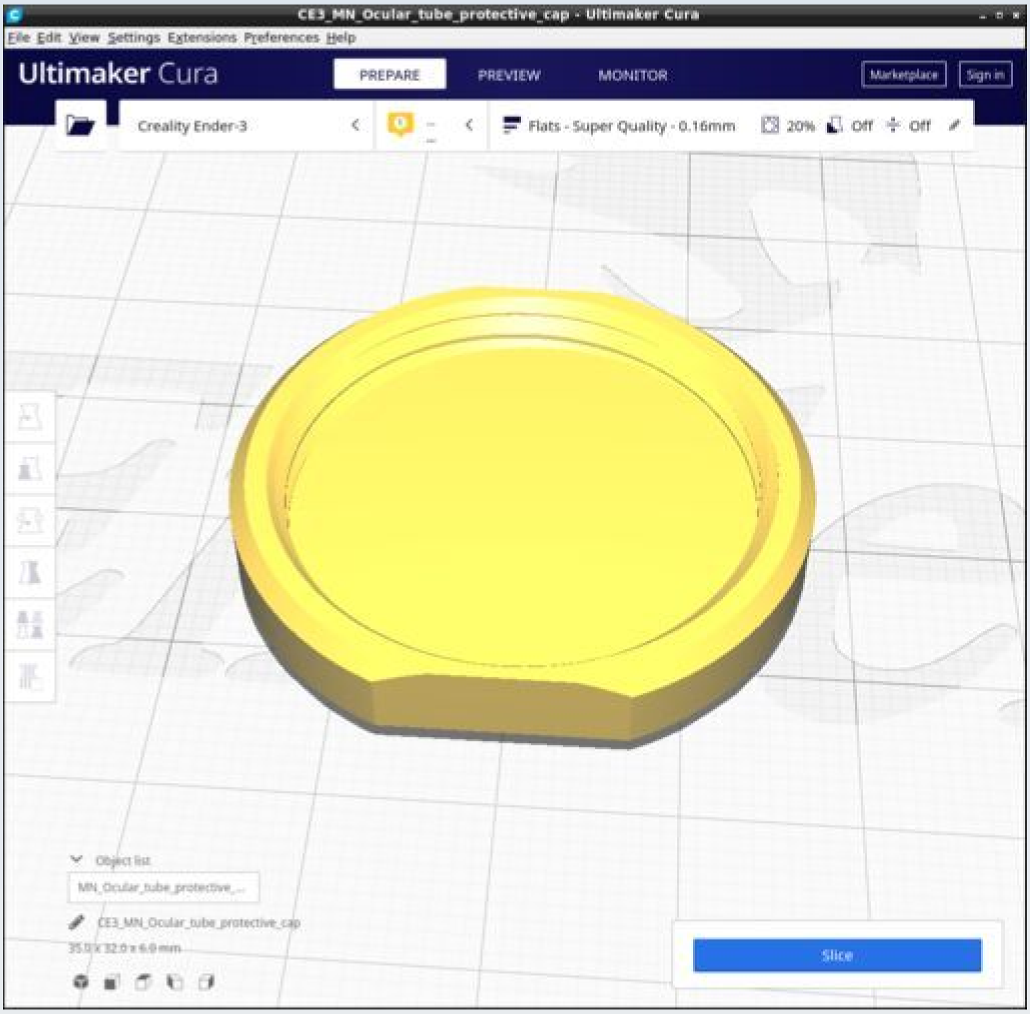
MN_Ocular_lock_nut



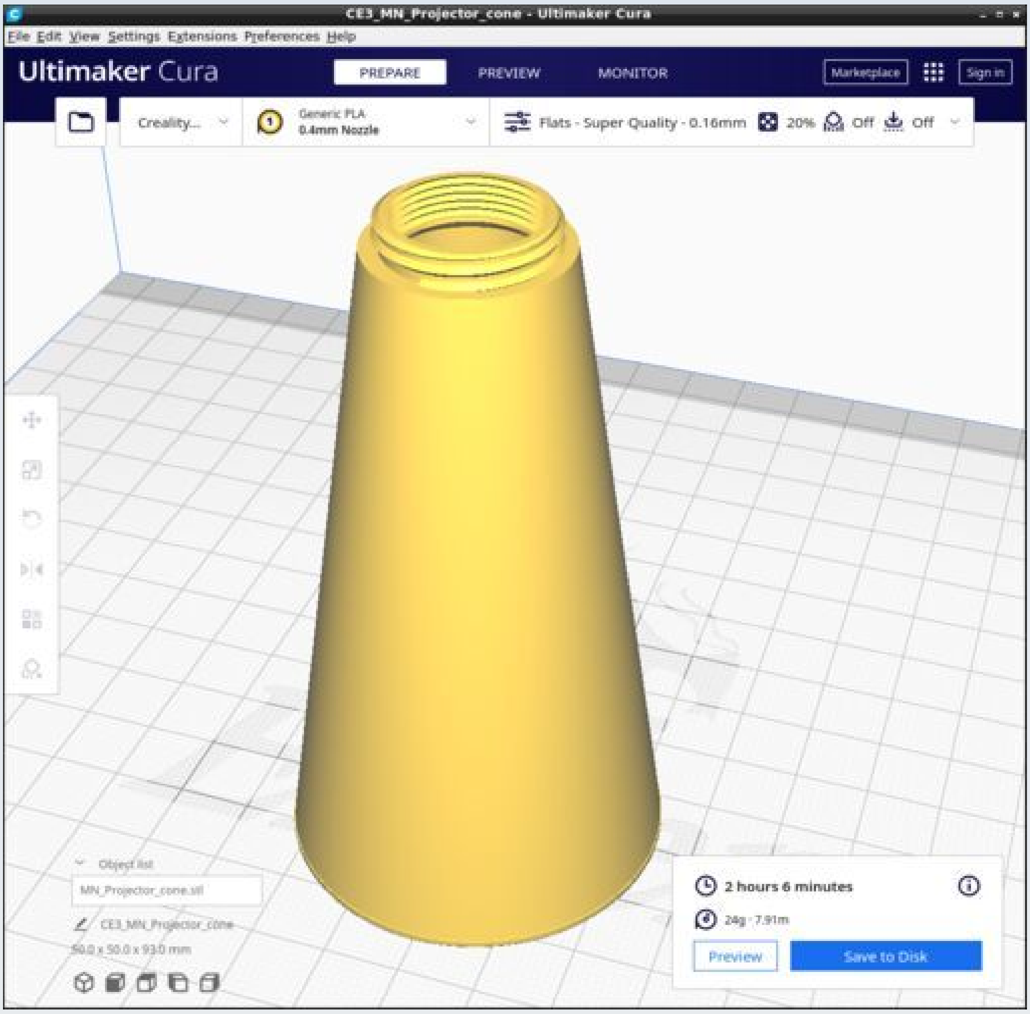
MN_Ocular_protective_cap



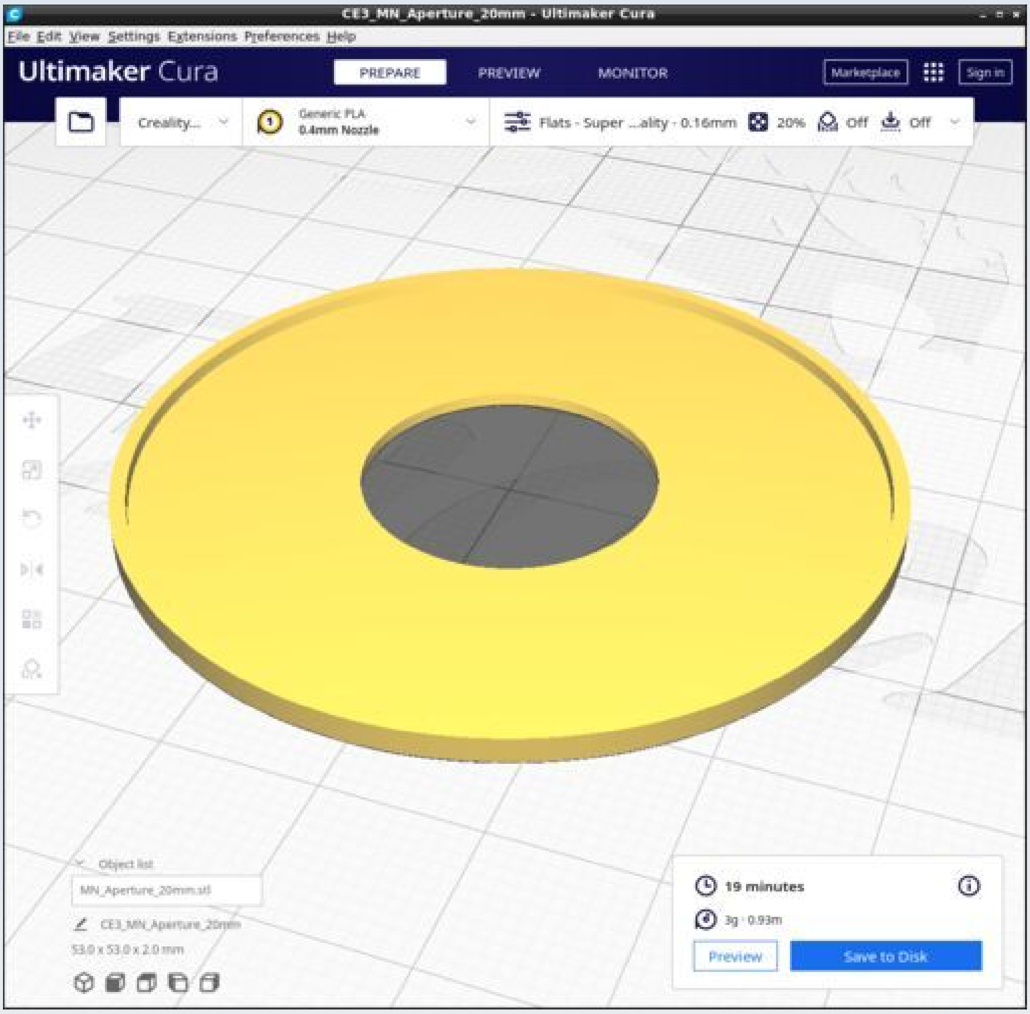
MN_Ocular_tube_protective_cap



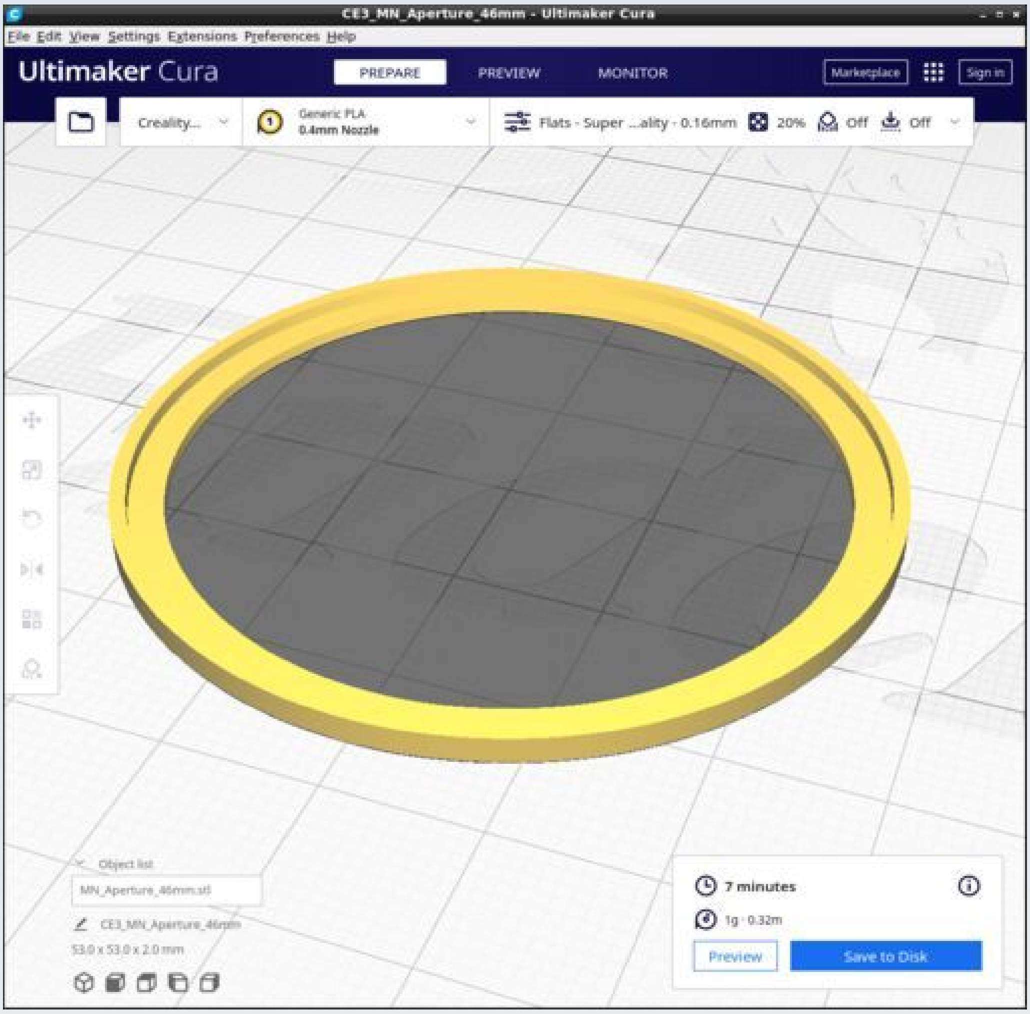
MN_Projector_cone



MN_Aperture_20mm



MN_Aperture_46mm



PUMA Control Console

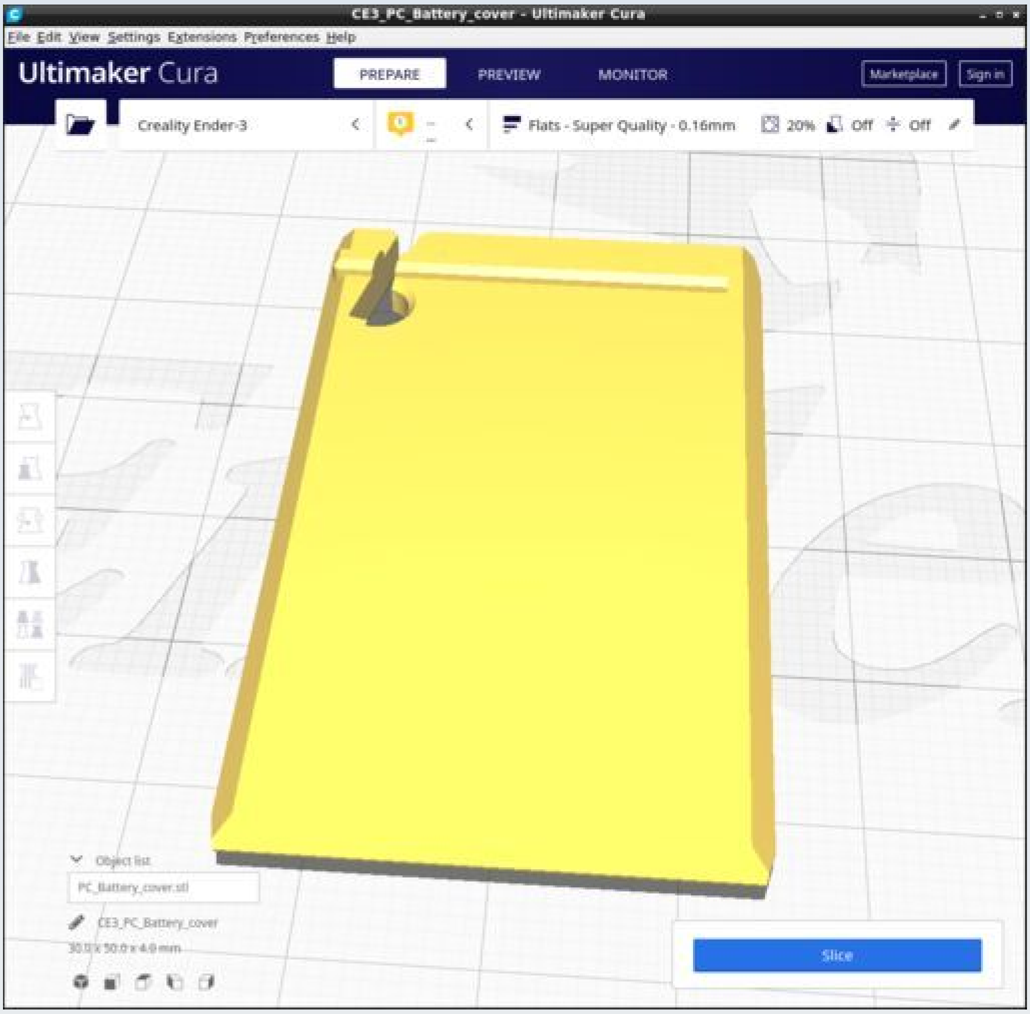
These are the parts for the PUMA Control Console (PCC) used not only to drive the LED light of the microscope but also allowing control of the Z-stage motor and 25x25 mm ST7789 TFT display (the display may be used for either the AR HUD, the SLM or the optional monitor attached to the PCC – only one TFT can be driven with the standard Arduino Nano-based PCC so you can only use one of those options at a time). The CAD source models for these files are found in the file PUMA_Control.FCStd.

Resources

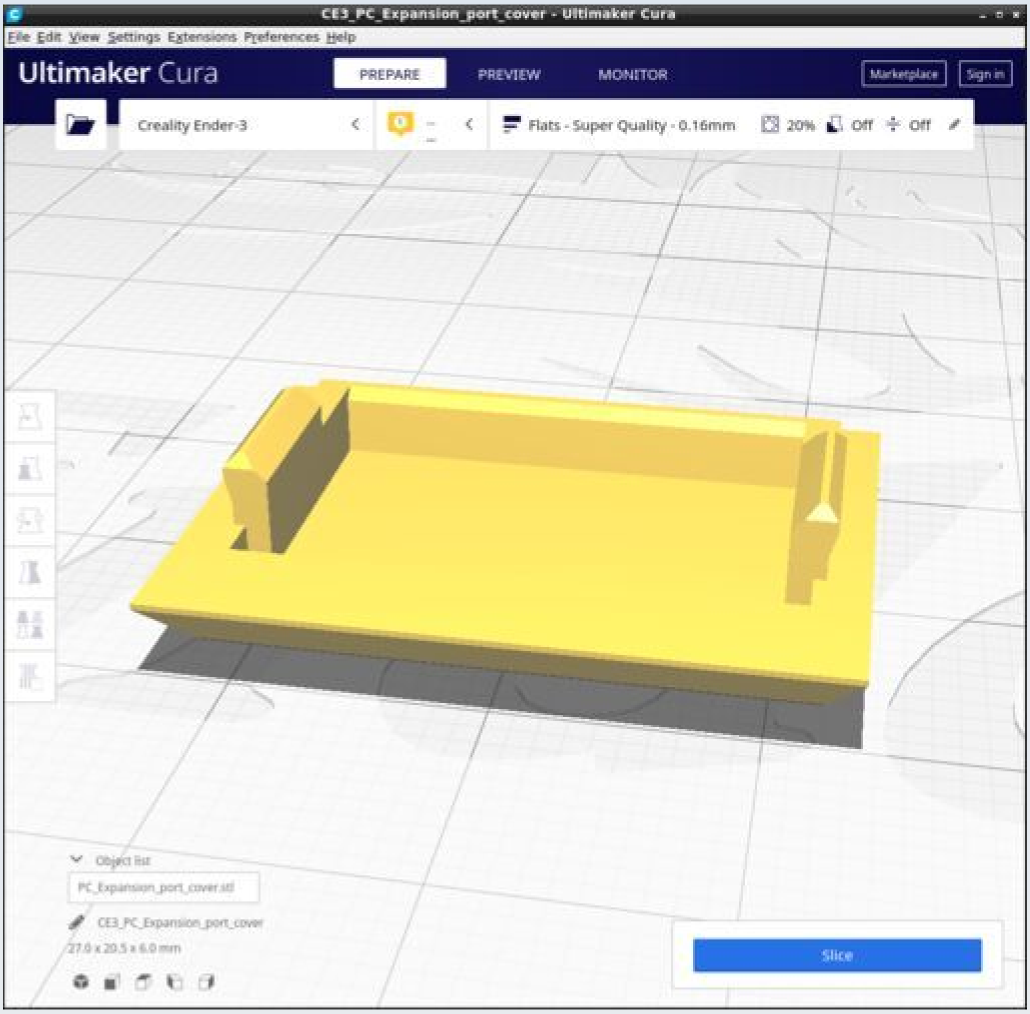
Cura calculates the following resources are required to print each model in this chapter:

PUMA Control Console	Time_Hr	Time_Min	PLA_Length(m)
PC_Battery_cover	0	31	1.44
PC_Expansion_port_cover	0	11	0.37
PC_Front_panel	4	21	7.44
PC_Joystick_PCB_clasp	0	18	0.71
PC_Lamp_insulator	0	1	0.02
PC_Left_panel_Base_Skeleton	12	44	24.27
PC_Top_back_panel	8	28	13.42
PC_Ardu_cover	0	6	0.17
PC_Current_knob	0	21	0.71
PC_Monitor_case	3	38	13.73
PC_Monitor_connector	0	24	1.05
PC_Monitor_lens_retainer	0	17	0.89
PC_Monitor_light_shield	0	28	0.79

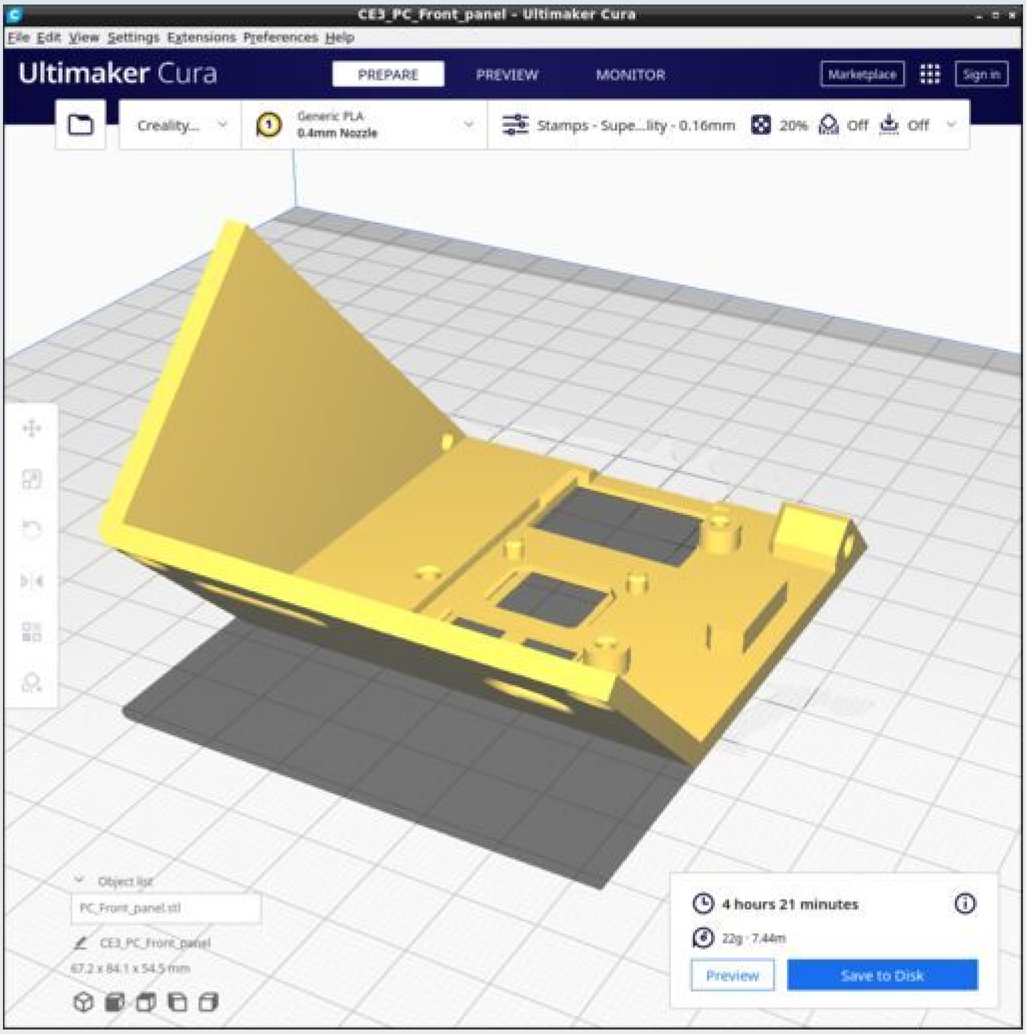
PC_Battery_cover



PC_Expansion_port_cover

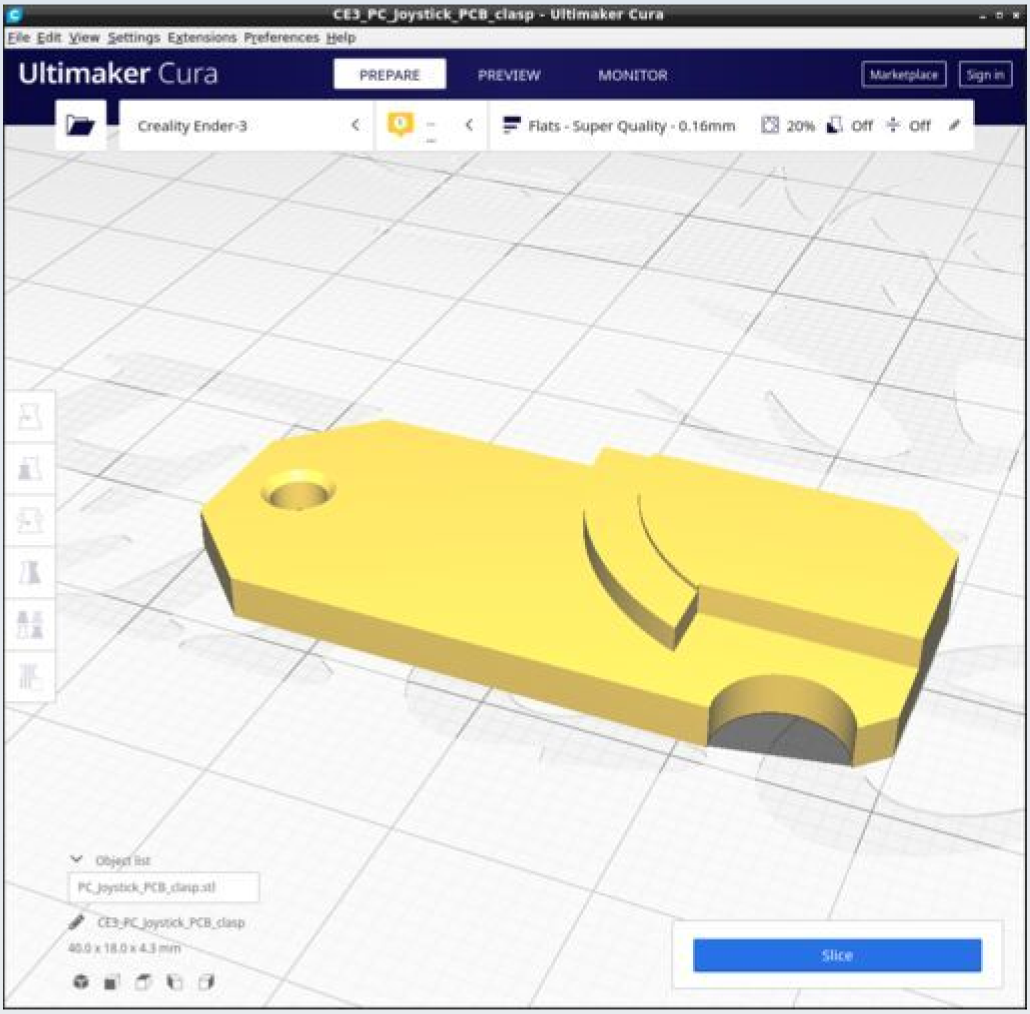


PC_Front_panel

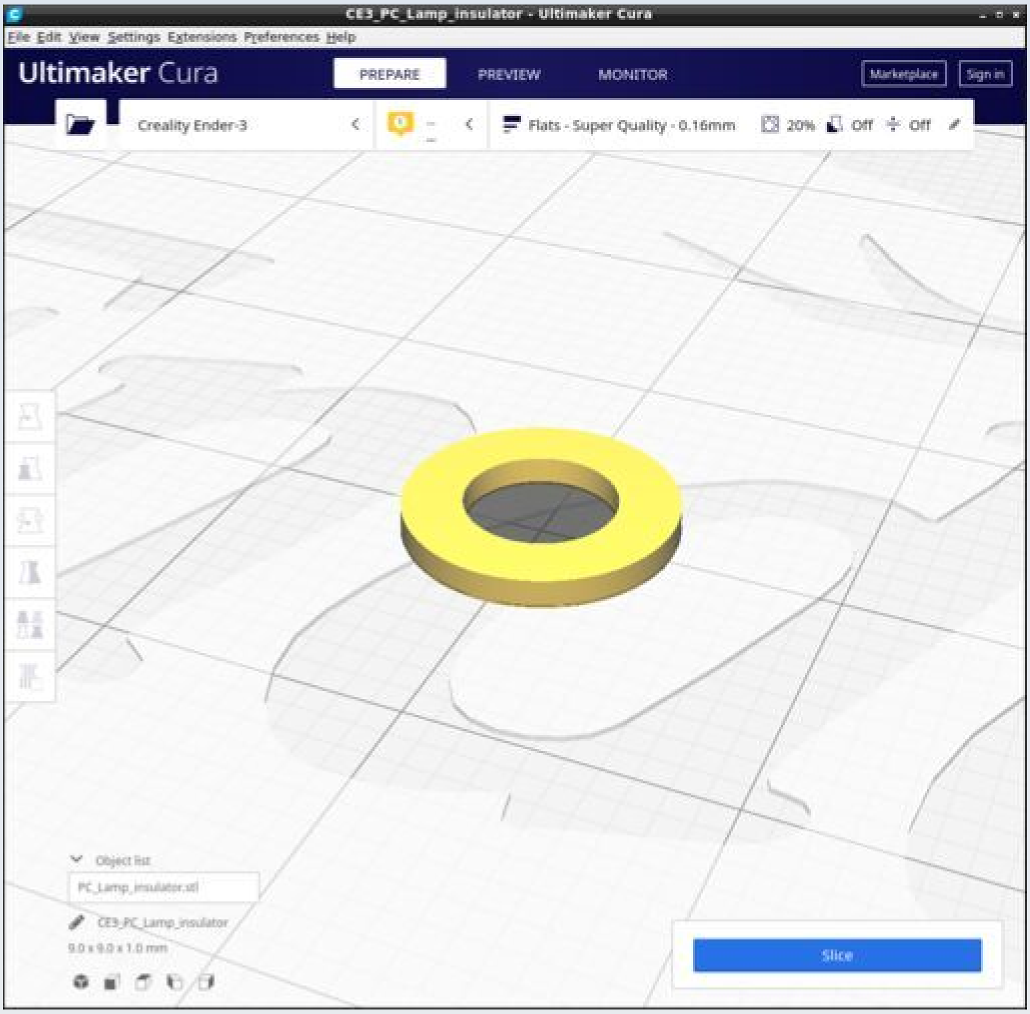


Use the ‘Stamps’ Cura profile. Ensure all supports are disabled.

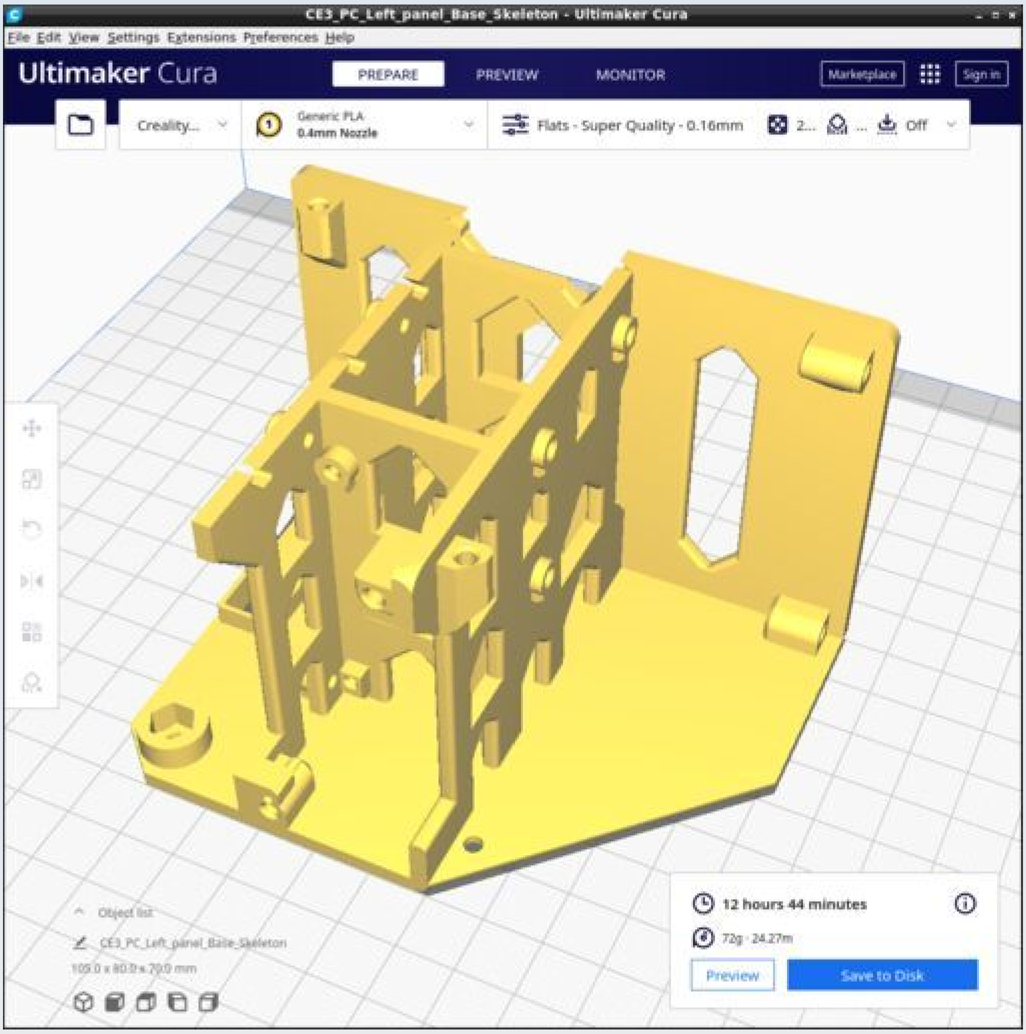
PC_Joystick_PCB_clasp



PC_Lamp_insulator

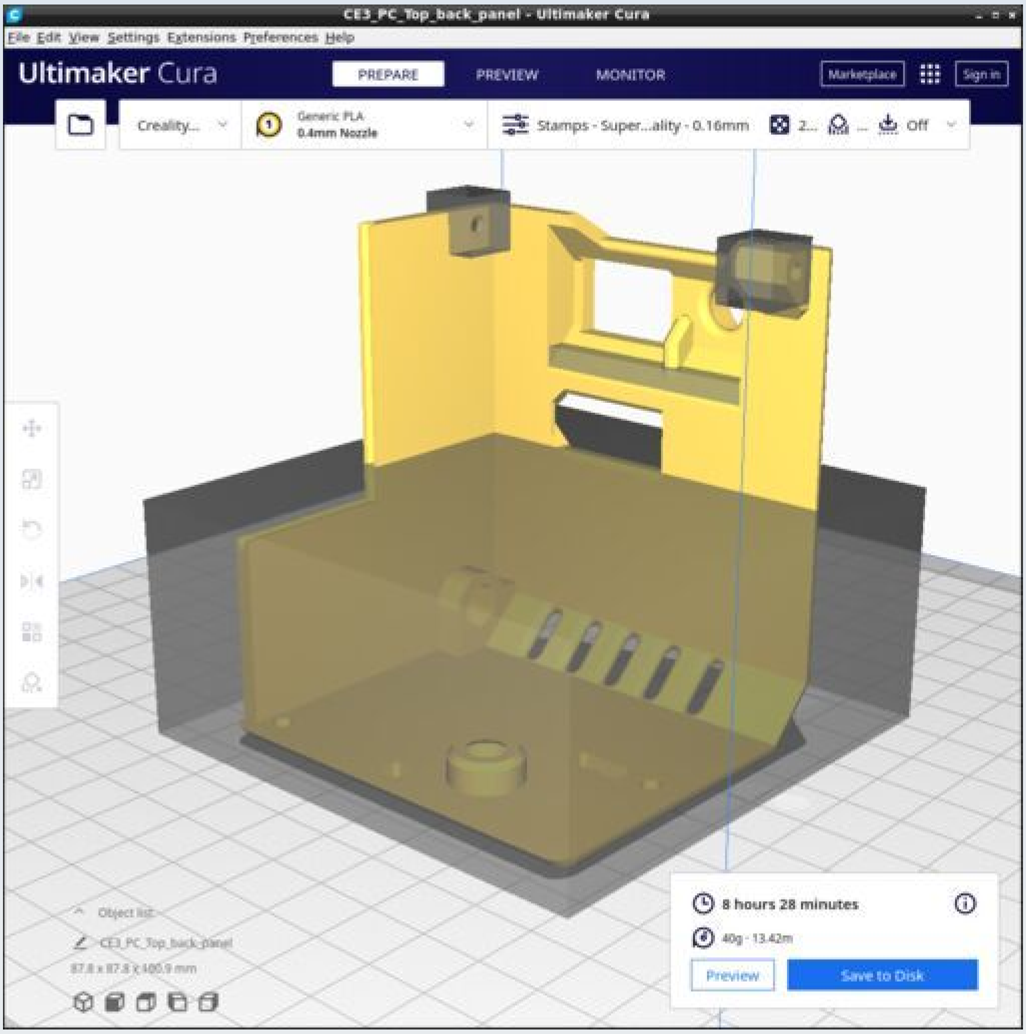


PC_Left_panel_Base_Skeleton

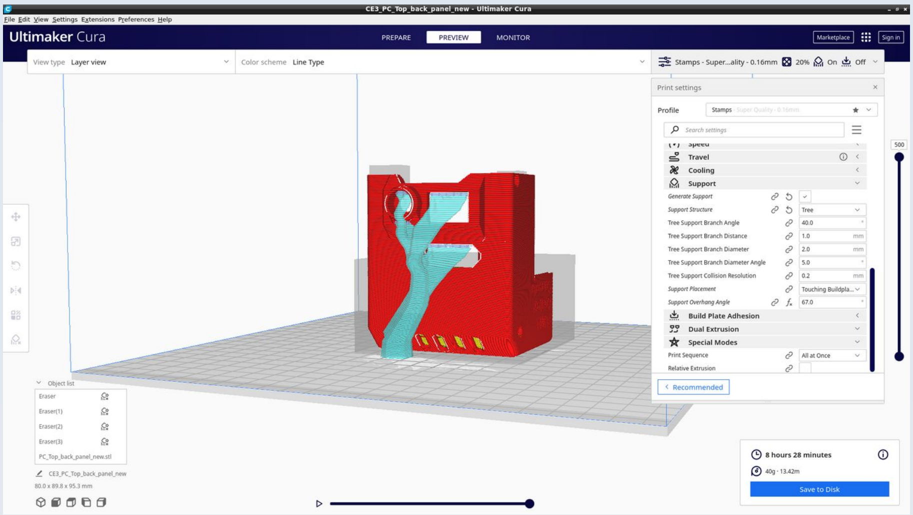


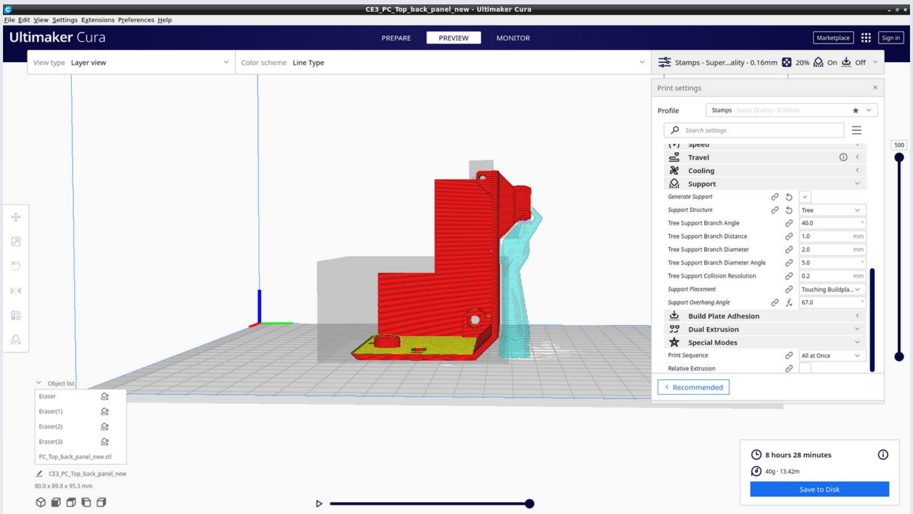
Ensure all supports are disabled.

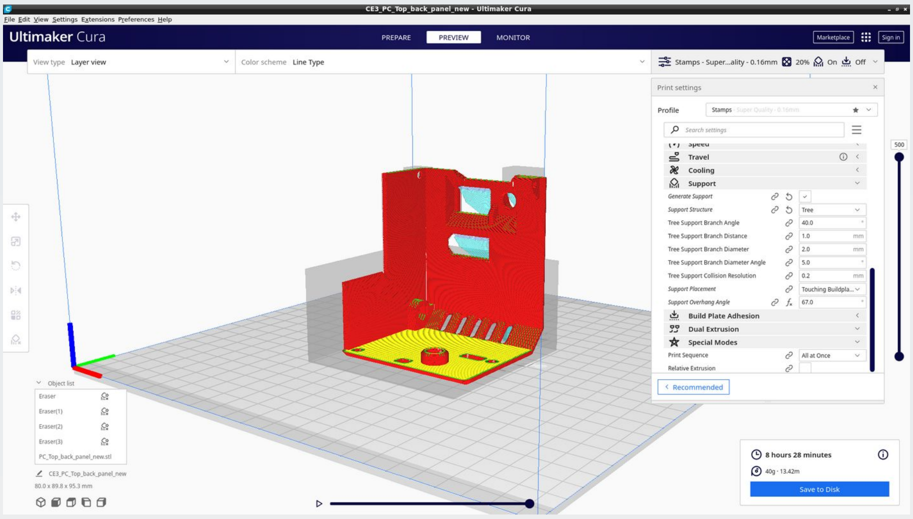
PC_Top_back_panel



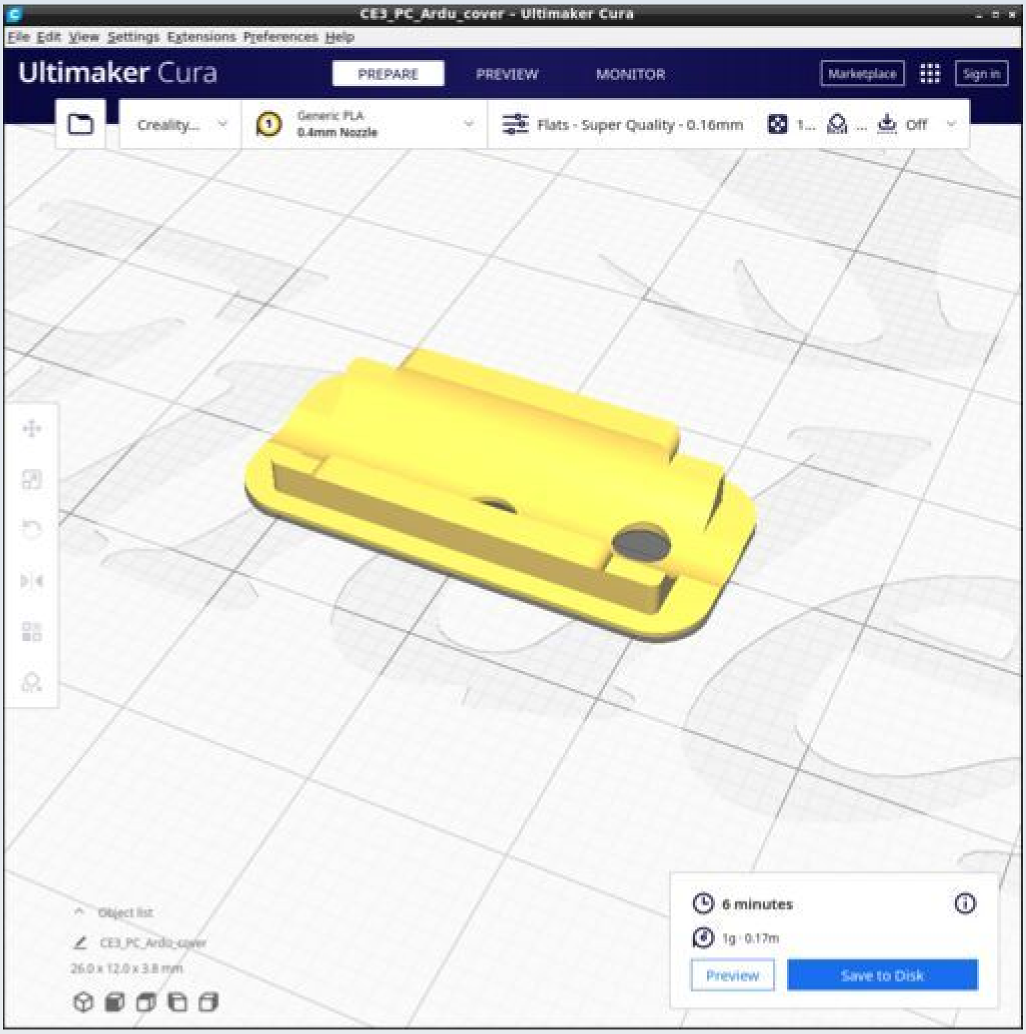
Use the ‘Stamps’ Cura profile and add a support blocker for everything except the back protrusion apertures and the top of the arduino window. The support type should be ‘Tree’ with a support branch angle of 40.0 and overhang of 67.0 and ‘Touching baseplate only’. You should get supports as shown in the following pictures.





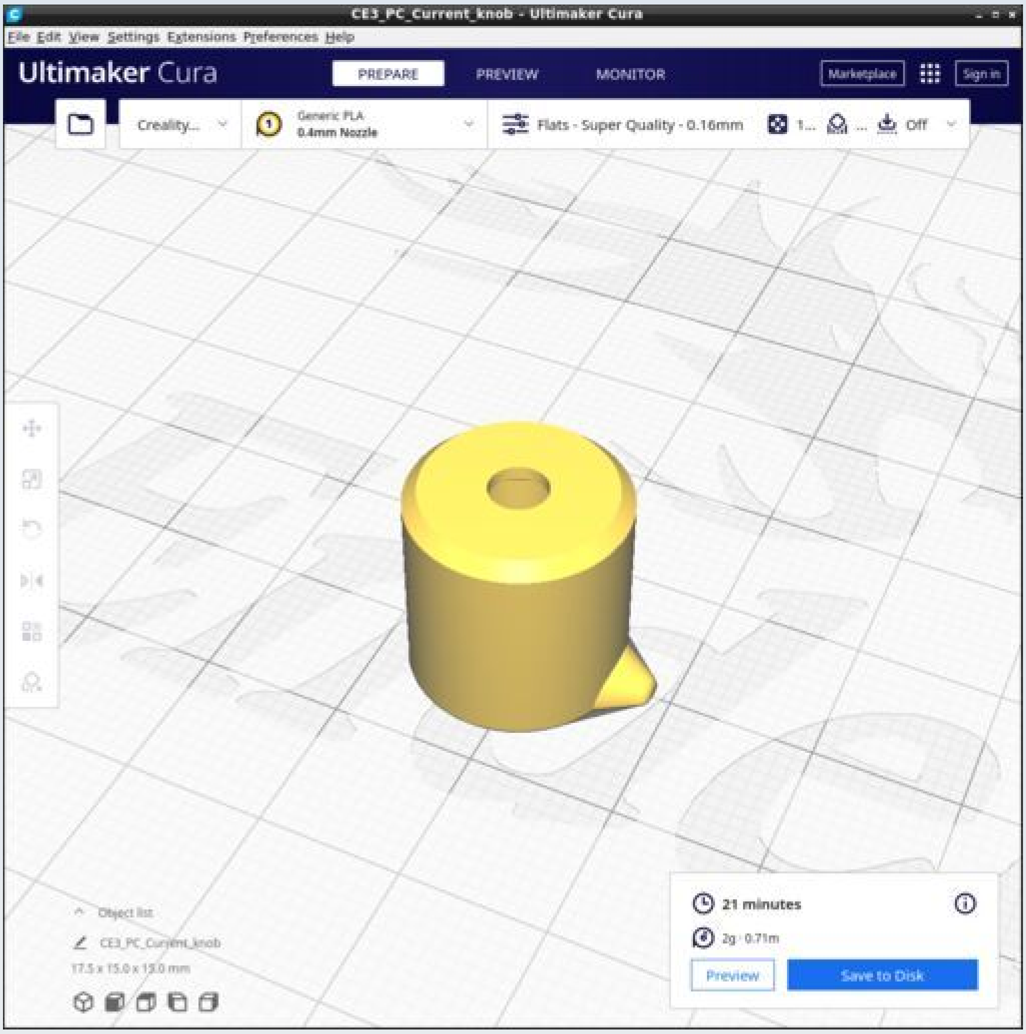


PC_Ardu_cover



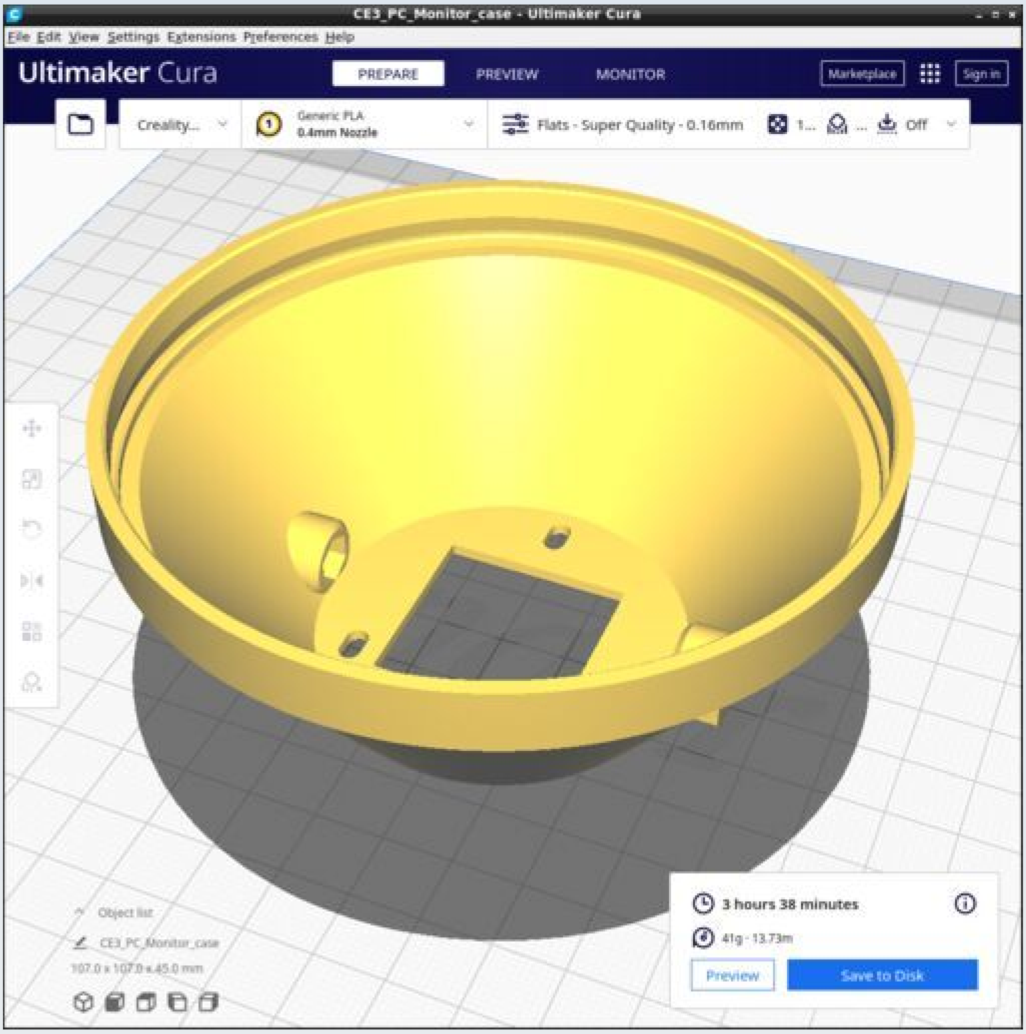
Use the ‘Flats’ Cura profile but change the infill to 100%. No supports.

PC_Current_knob



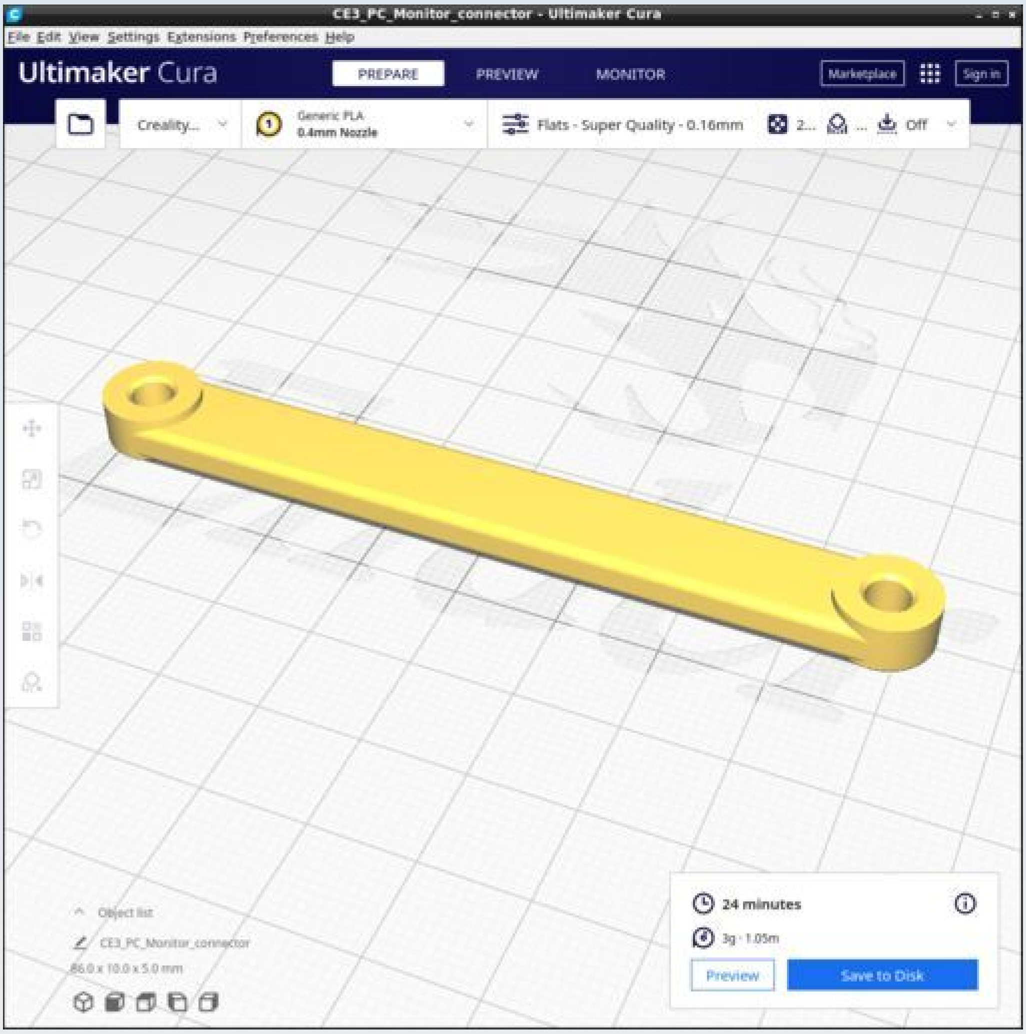
Use the ‘Flats’ Cura profile but change the infill to 100% and the ‘Top/Bottom’ pattern to ‘Concentric’. No supports.

PC_Monitor_case



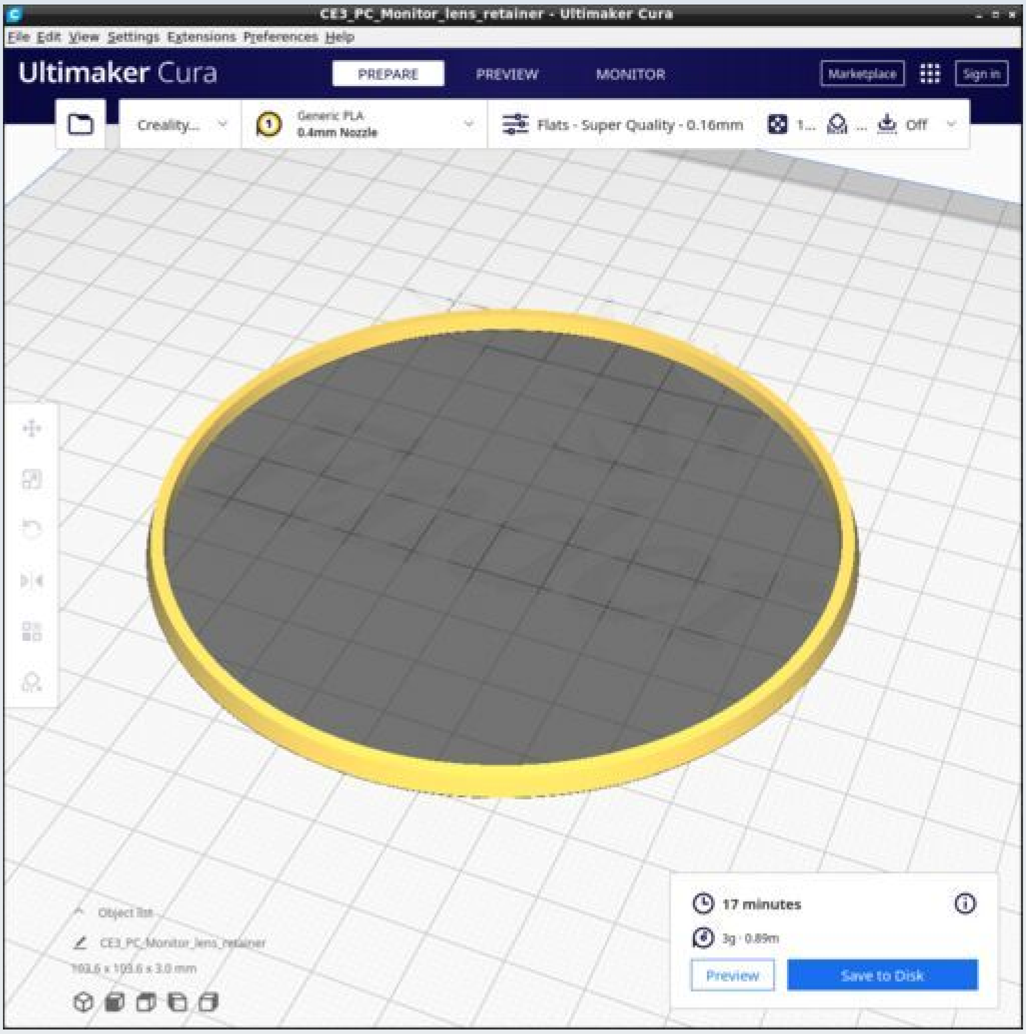
Use the ‘Flats’ Cura profile but change the infill to 10% and 'concentric' pattern of infill. No supports.

PC_Monitor_connector



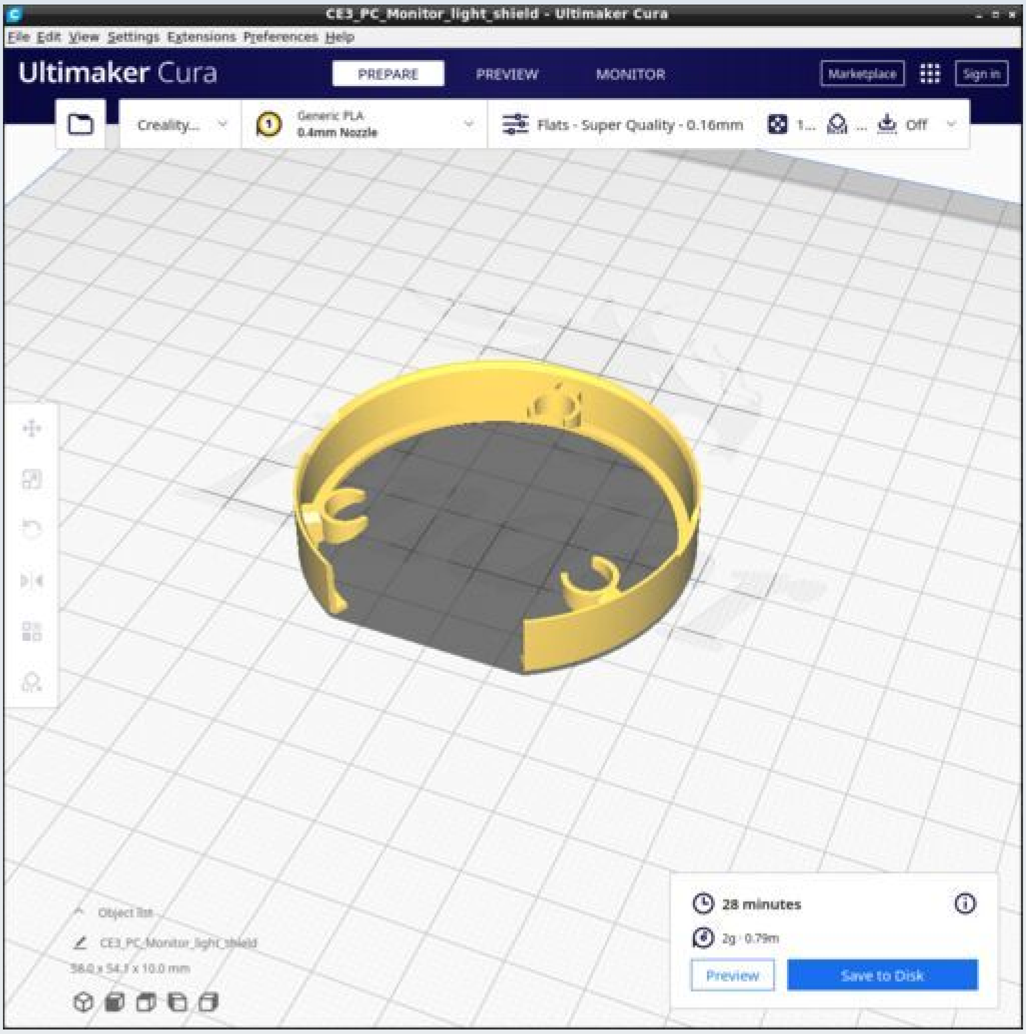
Use the ‘Flats’ Cura profile. No supports.

PC_Monitor_lens_retainer



Use the ‘Flats’ Cura profile but change the infill to 10% and 'concentric' pattern of infill. Also change and the ‘Top/Bottom’ pattern to ‘Concentric’. No supports.

PC_Monitor_light_shield



Use the ‘Flats’ Cura profile but change the infill to 10% and 'concentric' pattern of infill. Also change and the ‘Top/Bottom’ pattern to ‘Concentric’. No supports.

PUMA Lite

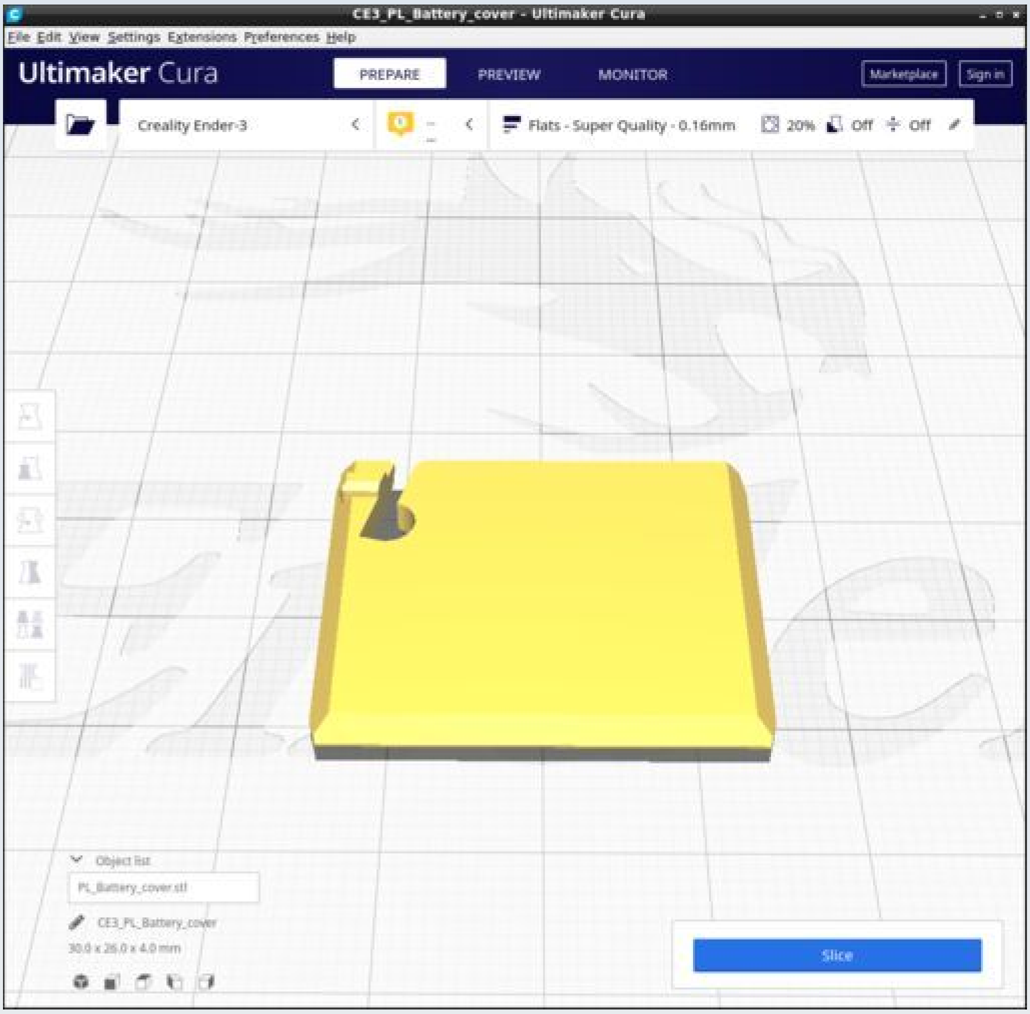
These are the parts for the simple control box use to drive the LED light source of the microscope (but provides no other functions). The CAD source models for these files are found in the file PUMALite.FCStd.

Resources

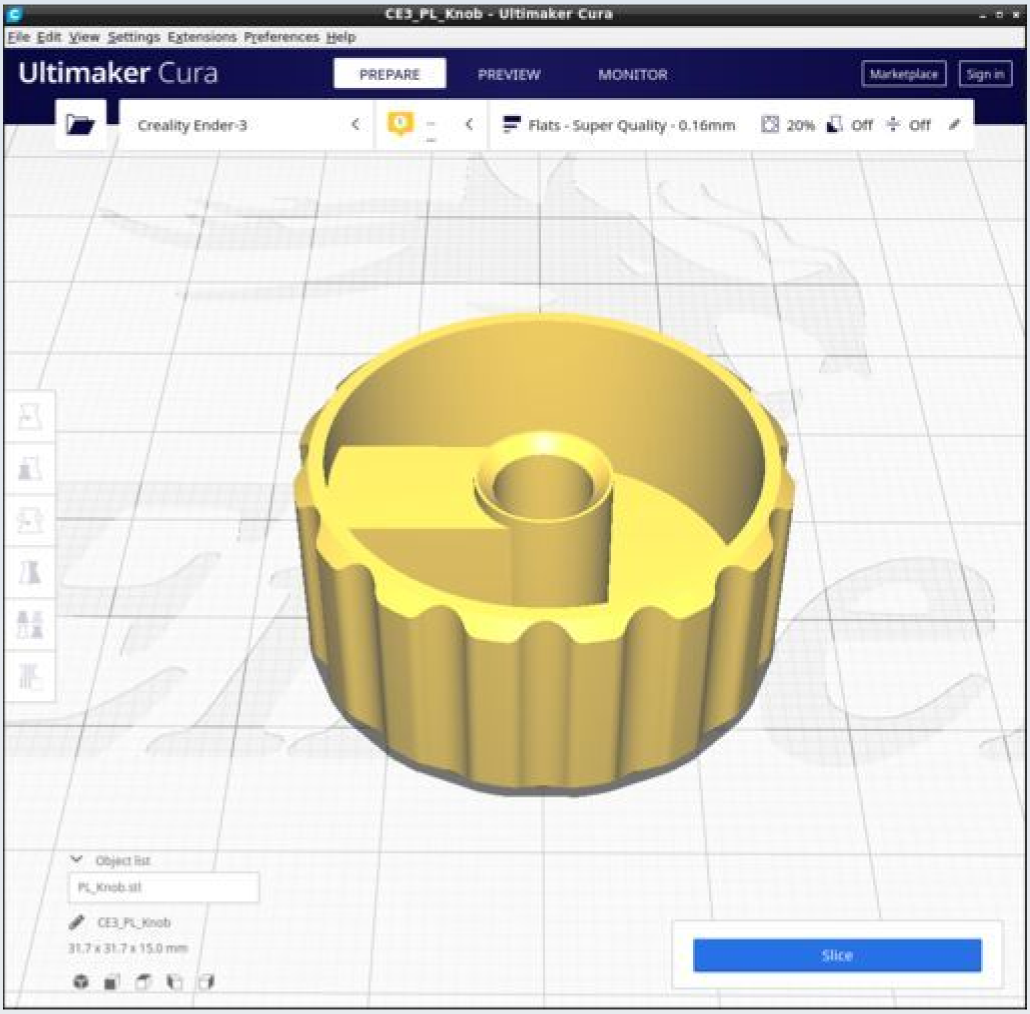
Cura calculates the following resources are required to print each model in this chapter:

PUMA_Lite	Time_Hr	Time_Min	PLA_Length(m)
PL_Battery_cover	0	17	0.72
PL_Knob	1	22	1.77
PL_Lamp_insulator	0	1	0.02
PL_Left_Base_Back	8	35	13.52
PL_Top_Front_Right	3	55	7.11

PL_Battery_cover



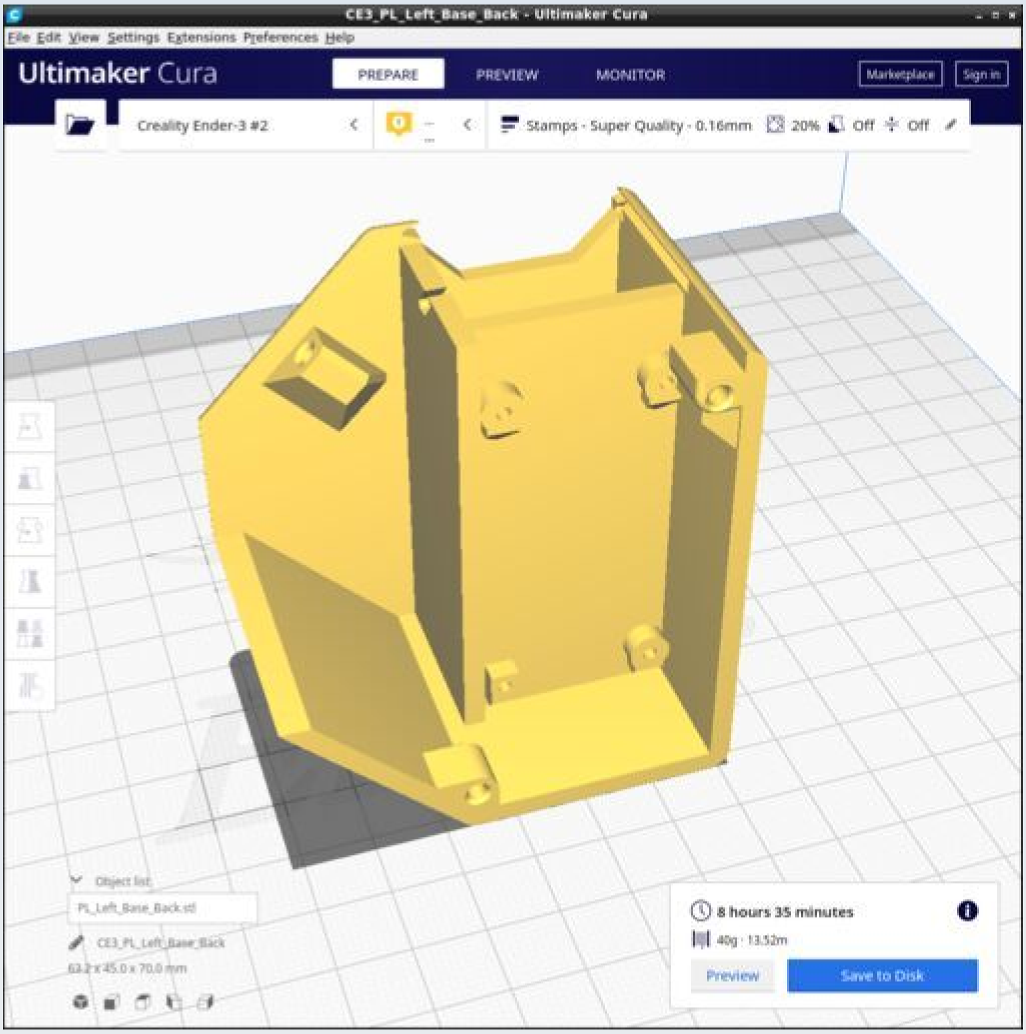
PL_Knob



PL_Lamp_insulator

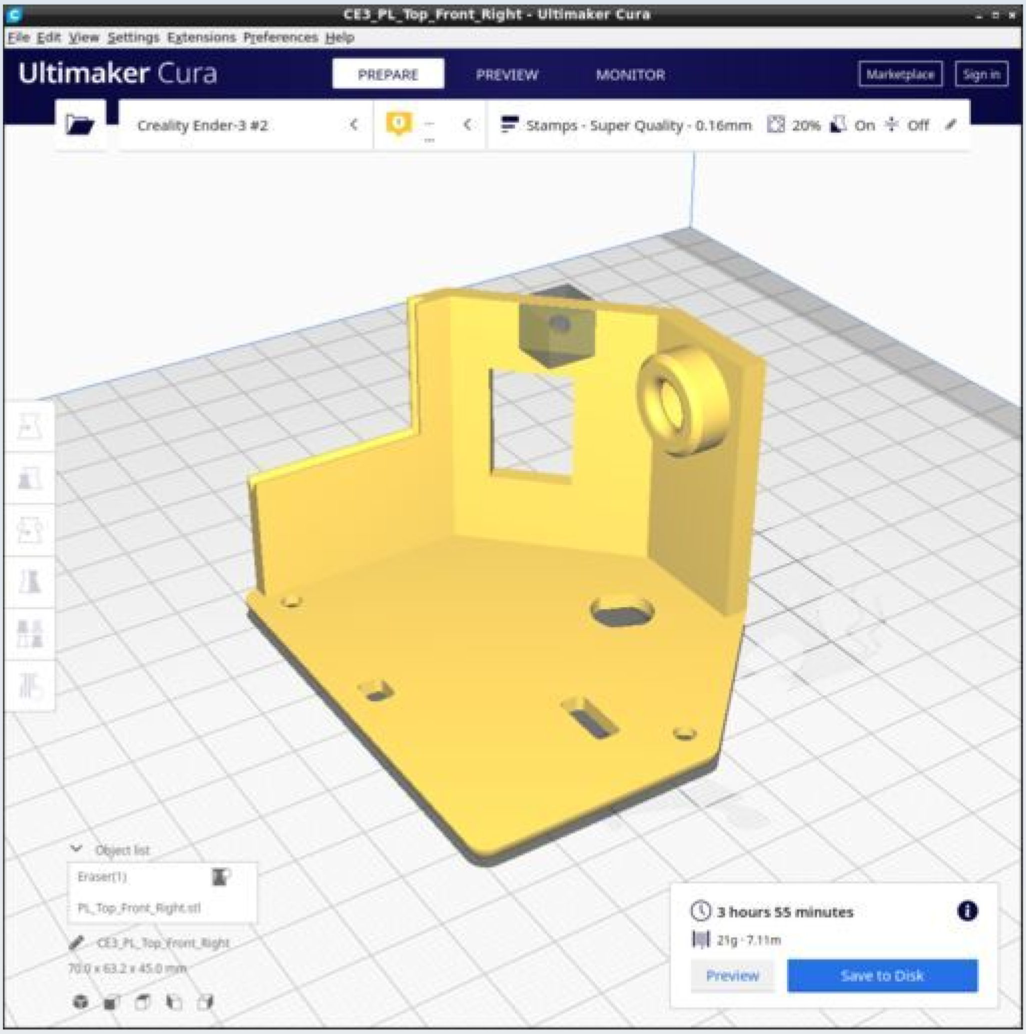
This is identical to the PC_Lamp_insulator of the PUMA Control Console (which see).

PL_Left_Base_Back

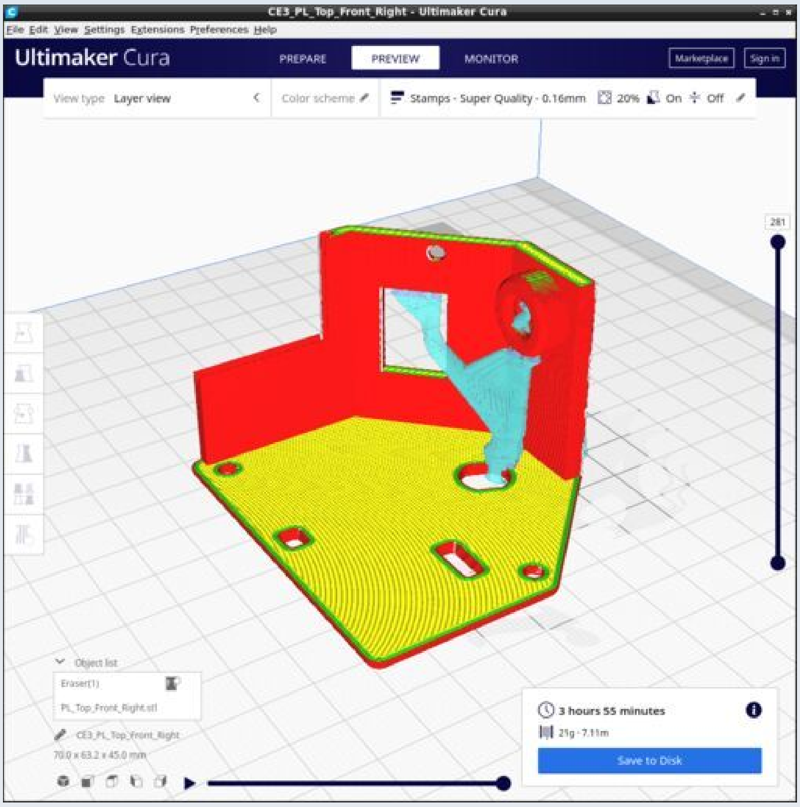


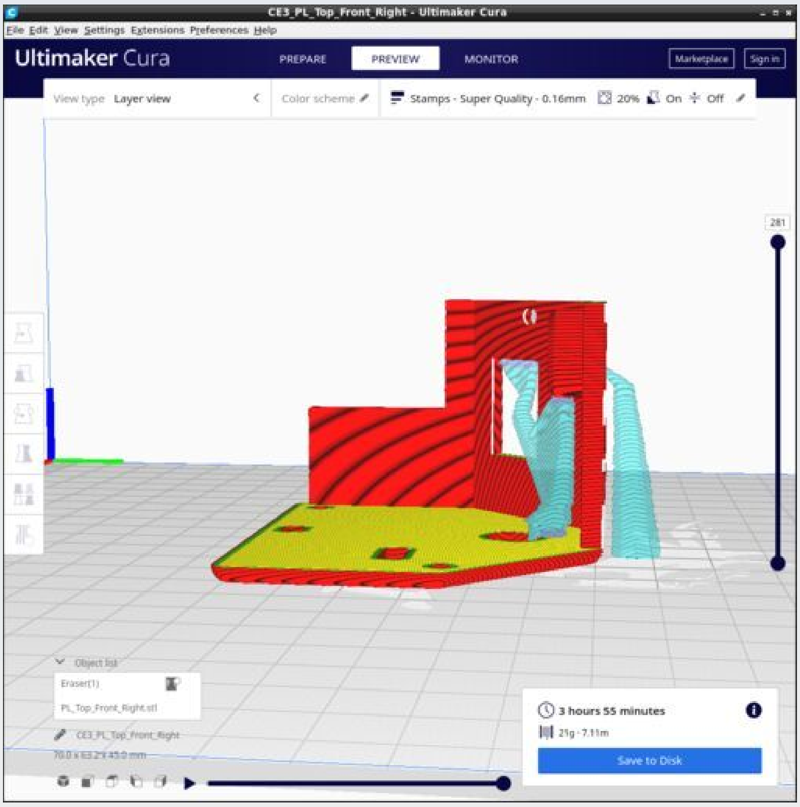
Ensure supports are disabled. Print with the PUMA custom Cura profile 'Stamps'

PL_Top_Front_Right



Use tree supports with support blocker to prevent the screw hole being supoported - as shown in the figure. Support 'everywhere' with overhang 67 degree and tree support branch angle 50 degrees.


CE3_PL_Top_Front_Right - Ultimaker Cura
File Edit View Settings Extensions Preferences Help
Ultimaker Cura
PREPARE
PREVIEW
MONITOR
Marketplace
Sign in
View type Layer view
Color scheme
Stamps - Super Quality - 0.16mm
20%
On
Off
281
Object list
Eraser(1)
PL_Top_Front_Right.stl
CE3_PL_Top_Front_Right
70.0 x 63.2 x 45.0 mm
3 hours 55 minutes
21g · 7.11m
Save to Disk


CE3_PL_Top_Front_Right - Ultimaker Cura
File Edit View Settings Extensions Preferences Help
Ultimaker Cura
PREPARE
PREVIEW
MONITOR
Marketplace
Sign in
View type Layer view
Color scheme
Stamps - Super Quality - 0.16mm
20%
On
Off
281
Object list
Eraser(1)
PL_Top_Front_Right.stl
CE3_PL_Top_Front_Right
70.0 x 63.2 x 45.0 mm
3 hours 55 minutes
21g · 7.11m
Save to Disk

Quick Release Objective Holder

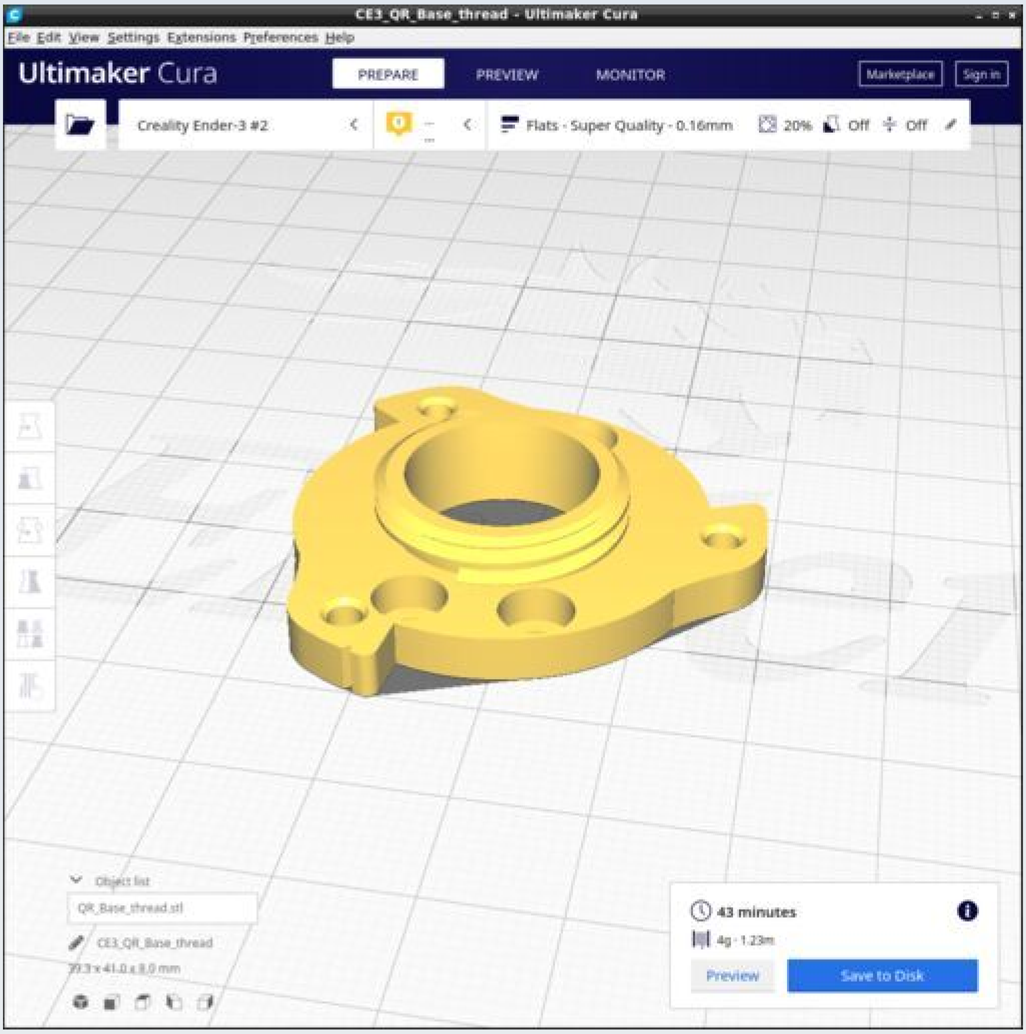
These are the parts for the objective holder that fits onto the focus platform of the microscope stage via a quick-release mechanism. The CAD source models for these files are found in the file QuickRelease_v2.0.FCStd.

Resources

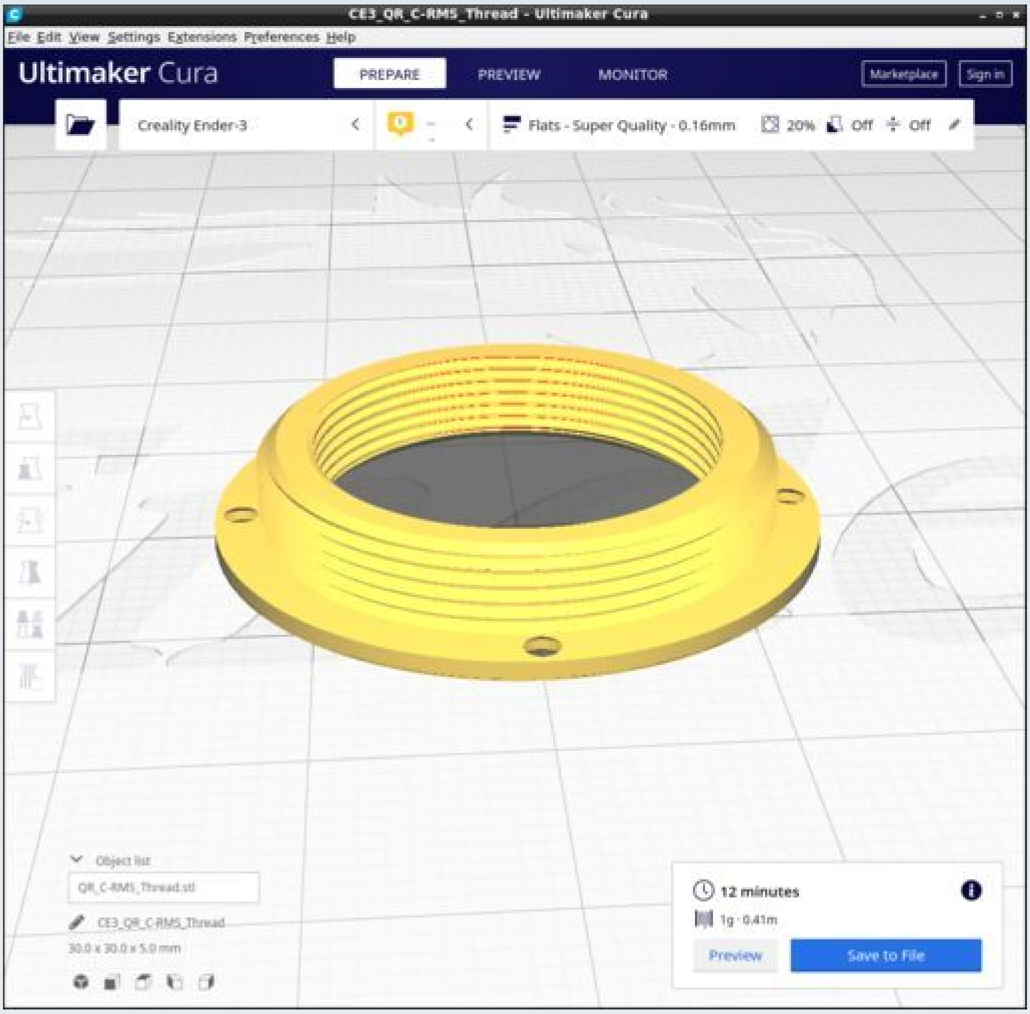
Cura calculates the following resources are required to print each model in this chapter:

Quick Release Objective Holder	Time_Hr	Time_Min	PLA_Length(m)
QR_Base_thread	0	43	1.23
QR_C-RMS_Thread	0	12	0.41
QR_Male_C_extn_1mm	1	30	2.47
QR_Male_C_extn_4mm	1	42	2.82
QR_Trainer	1	8	2.5
QR_Trainer_Male	1	25	2.96

QR_Base_thread



QR_C-RMS_Thread

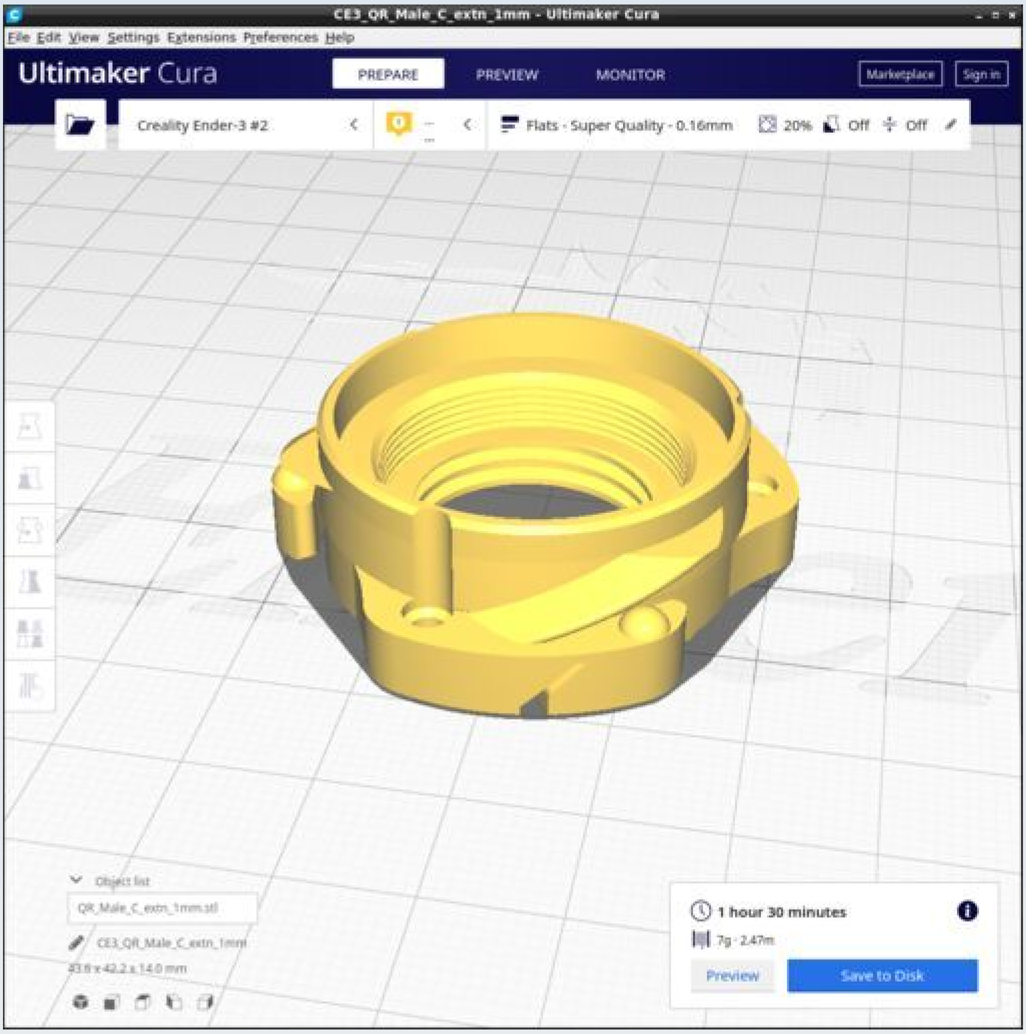


This thread adapter was designed to conform to measurements of similar adapters that are commercially available and made of metal. Thus you can use the metal adapter if you want all-metal threads (which are easier to align with your objective and harder to cross-thread and destroy and wear out).

If using this 3D printed plastic version, the female RMS thread will require training with a metal RMS male thread (such as on an objective lens). Great care is required not to cross the 3D printed plastic thread and damage it at all times but especially during training.

The male C thread is best trained on a metal C thread such as may be found on a C/CS thread extender ring.

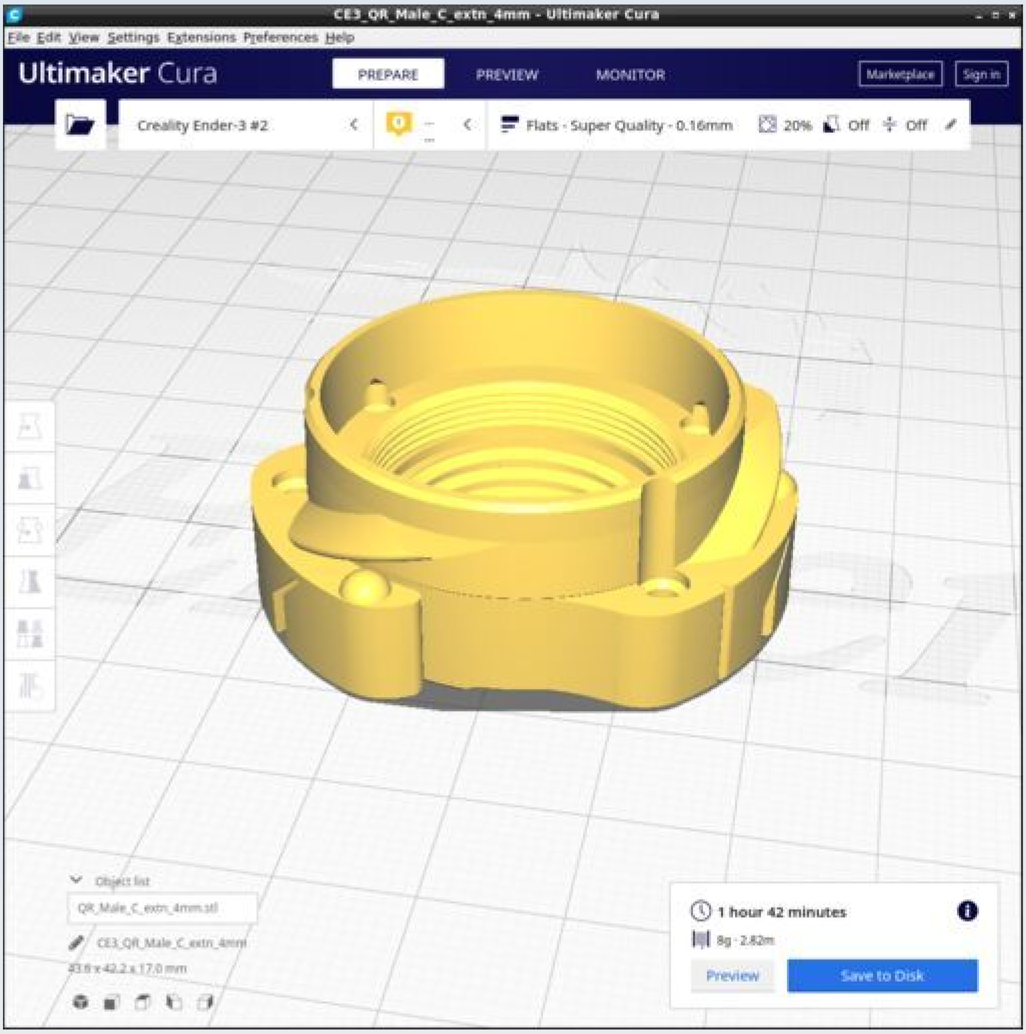
QR_Male_C_extn_1mm



The female C thread is best trained on a metal C thread such as may be found on a C-mount lens or C/CS thread extender adapter ring. Great care is required to avoid crossing the 3D printed plastic thread and thereby damaging or destroying it.

The outer quick-release makle tri-helix thread should be trained using the QR_Trainer 3D printed tool (see below).

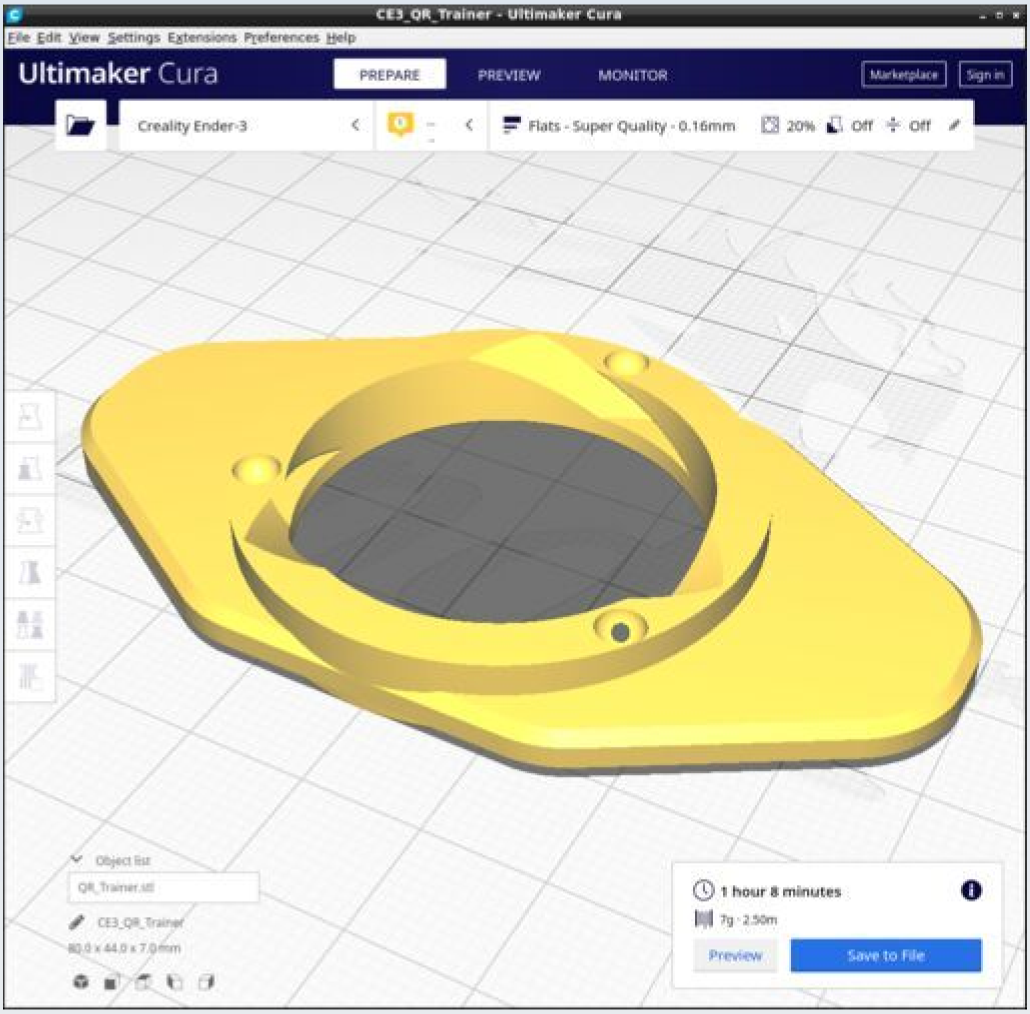
QR_Male_C_extn_4mm



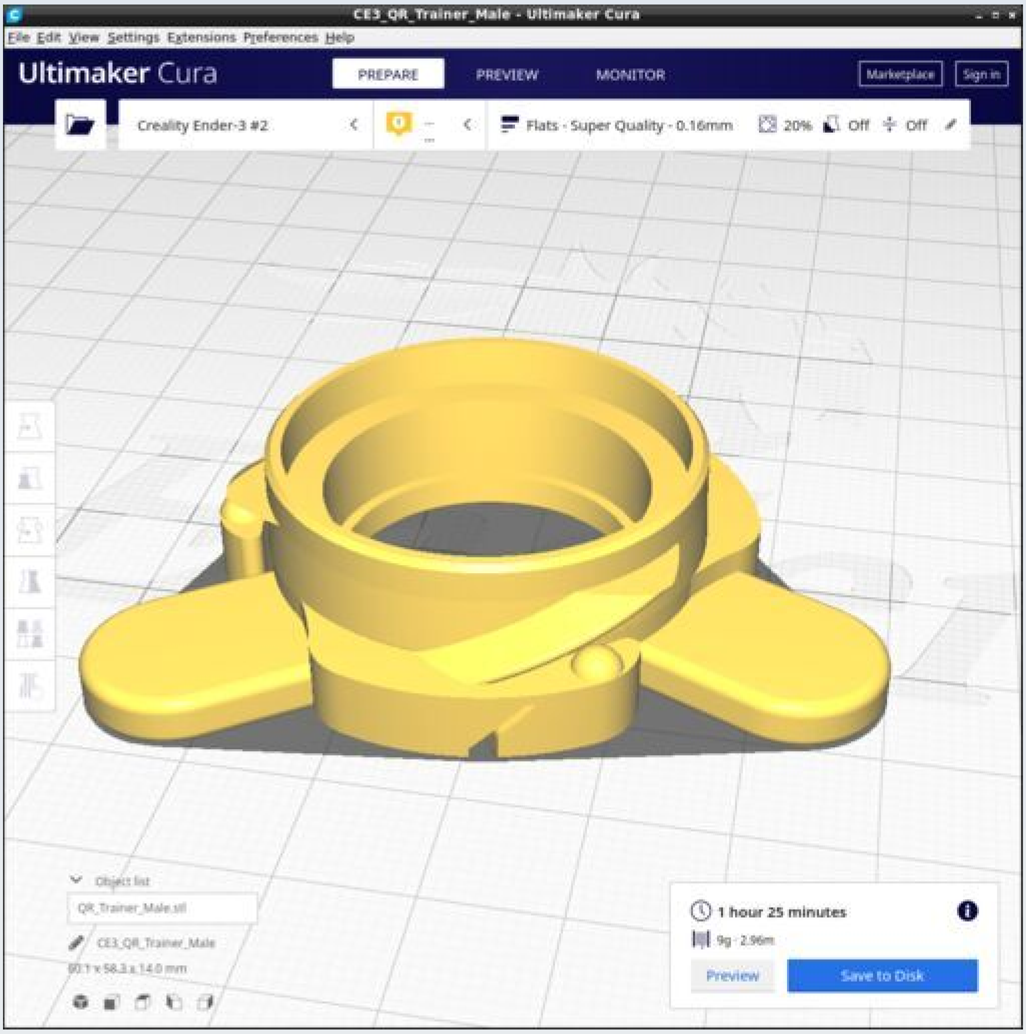
The female C thread is best trained on a metal C thread such as may be found on a C-mount lens or C/CS thread extender adapter ring. Great care is required to avoid crossing the 3D printed plastic thread and thereby damaging or destroying it.

The outer quick-release makle tri-helix thread should be trained using the QR_Trainer 3D printed tool (see below).

QR_Trainer


CE3_QR_Trainer - Ultimaker Cura
File Edit View Settings Extensions Preferences Help
Ultimaker Cura
PREPARE
PREVIEW
MONITOR
Marketplace
Sign in
Creality Ender-3
Flats - Super Quality - 0.16mm
20%
Off
Off
Object list
QR_Trainer.stl
CE3_QR_Trainer
80.0 x 44.0 x 7.0 mm
1 hour 8 minutes
7g · 2.50m
Preview
Save to File

QR_Trainer_Male



Stabiliser

These are the parts for the optional stabiliser exoskeleton bracket. The CAD source models for these files are found in the file Stabiliser.FCStd.

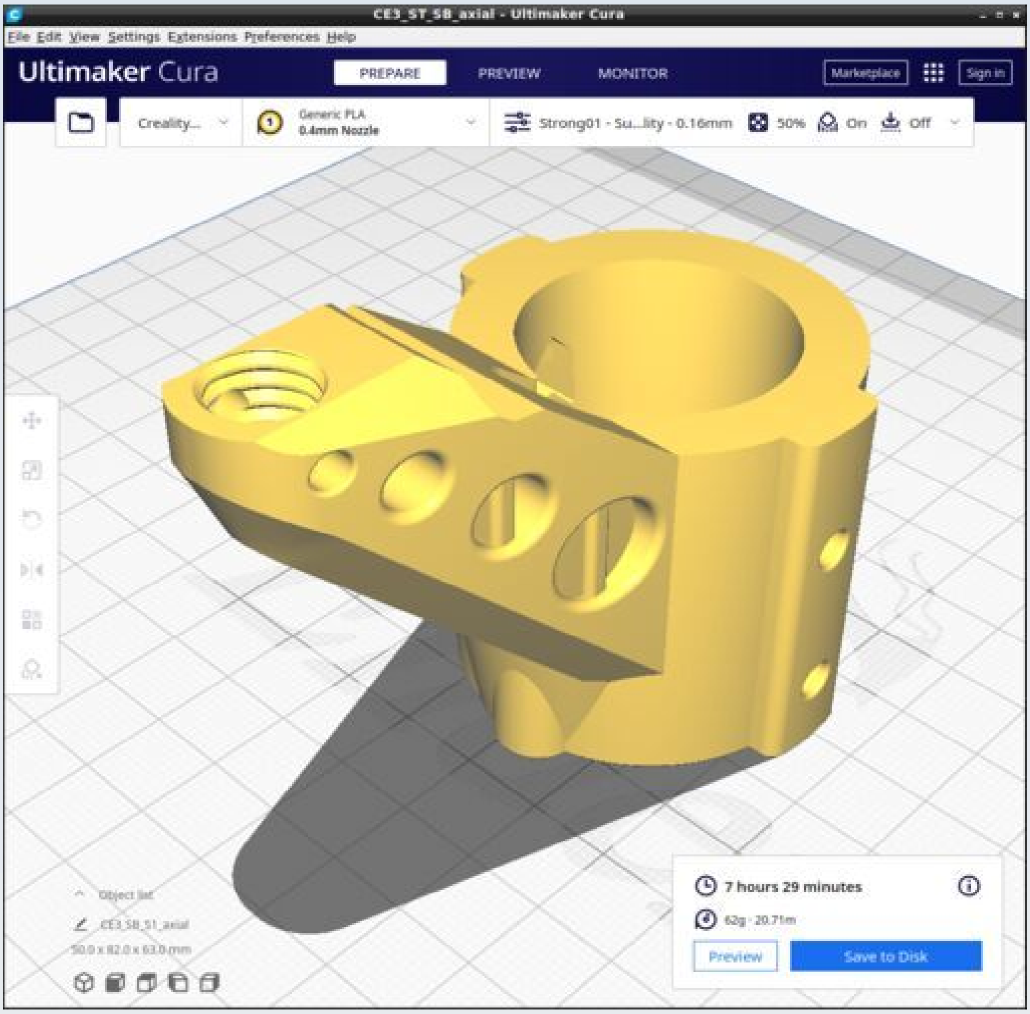
Use the ‘Strong01’ Cura profile to print the parts.

Resources

Cura calculates the following resources are required to print each model in this chapter:

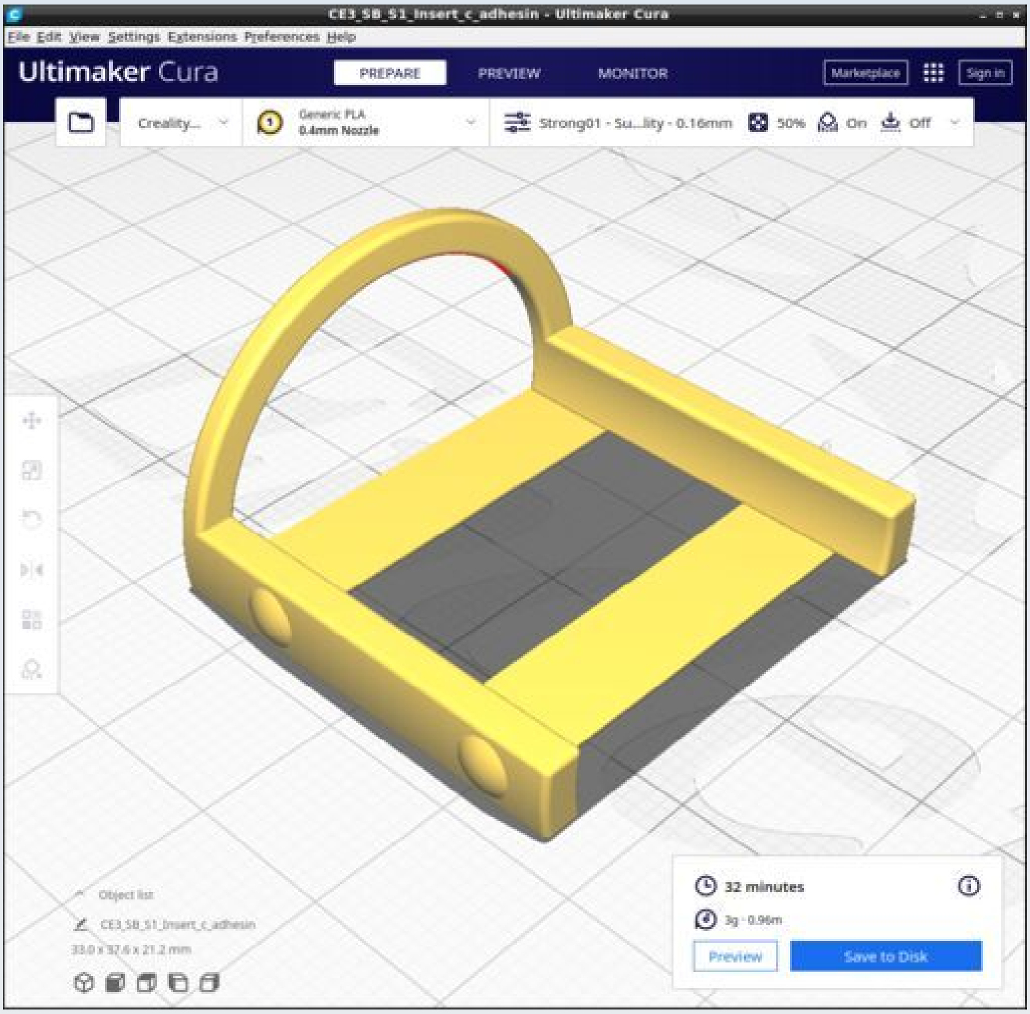
Stabiliser	Time_Hr	Time_Min	PLA_Length(m)
SB_S1_Axial	7	29	20.71
SB_S1_Insert_c_adhesin	0	32	0.96
SB_S1_Lateral_strut_Left	2	5	6.26
SB_S1_Lateral_strut_Right	2	6	6.26
SB_S1_Peg	0	16	0.44

SB_S1_Axial



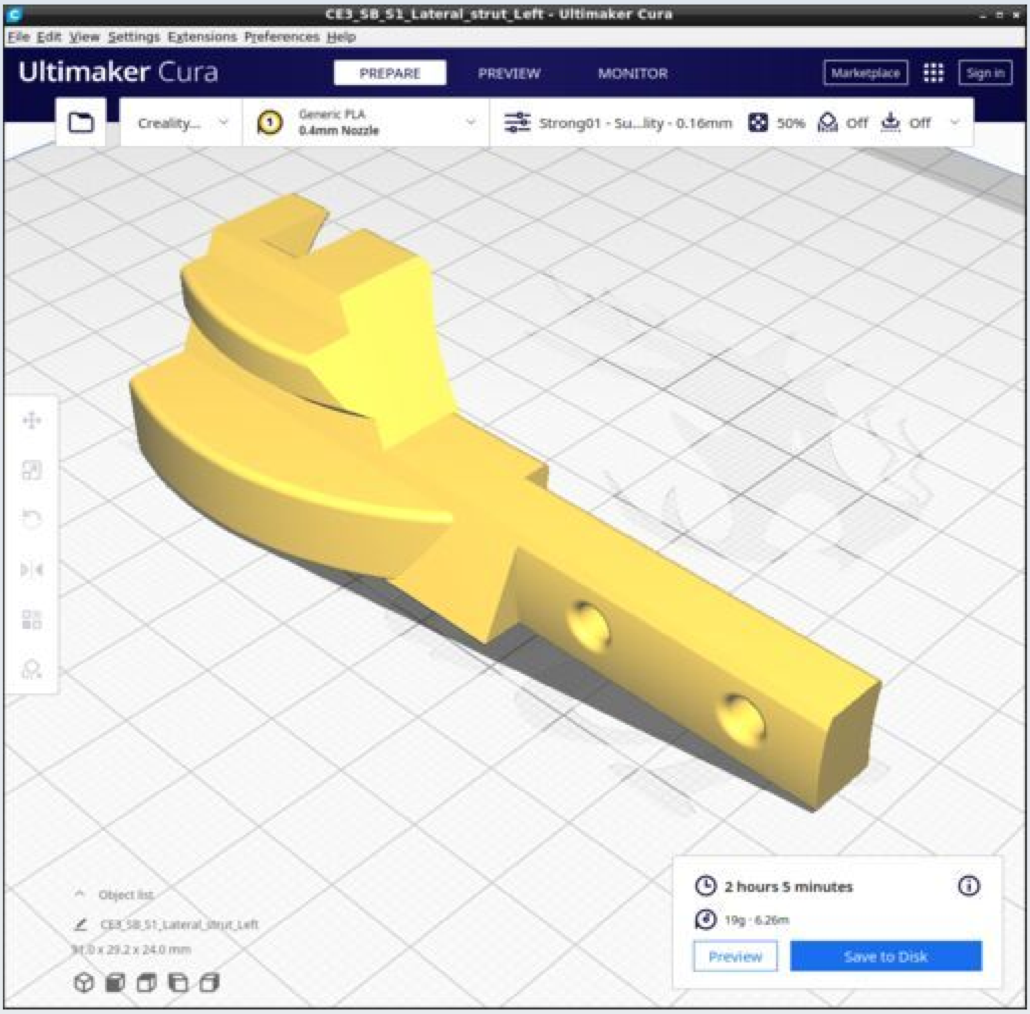
Use 'Strong01' profile with concentric top-bottom pattern and with supports 'touching baseplate only'.

SB_S1_Insert_c_adhesin



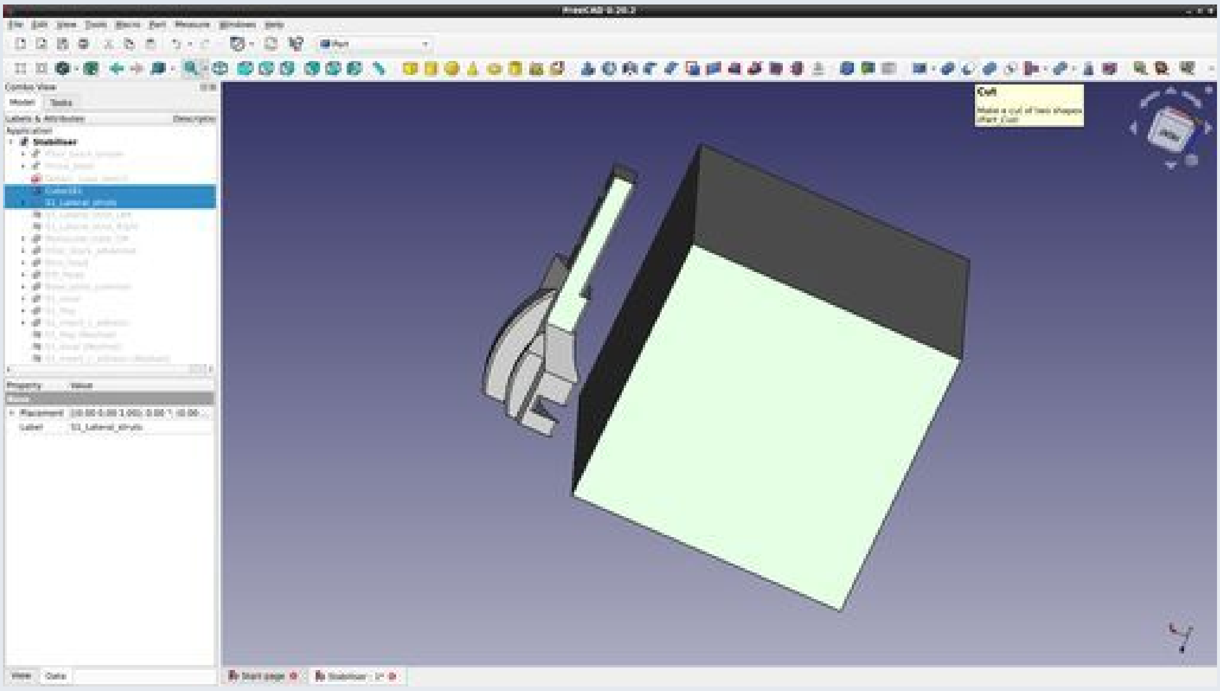
Use 'Strong01' profile with 'lines' top-bottom pattern and with supports 'everywhere' and overhang of 40 degrees.

SB_S1_Lateral_strut_Left



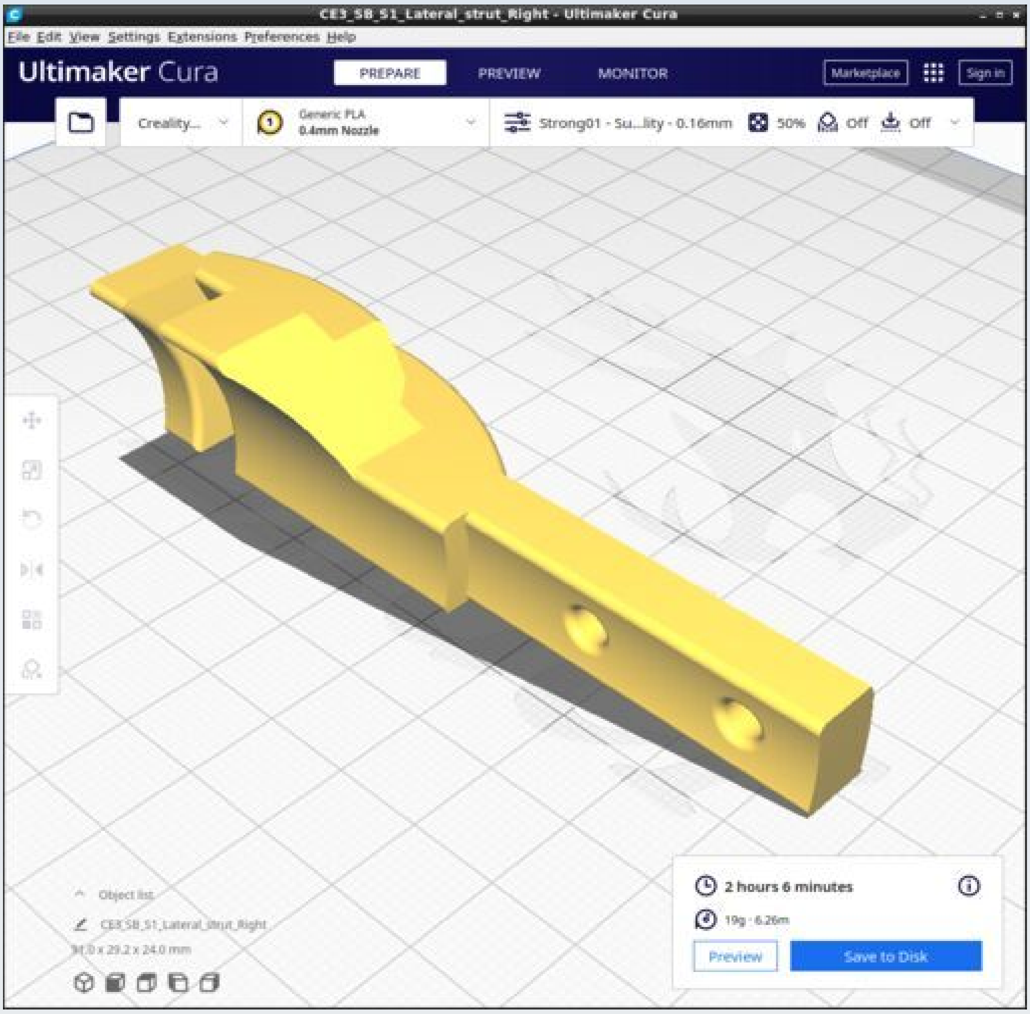
The left and right strut models may be printed together (as they are one model in the FreeCAD file) but I recommend they be printed separately as shown here in order to avoid stringing and unnecessary back-forth movements of the print head.

To achieve this, create a cube shape in FreeCAD (‘Parts’ workbench) and make the cut larger than either one of the struts. Then place the cube over the strut you don’t want and perform a subtraction between the struts model and the cube using the shape ‘Cut’ opoeration (see the figure below).



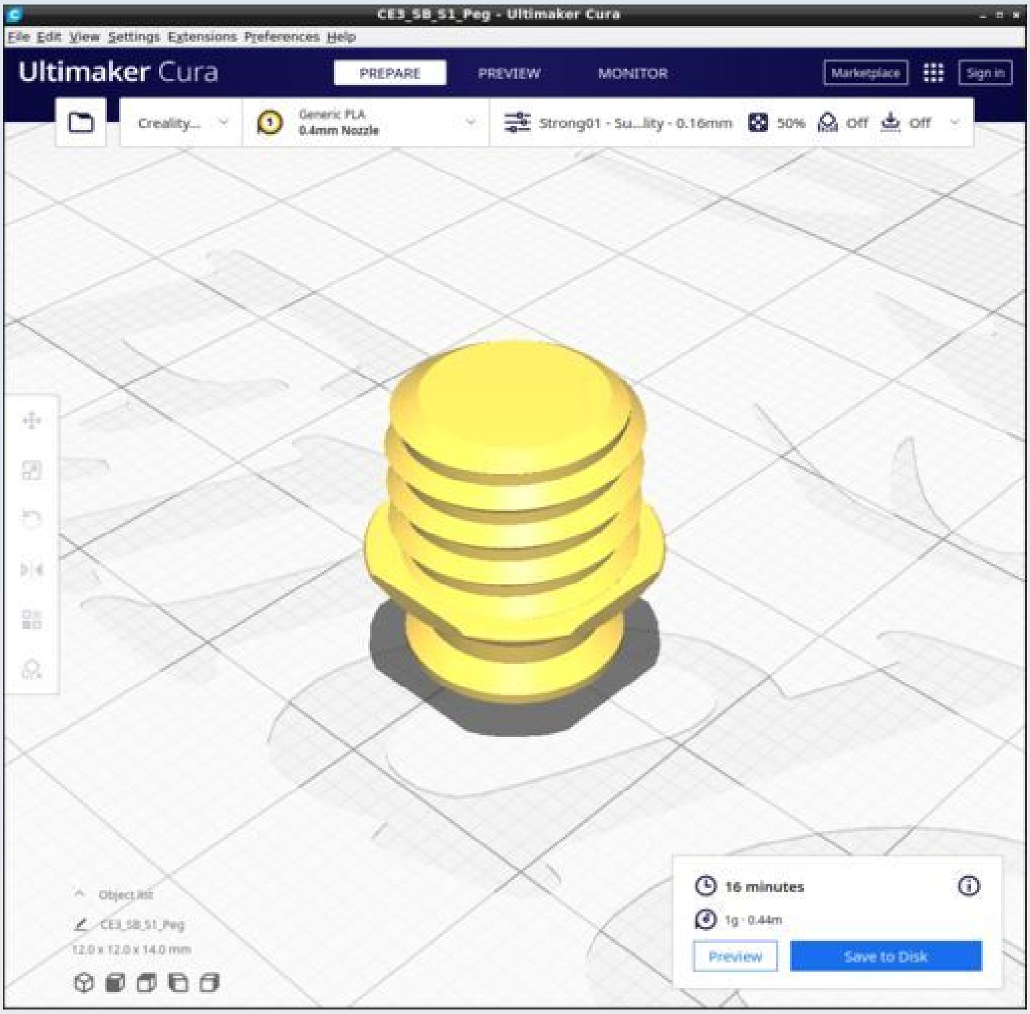
Then generate the mesh of the one remaining strut. Once the mesh is made, undo the shape cut, move the cube over the opposite strut and repeat the process to get the other mesh.

SB_S1_Lateral_strut_Right



The left and right strut models may be printed together (as they are one model in the FreeCAD file) but I recommend they be printed separately as shown here in order to avoid stringing and unnecessary back-forth movements of the print head. The notes on the previous page show how to do this.

SB_S1_Peg



It may help to set top/bottom layer pattern to ‘concentric’

Stage

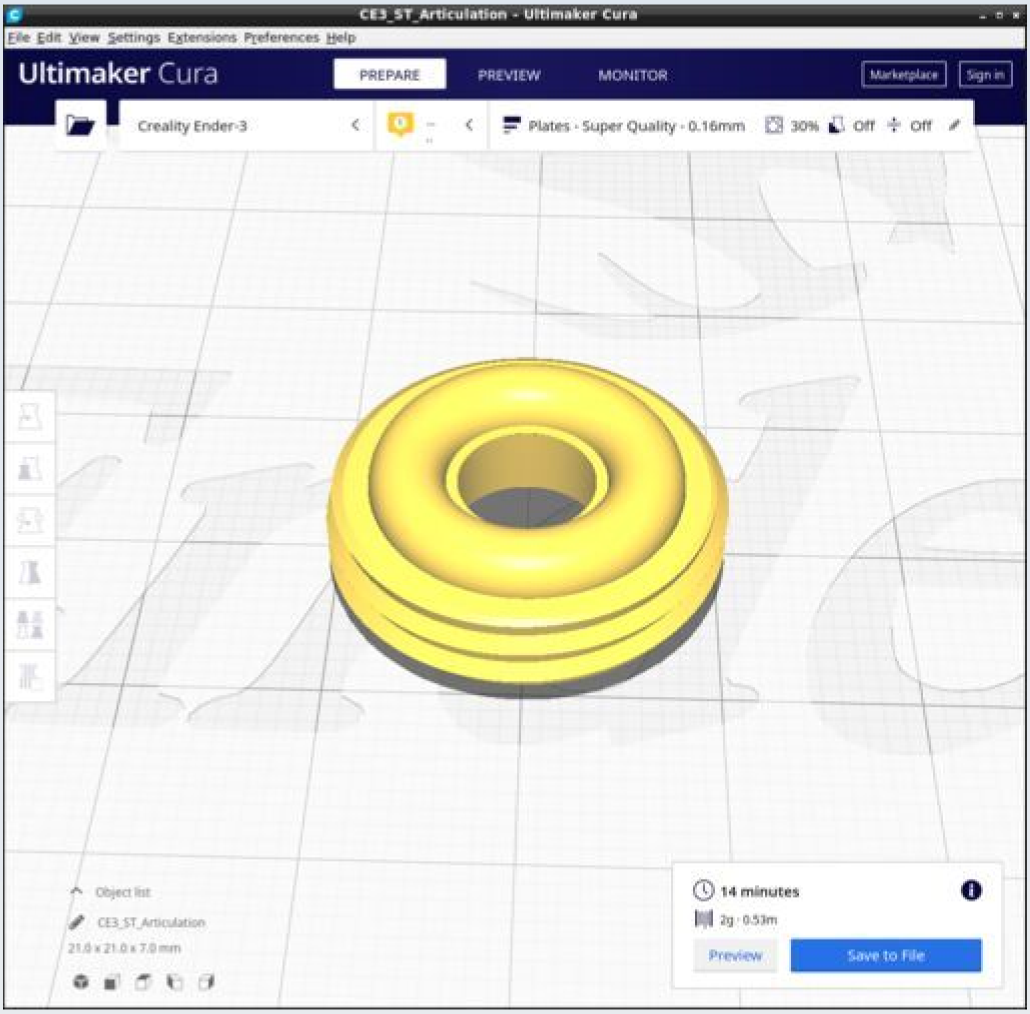
These are the parts for the main stage base plate and focus platform of the microscope. The CAD source models for these files are found in the file Stage.FCStd.

Resources

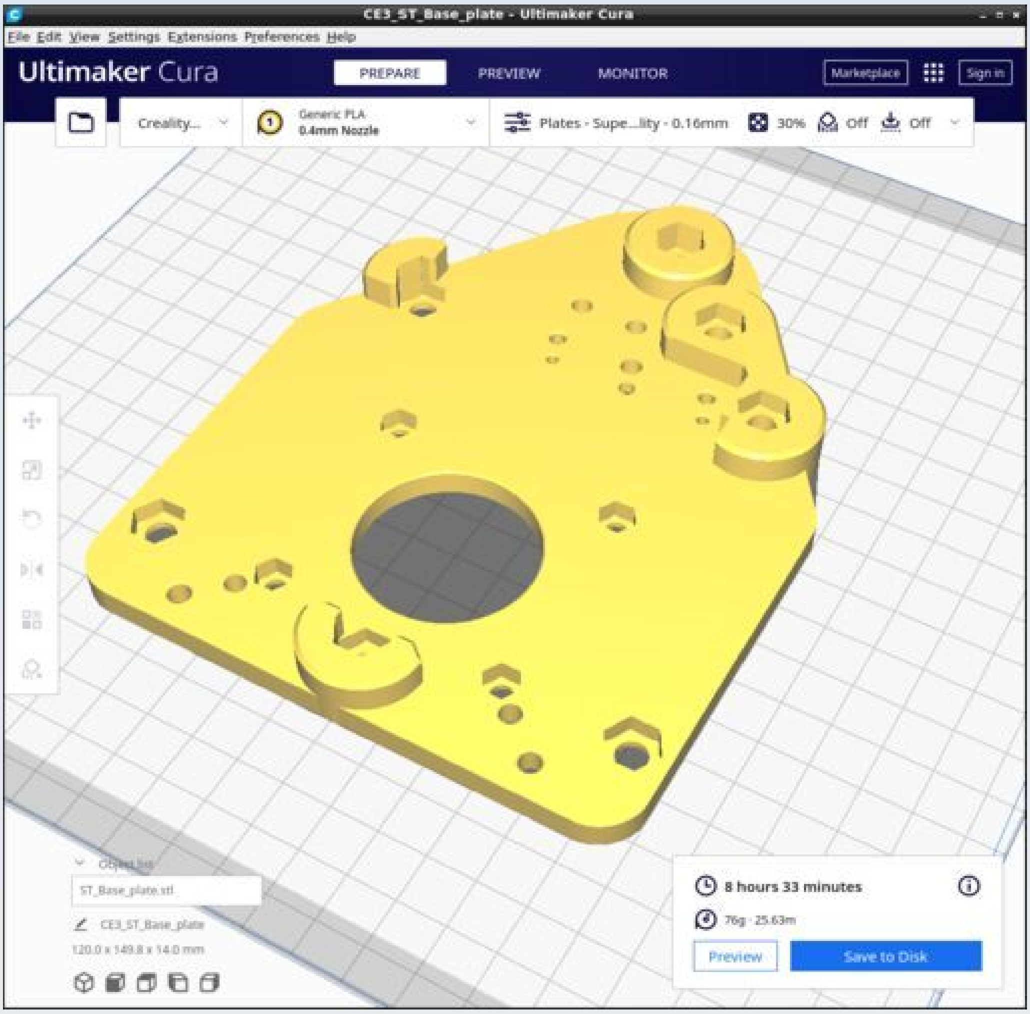
Cura calculates the following resources are required to print each model in this chapter:

Stage	Time_Hr	Time_Min	PLA_Length(m)
ST_Articulation	0	14	0.53
ST_BasePlate	8	23	25.63
ST_FocusPlate	4	8	11.22

ST_Articulation

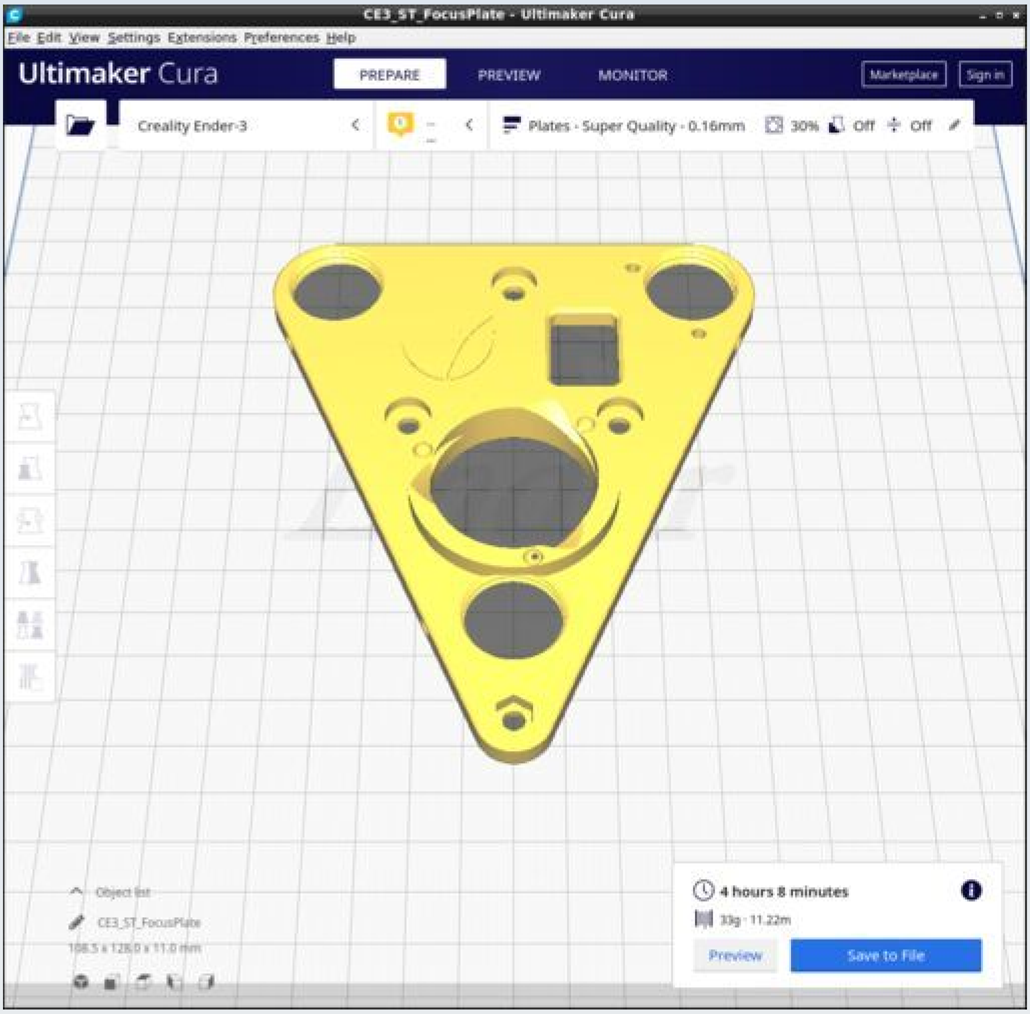


ST_BasePlate



Print with the ‘Plates’ custom Cura profile.

ST_FocusPlate



Print with the ‘Plates’ custom Cura profile.

Trinocular Camera Port

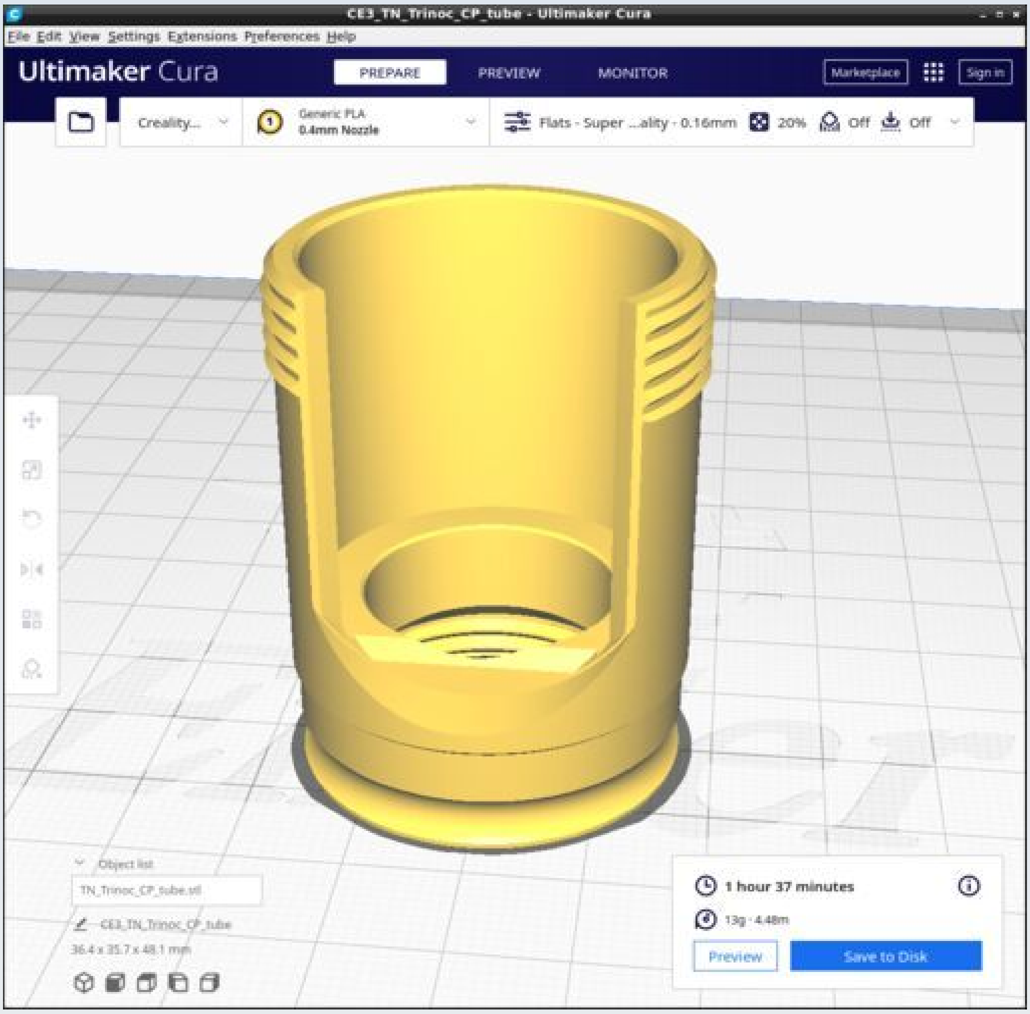
This is the part for the trinocular extension that attaches to the advanced filter block and allows a third eyepiece and / or a camera to be attached (in addition to any cameras or eyepieces that may be attached to the main viewing oculars in the ocular head). The CAD source models for these files are found in the file Trnocular_CP_v1.FCStd.

Resources

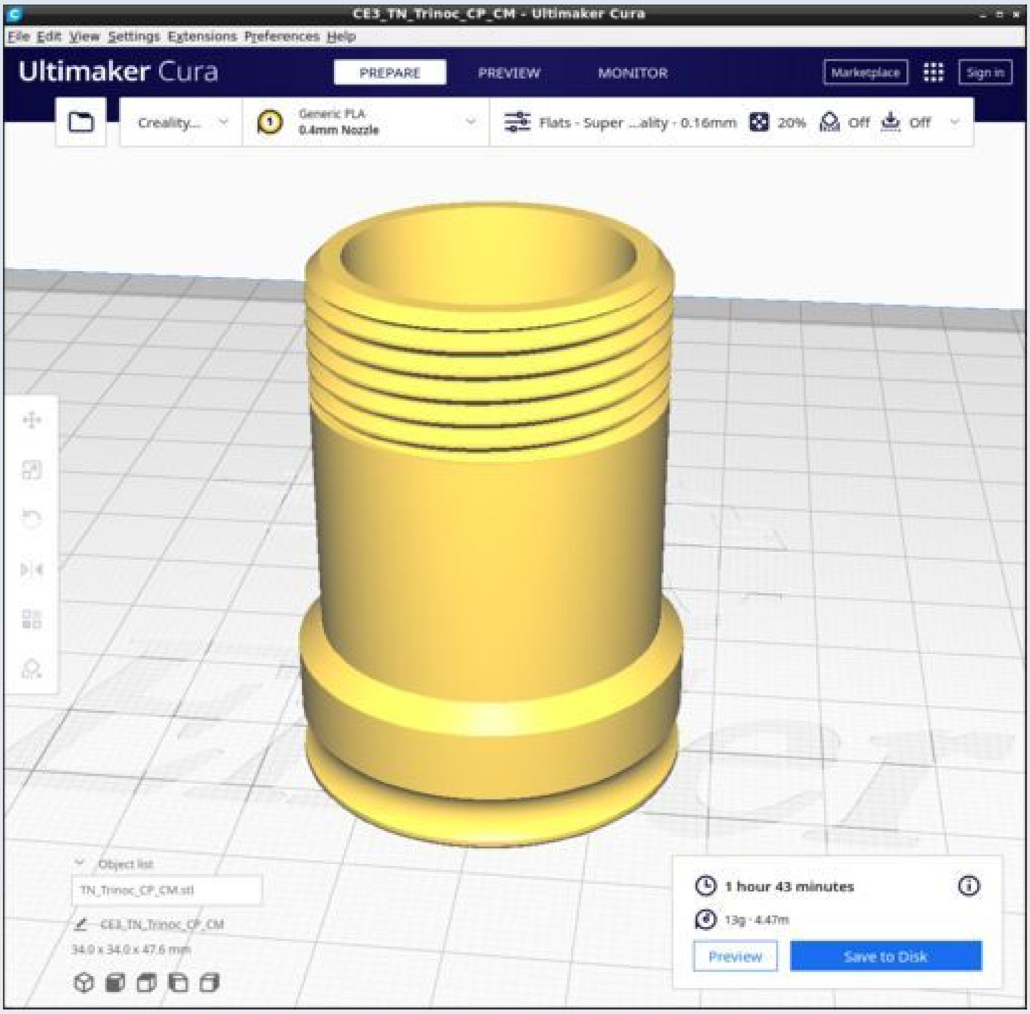
Cura calculates the following resources are required to print each model in this chapter:

Trinocular_Camera_Port	Time_Hr	Time_Min	PLA_Length(m)
TN_Trinoc_CP_tube	1	37	4.48
TN_Trinoc_CP_CM	1	43	4.47
TN_Ocular_spacer_ring_1p44	0	7	0.28

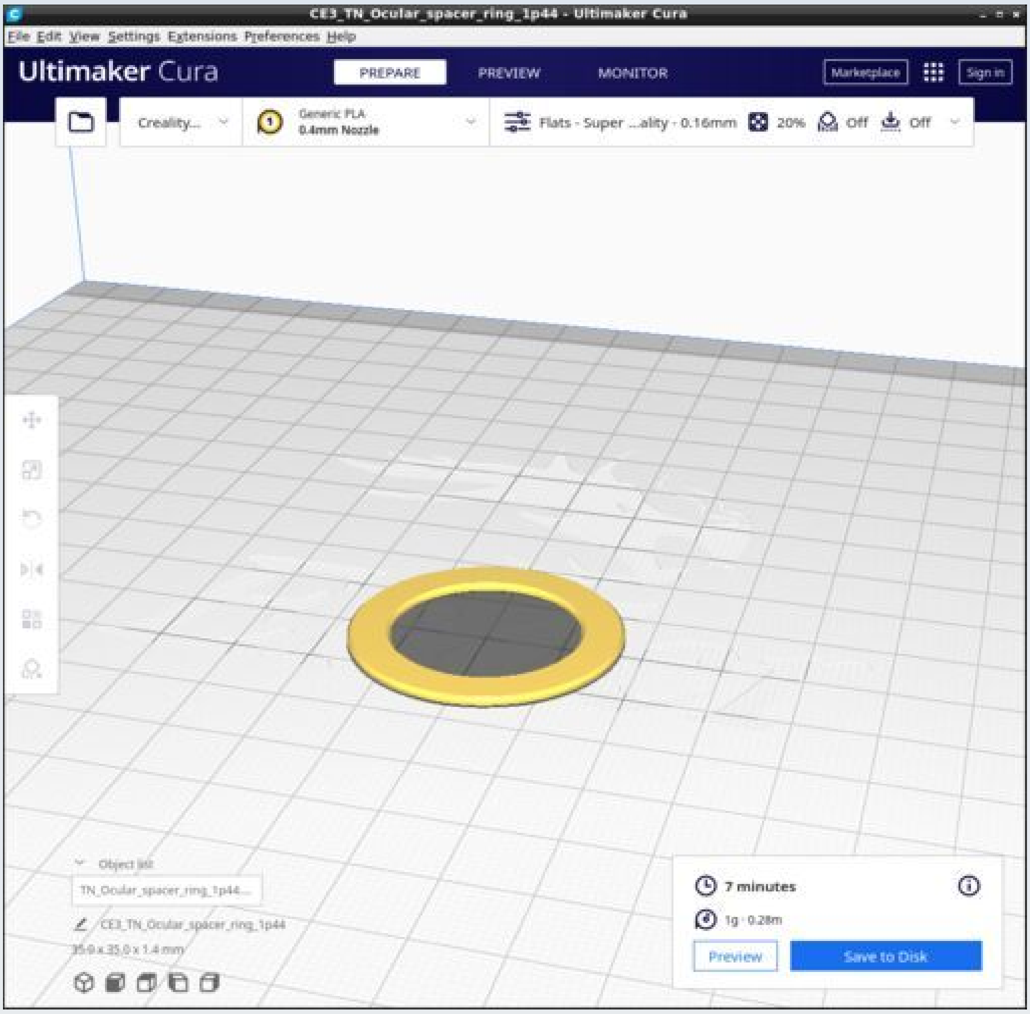
TN_Trinoc_CP_tube



TN_Trinoc_CP_CM



TN_Ocular_spacer_ring_1p44



XY Stabiliser

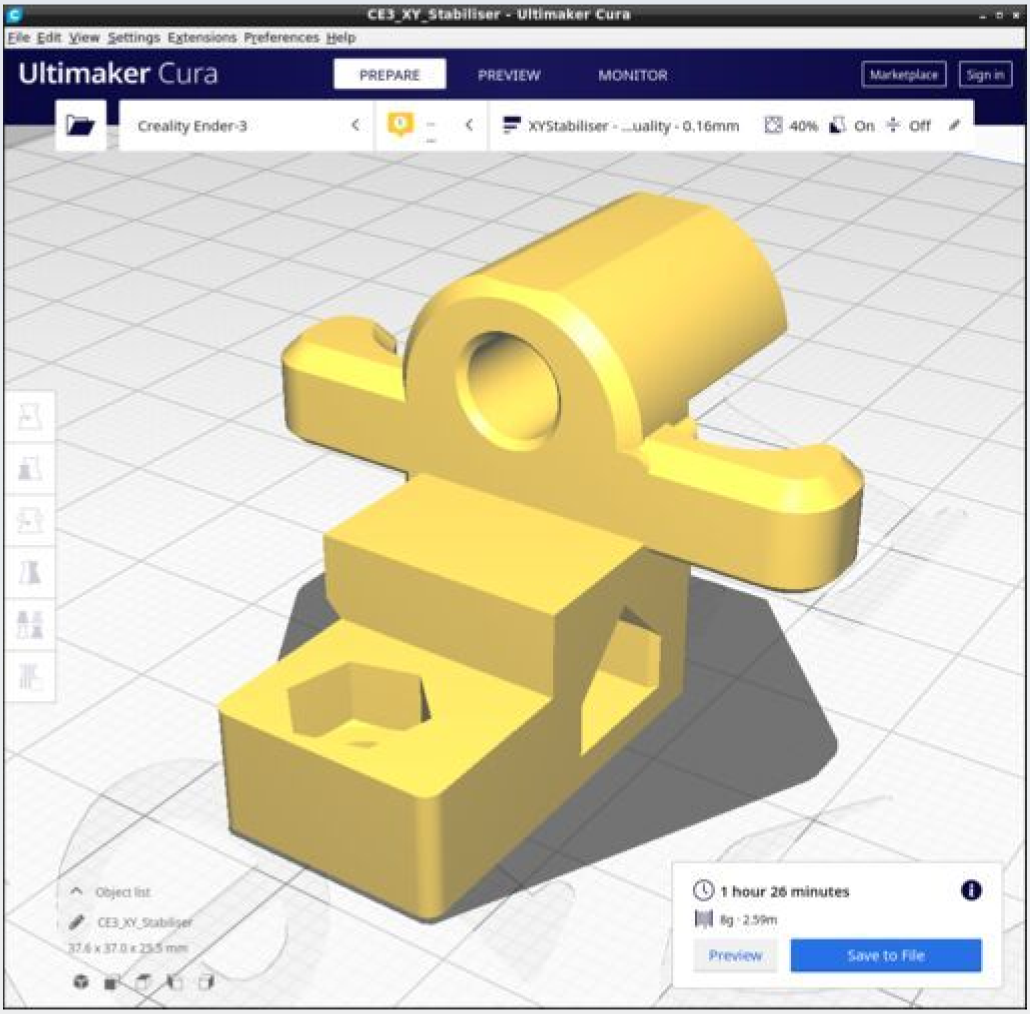
This is the part for an optional mechanism to make the standard XY mechanichal stage calipers more stable in their motion. The CAD source models for this STL file is found in the file XY_Stabiliser.FCStd.

Resources

Cura calculates the following resources are required to print each model in this chapter:

XY_Stabiliser	Time_Hr	Time_Min	PLA_Length(m)
XY_Stabiliser	1	26	2.59

XY_Stabiliser



Print with the ‘XYStabiliser’ custom Cura profile.

Z-Motor

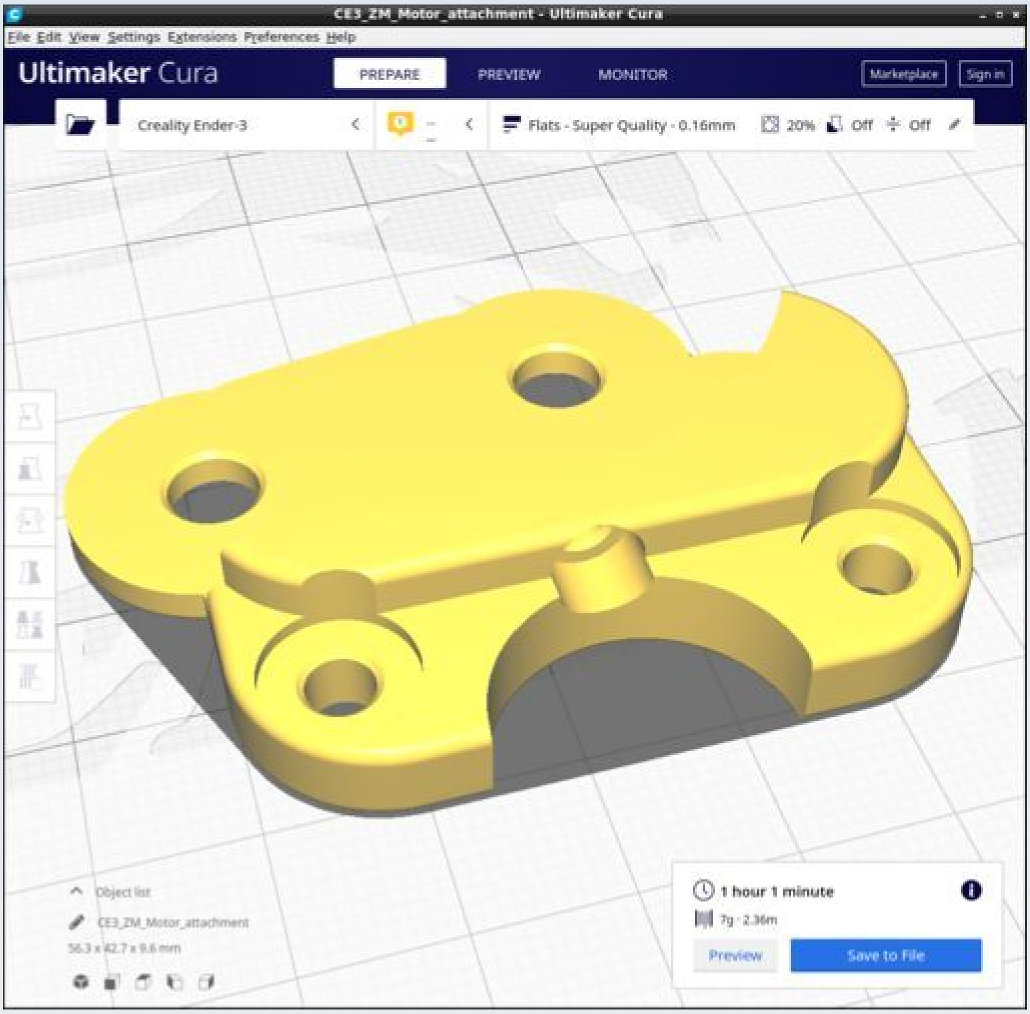
These are the parts for adding a Z-motor to the stage. The CAD source models for these files are found in the file Z_Motor.FCStd.

Resources

Cura calculates the following resources are required to print each model in this chapter:

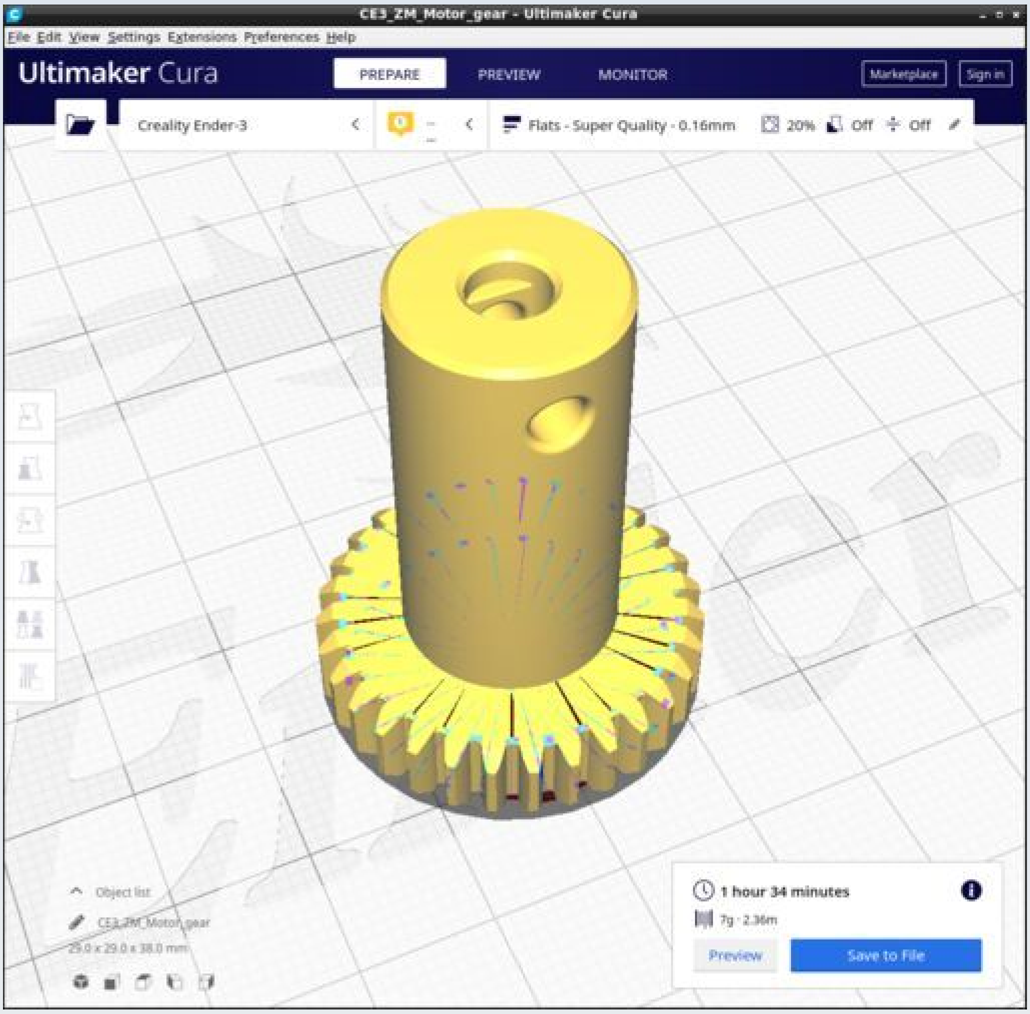
Z-Motor	Time_Hr	Time_Min	PLA_Length(m)
ZM_Motor_attachment	1	1	2.36
ZM_Motor_gear	1	34	2.36
ZM_Z_Limit_Sw_Mount	0	17	0.44
ZM_Z_Probe	1	4	2.04
ZM_Z_Yoke	0	22	0.66

ZM_Motor_attachment

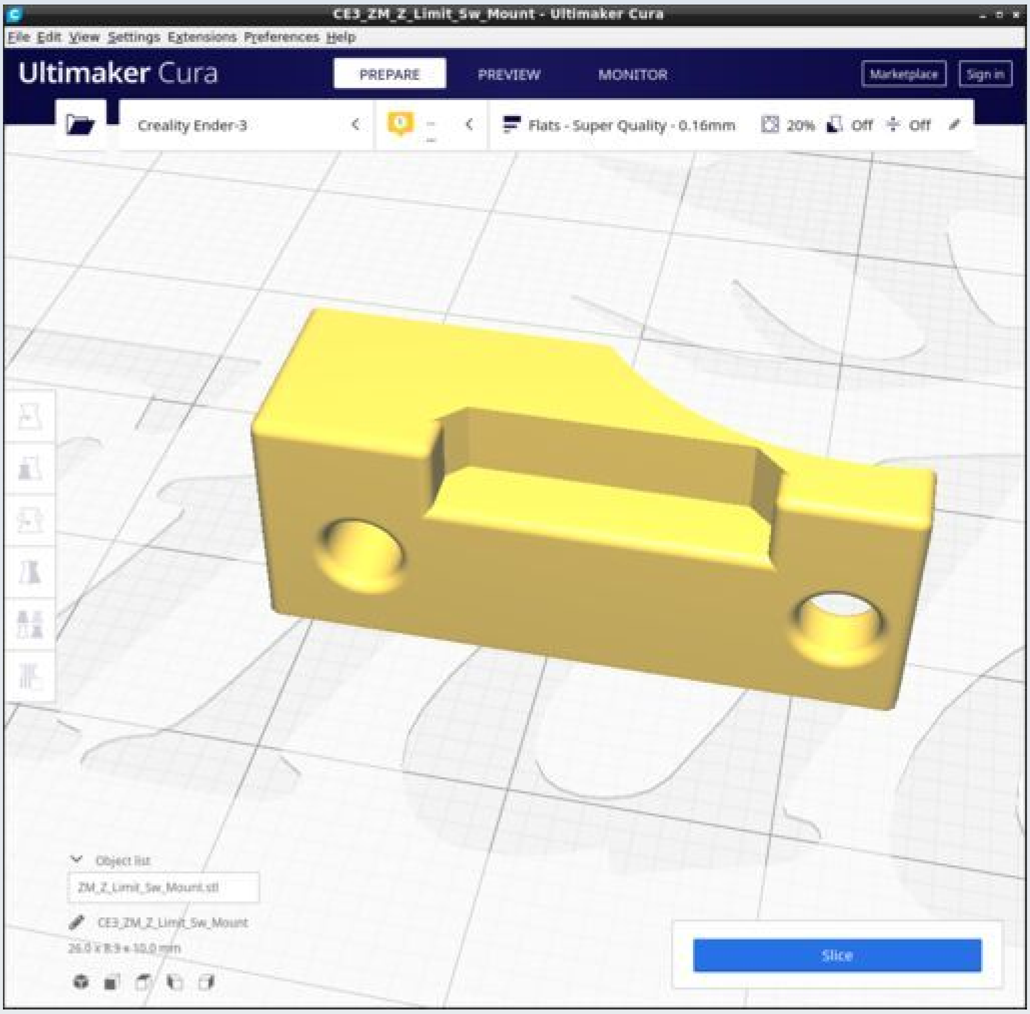


Ensure supports are disabled. It is not possible to properly rotate this in Cura using the method described below (for ZM_Z_Limit_Sw_Mount) so the mesh is rotated 235 degrees in FreeCAD prior to saving to get the flat parts of the front surface aligned to the X-axis.

ZM_Motor_gear



ZM_Z_Limit_Sw_Mount



Ensure supports are disabled. It is difficult to get the flat outer surface exactly in line with the X-axis of the printer. To do this follow these steps:

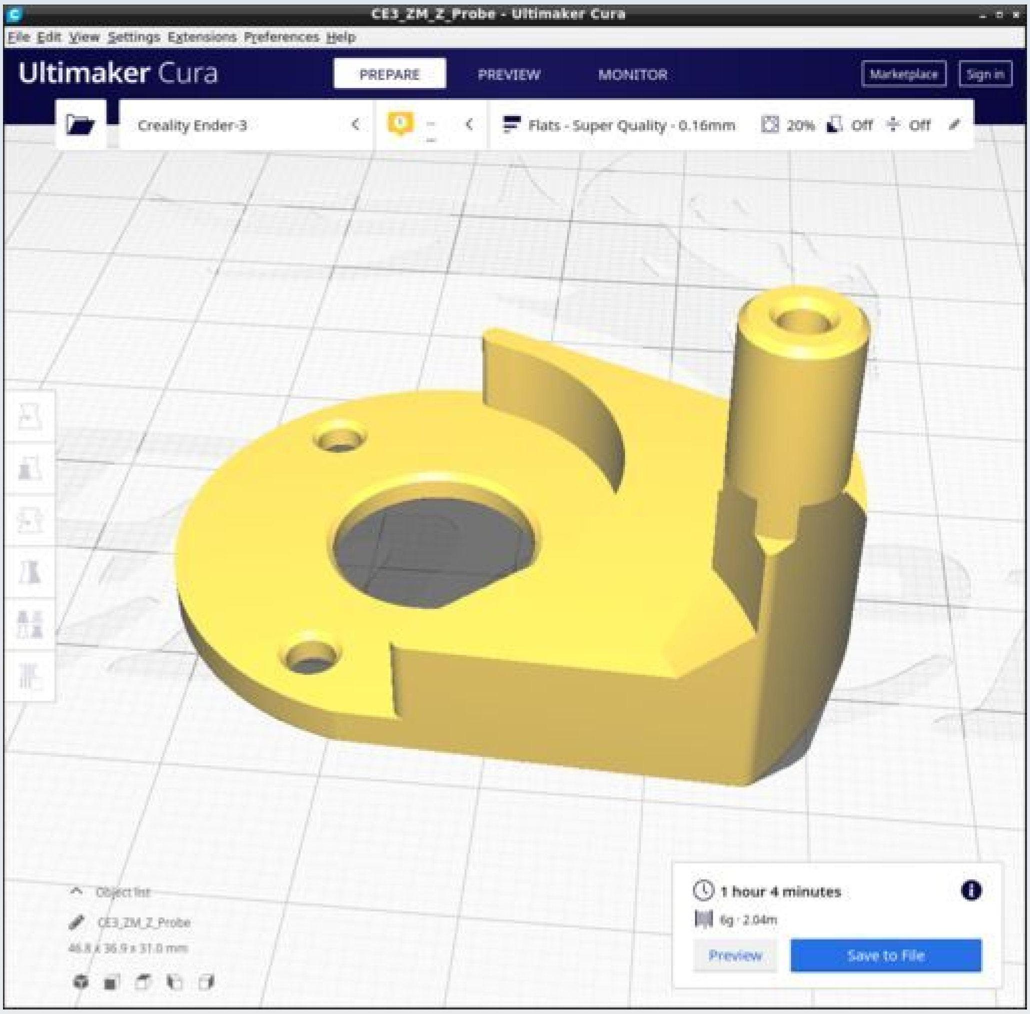
1. Load into Cura.

2. Rotate it so the flat surface with the screw holes faces the buildplate then use the 'Lay flat' option of Cura to calculate the exact rotation to make that surface flat against the build plate.

3. When done, simply use snap rotation to 90 degrees about the long axis of the model so that the flat surface that was laying on the build plate now faces to the front of the printer.

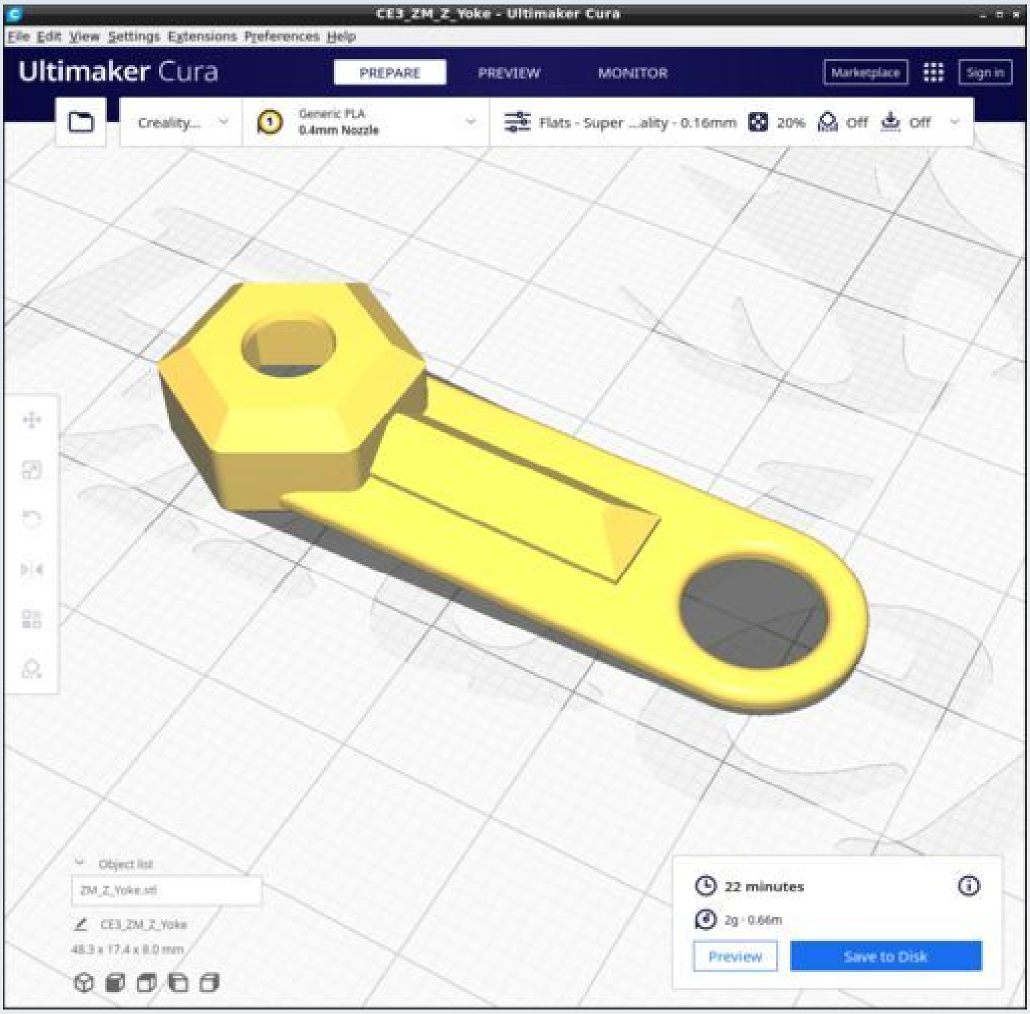
The resulting position is as shown in the figure.

ZM_Z_Probe



Ensure supports are disabled. It is difficult to get the flat outer surface exactly in line with the X-axis of the printer so a method similar to that described above for ‘ZM_Z_Limit_Sw_Mount’ is used. The result is as shown in the picture.

ZM_Z_Yoke


CE3_ZM_Z_Yoke - Ultimaker Cura
File Edit View Settings Extensions Preferences Help
Ultimaker Cura
PREPARE
PREVIEW
MONITOR
Marketplace
Sign in
Creality...
Generic PLA
0.4mm Nozzle
Flats - Super ...ality - 0.16mm
20%
Off
Off
Object list
ZM_Z_Yoke.stl
CE3_ZM_Z_Yoke
48.3 x 17.4 x 8.0 mm
22 minutes
2g · 0.66m
Preview
Save to Disk

CNC-Stage

These are the parts for making the CNC precision motorised XYZ stage. The CAD source models for these files are found in the file CNC_Stage.FCStd.

All models are printed with the basic Cura profile ‘Strong02’ (10 wall layers and 10 layers top and bottom) and most are printed with an infill of 30%. Details of any modifications to this and any supports / support blockers will be provided with each model.

Location of the models

File: CNC_Stage.FCStd

Group: PSU

PSU_CableFixture_front

PSU_DC_CableCover

PSU_Mains_CableCover

PSU_Peg_Leg

Group: Arduino

Ardu_bus_bar_mount

Ardu_Bus_Clip_set

Ardu_M3_Washer

Group: X_Axis

X_Lim_Sarcoph_L

X_Lim_Sarcoph_R

X_NEMA11_Bracket

X_NEMA11_Counter_weight

X_NEMA11_CW_Hopper

X_Probe

X_Probe_Housing_L

X_Probe_Housing_R

X_Probe_shim

XY_NEMA11_Undertable_Support

Group: Y_Axis

Y_Lim_Sarcoph_Susp_B

Y_Lim_Sarcoph_Susp_F

Y_NEMA11_Bracket

Y_Probe_Susp_Nemesh
Y_Suspension_platform_B
Y_Suspension_platform_F

Group: Z_Axis

Z_Coupler
Z_Lim_Attachment
Z_Lim_Back_baffle
Z_Lim_Probe
Z_M4_small_washer
Z_Mount
Z_N11_Syringe_body
Z_N11_Syringe_cover
Z_N11_Syringe_Gearbox_plunger
Z_N11_Syringe_mount

Group: Sample_holder

Sam_Counter_weight
Sam_Pincer_Extn1_L
Sam_Pincer_Extn1_R
Sam_Pincer_Extn2_L
Sam_Pincer_Extn2_R
Sam_Presser_wings
Sam_Spring_arm_assy
Sam_Stage_Top

Group: BaseBoard

BB_Jig_Back_Left
BB_Jig_Back_Measure
BB_Jig_Back_Right
BB_Jig_Front_Left
BB_Jig_Front_Measure
BB_Jig_Front_Right
BB_Jig_Left_Measure
BB_Jig_Right_Measure
BB_Jig_Undercarriage
BB_Jig_XYTable
BB_Jig_Y_Lim

Group: Frame

F_Ardu_strut_BL

F_Ardu_strut_BR

F_Ardu_strut_TL

F_Ardu_strut_TR

F_DM3_Mount

F_OM_QR_Plate

F_Overmount

F_UM_Opt_gripper

F_UM_Opt_Gripper_washer

F_UM_Opt_to_QR_F

F_Undercarriage_platform

Group: Shields

SD_2020_End_cap

SD_2020_Protector

SD_Aft_clip

SD_Aft_Hole_cover

SD_Aft_Left

SD_Aft_Mid

SD_Aft_Right

SD_Aft_Rivet_block

SD_DIN_End_Protector

SD_DIN_Foot_Protector

SD_Dorsal_Key_head

SD_Dorsal_Key_key

SD_Dorsal_Key_main

SD_Dorsal_Key_wedge

SD_Dorsal_L

SD_Dorsal_M

SD_Dorsal_R

SD_Dorsal_Rivet_plate

SD_Dorsal_suture

SD_Forward_L

SD_Forward_R

SD_Forward_Rivet_handle_1

SD_Forward_Rivet_handle_2
SD_Forward_Rivet_lock
SD_Forward_Rivet_tool
SD_Forward_suture
SD_Lateral_Left
SD_Lateral_Right
SD_Letters_CNC
SD_Letters_PUMA
SD_T_nut_positioner
SD_XMotor_cover_L
SD_XMotor_cover_R

Resources

Cura 4.13.1 calculates the following resources are required to print each model in this chapter:

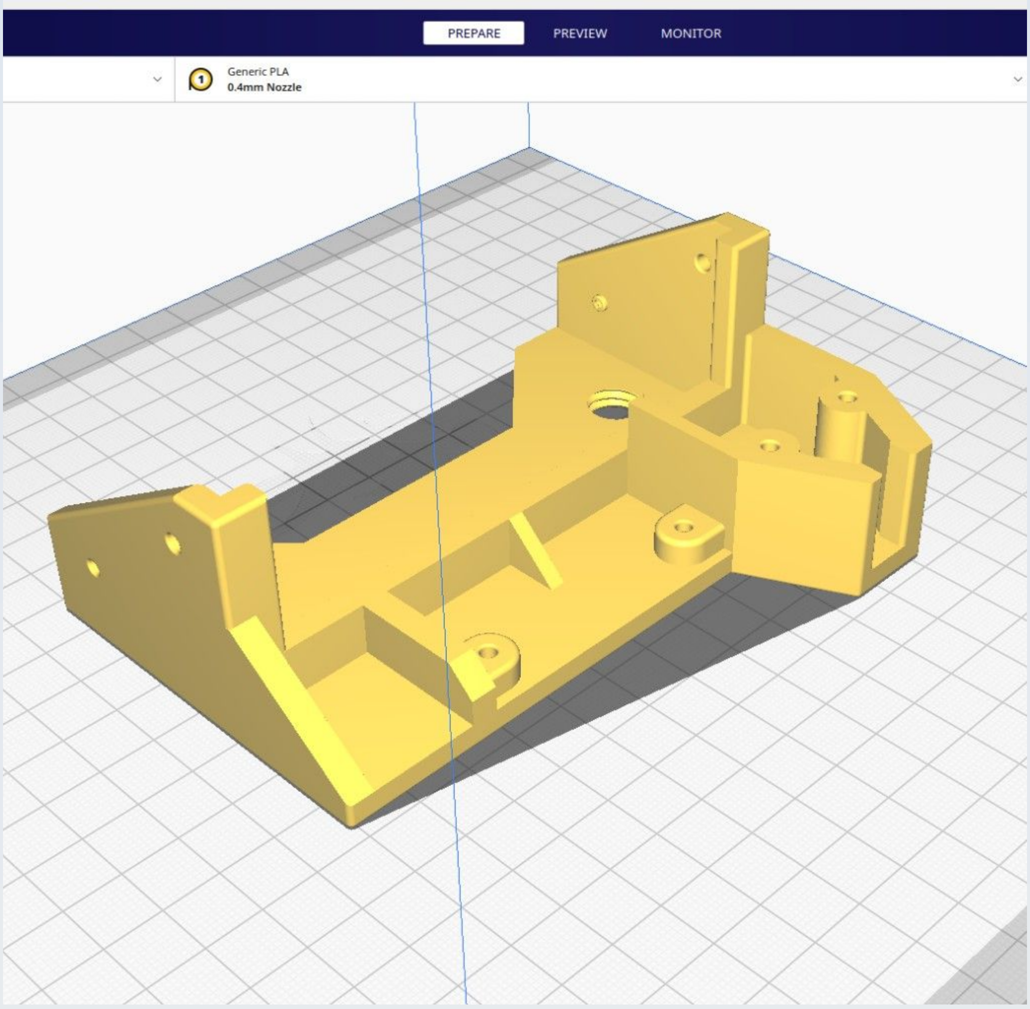
CNC-Stage	Time_Hr	Time_Min	PLA_Length(m)
CN_PSU_CableFixture_front	9	1	29.11
CN_PSU_DC_CableCover	0	32	1.66
CN_PSU_Mains_CableCover	1	1	2.99
CN_PSU_Peg_Leg	0	9	0.3
CN_Ardu_bus_bar_mount	7	29	20.74
CN_Ardu_Bus_Clip_set	4	13	6.1
CN_Ardu_M3_Washer	0	1	0.02
CN_X_Lim_Sarcoph_L	2	35	7.11
CN_X_Lim_Sarcoph_R	2	30	7.12
CN_X_NEMA11_Bracket	9	41	21.55
CN_X_NEMA11_Counter_weight	10	32	25.04
CN_X_NEMA11_CW_Hopper	3	27	11.69
CN_X_Probe	0	26	1.04
CN_X_Probe_Housing_L	0	53	2.77
CN_X_Probe_Housing_R	0	54	2.77
CN_X_Probe_shim	0	2	0.1

CN_XY_NEMA11_Undertable_Support	0	34	1.72
CN_Y_Lim_Sarcoph_Susp_B	4	36	12.35
CN_Y_Lim_Sarcoph_Susp_F	4	36	12.35
CN_Y_NEMA11_Bracket	9	7	20.82
CN_Y_Probe_Susp_Nemesh	3	53	9.31
CN_Y_Suspension_platform_B	0	36	1.97
CN_Y_Suspension_platform_F	0	36	1.97
CN_Z_Coupler	0	37	2.2
CN_Z_Lim_Attachment	2	23	6.44
CN_Z_Lim_Back_baffle	0	33	0.62
CN_Z_Lim_Probe	0	16	0.6
CN_Z_M4_small_washer	0	0.4	0.02
CN_Z_Mount	10	17	28.73
CN_Z_N11_Syringe_body	6	11	14.84
CN_Z_N11_Syringe_cover	0	42	1.66
CN_Z_N11_Syringe_Gearbox_plunger	2	45	7.09
CN_Z_N11_Syringe_mount	8	26	23.77
CN_Sam_Counter_weight	1	6	3.15
CN_Sam_Pincer_Extn1_L	0	52	2.3
CN_Sam_Pincer_Extn1_R	0	52	2.3
CN_Sam_Pincer_Extn2_L	1	24	3.92
CN_Sam_Pincer_Extn2_R	1	24	3.94
CN_Sam_Presser_wings	0	53	2.47
CN_Sam_Spring_arm_assy	6	1	15.43
CN_Sam_Stage_Top	11	0	28.98
CN_BB_Jig_Back_Left	5	10	12.8
CN_BB_Jig_Back_Measure	1	13	3.02
CN_BB_Jig_Back_Right	5	10	12.8
CN_BB_Jig_Front_Left	4	57	12.47
CN_BB_Jig_Front_Measure	0	17	0.87
CN_BB_Jig_Front_Right	4	57	12.47
CN_BB_Jig_Left_Measure	1	22	3.6
CN_BB_Jig_Right_Measure	1	22	3.6

CN_BB_Jig_Undercarriage	4	49	12.12
CN_BB_Jig_XYTable	5	33	13.98
CN_BB_Jig_Y_Lim	0	38	2.09
CN_F_Ardu_strut_BL	1	49	5.8
CN_F_Ardu_strut_BR	1	49	5.8
CN_F_Ardu_strut_TL	1	49	5.8
CN_F_Ardu_strut_TR	1	49	5.8
CN_F_DM3_Mount	2	12	6.32
CN_F_OM_QR_Plate	9	43	27.37
CN_F_Overmount	9	33	26.48
CN_F_UM_Opt_gripper	1	42	4.63
CN_F_UM_Opt_Gripper_washer	0	3	0.16
CN_F_UM_Opt_to_QR_F	2	40	7.81
CN_F_Undercarriage_platform	8	36	23.99
CN_SD_2020_End_cap	0	13	0.46
CN_SD_2020_Protector	0	23	0.9
CN_SD_Aft_clip	0	5	0.07
CN_SD_Aft_Hole_cover	0	34	1.84
CN_SD_Aft_Left	16	13	67.98
CN_SD_Aft_Mid	15	2	54.76
CN_SD_Aft_Right	16	12	67.98
CN_SD_Aft_Rivet_block	0	9	0.39
CN_SD_DIN_End_Protector	0	20	0.86
CN_SD_DIN_Foot_Protector	0	48	2.3
CN_SD_Dorsal_Key_head	0	10	0.38
CN_SD_Dorsal_Key_key	0	7	0.35
CN_SD_Dorsal_Key_main	0	4	0.1
CN_SD_Dorsal_Key_wedge	0	0.4	0.01
CN_SD_Dorsal_L	15	51	47.81
CN_SD_Dorsal_M	8	40	29.69
CN_SD_Dorsal_R	15	56	48.14
CN_SD_Dorsal_Rivet_plate	0	40	2.1
CN_SD_Dorsal_suture	0	16	0.68

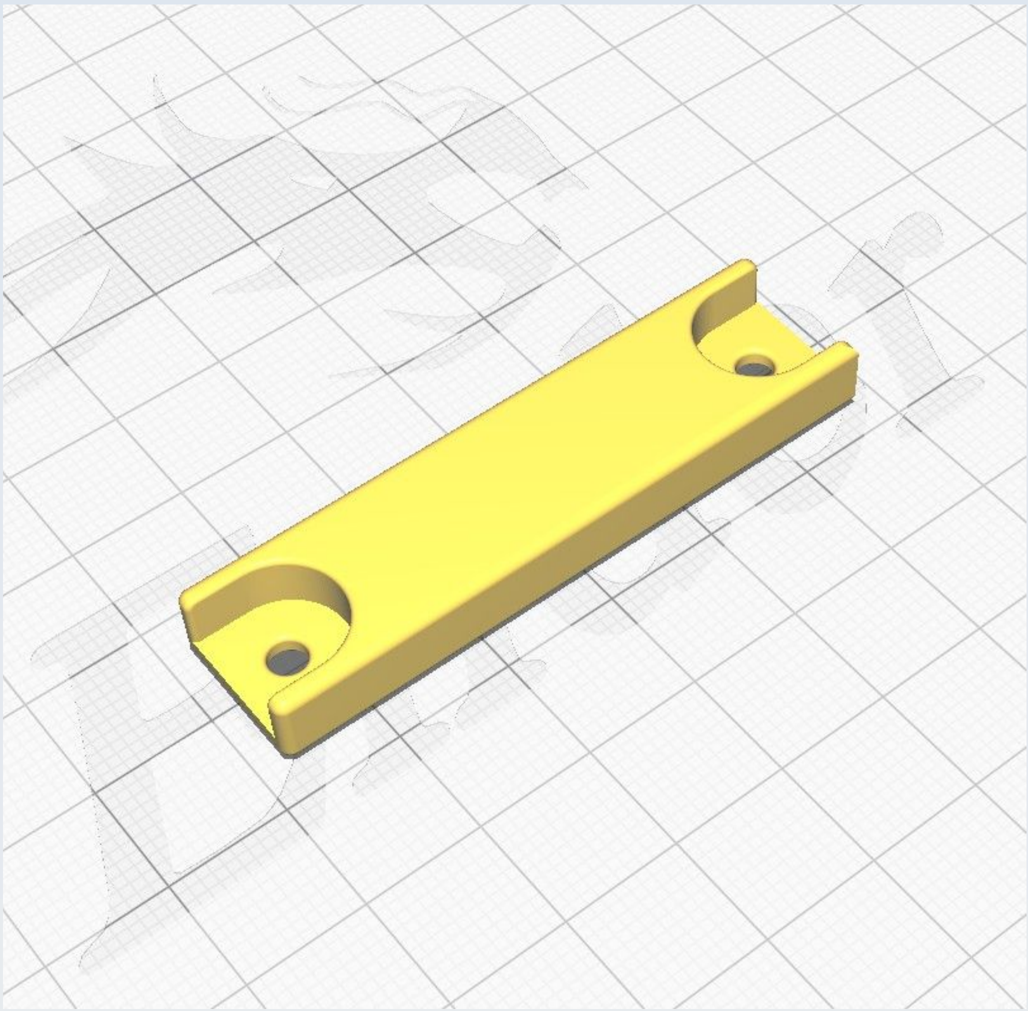
CN_SD_Forward_L	3	50	11.71
CN_SD_Forward_R	3	52	11.72
CN_SD_Forward_Rivet_handle_1	0	4	0.1
CN_SD_Forward_Rivet_handle_2	0	4	0.1
CN_SD_Forward_Rivet_lock	0	9	0.28
CN_SD_Forward_Rivet_tool	0	3	0.12
CN_SD_Forward_suture	0	40	1.86
CN_SD_Lateral_Left	22	47	78.26
CN_SD_Lateral_Right	22	30	78.23
CN_SD_Letters_CNC	0	11	0.52
CN_SD_Letters_PUMA	0	15	0.74
CN_SD_T_nut_positioner	0	4	0.07
CN_SD_XMotor_cover_L	9	2	36.4
CN_SD_XMotor_cover_R	9	2	36.4

CN_PSU_CableFixture_front

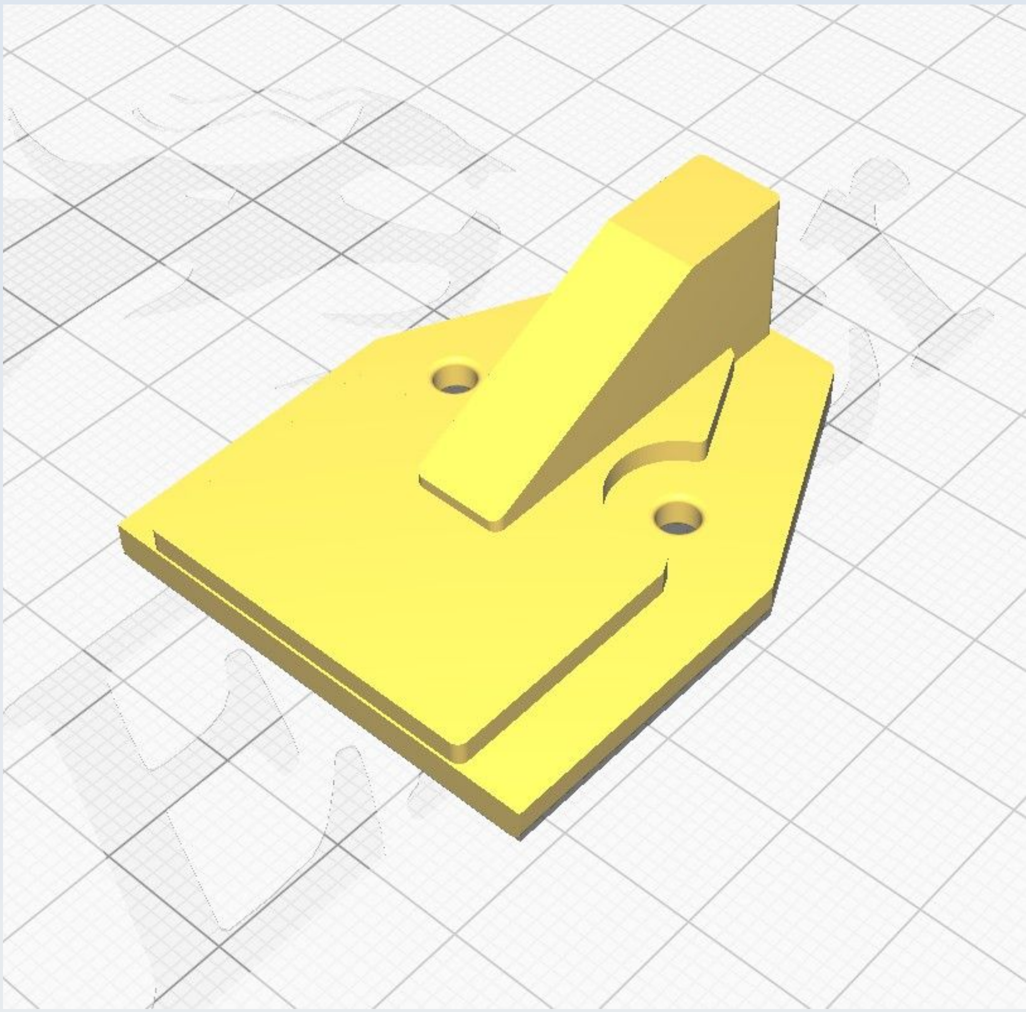


.

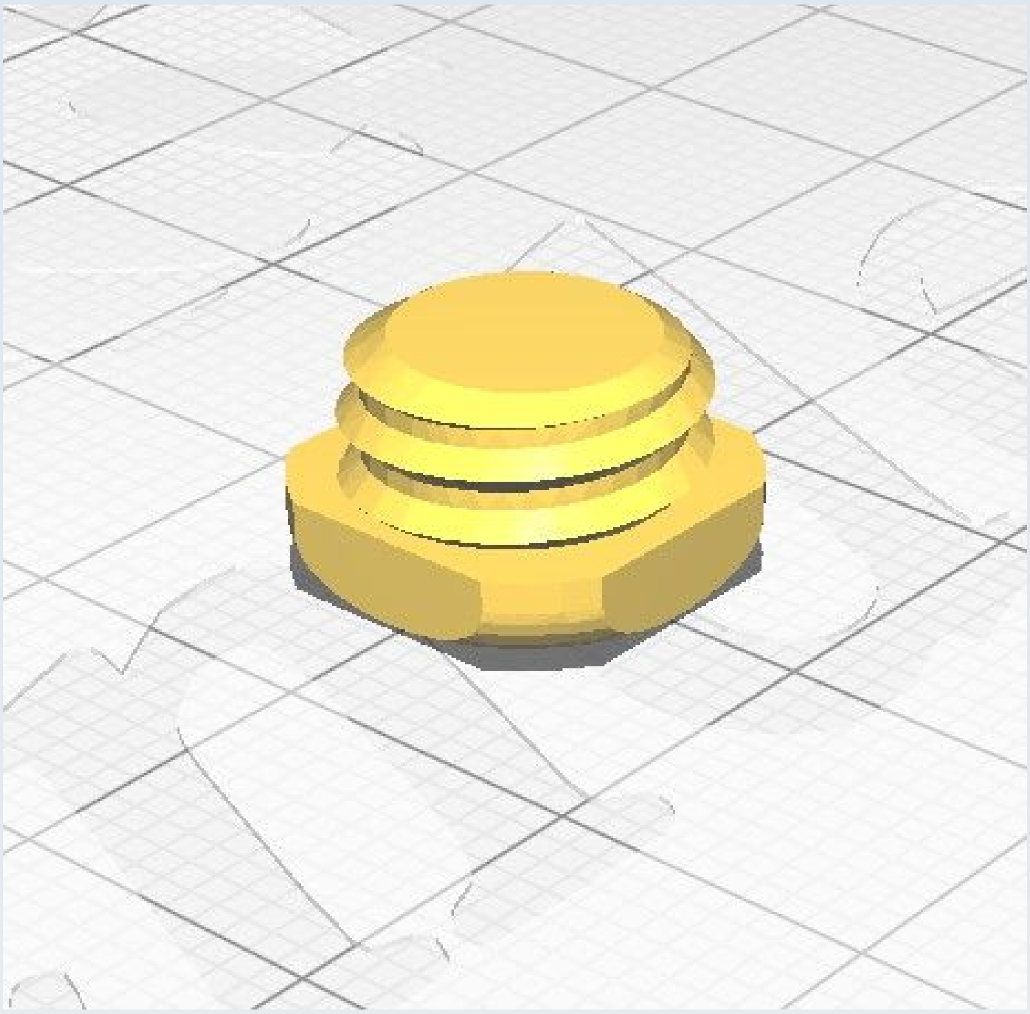
CN_PSU_DC_CableCover



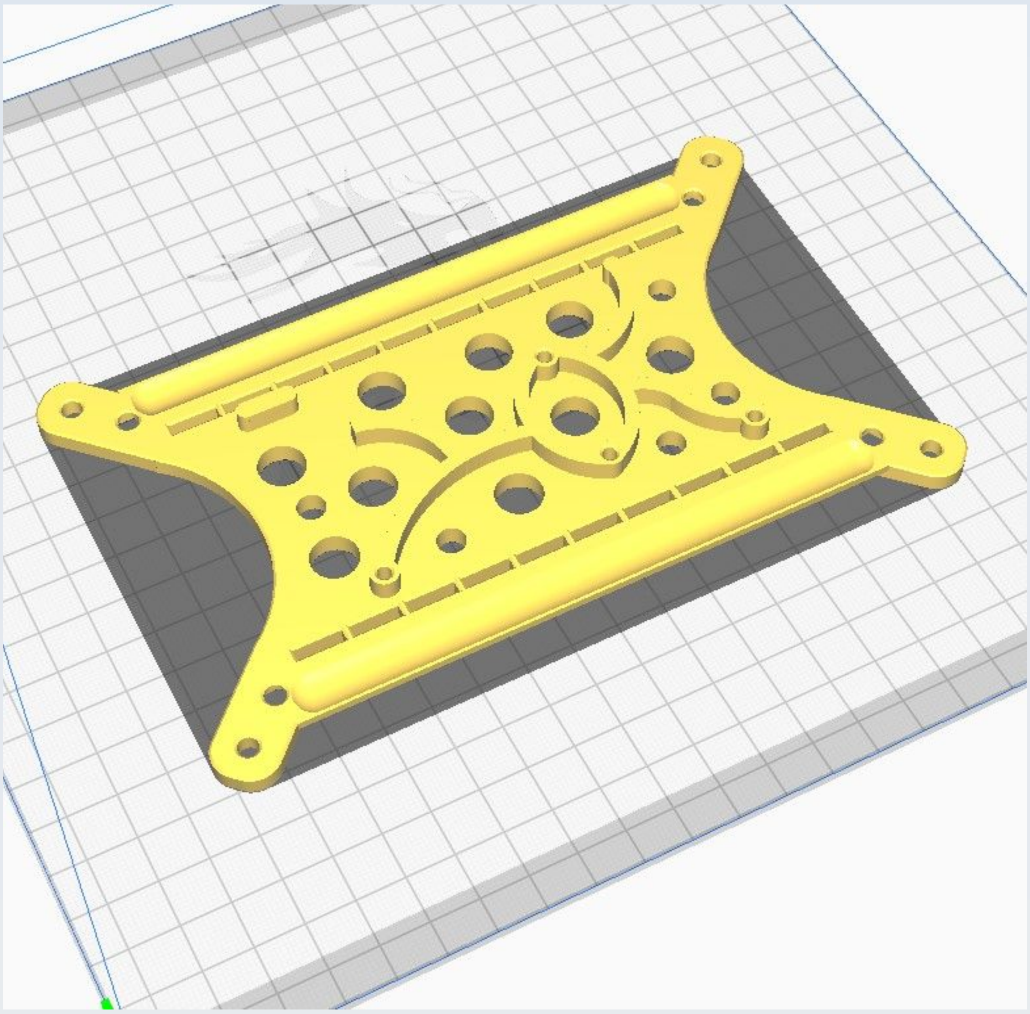
CN_PSU_Mains_CableCover



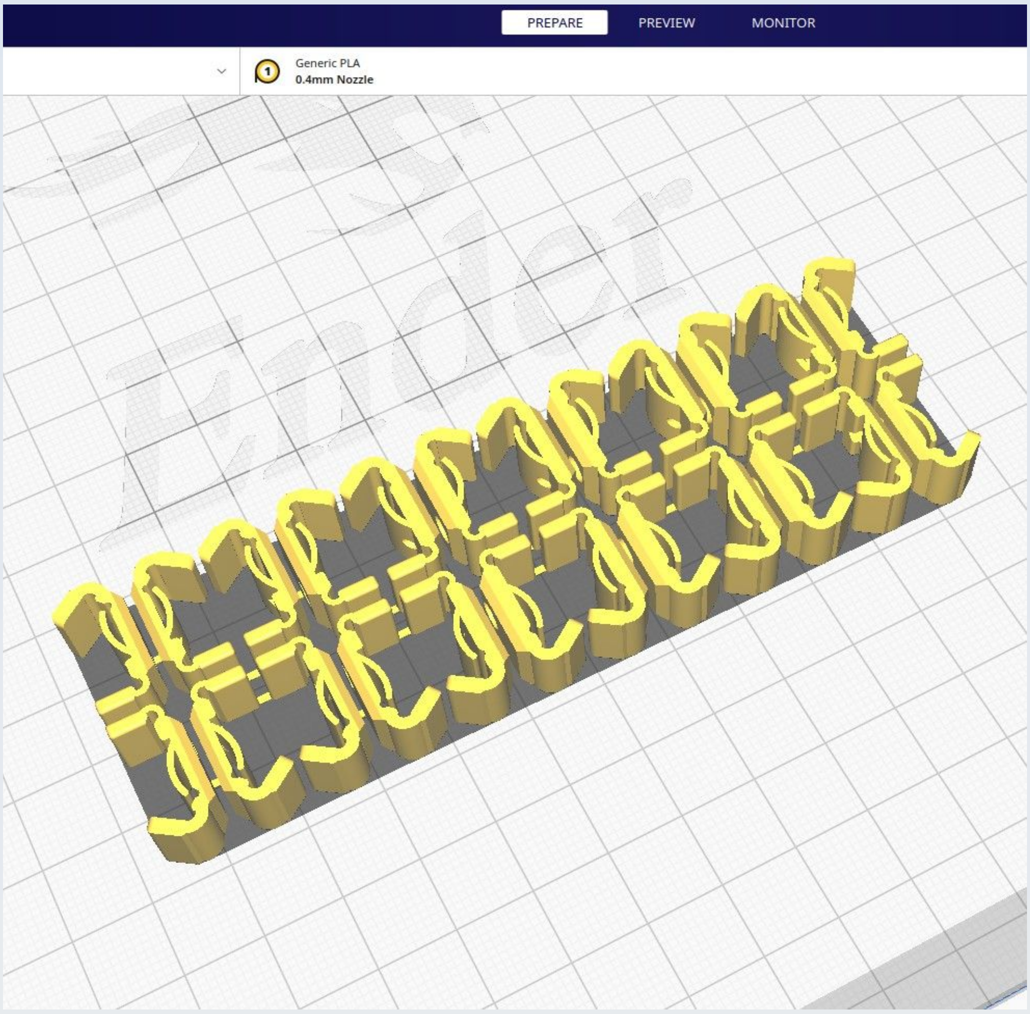
CN_PSU_Peg_Leg



CN_Ardu_bus_bar_mount

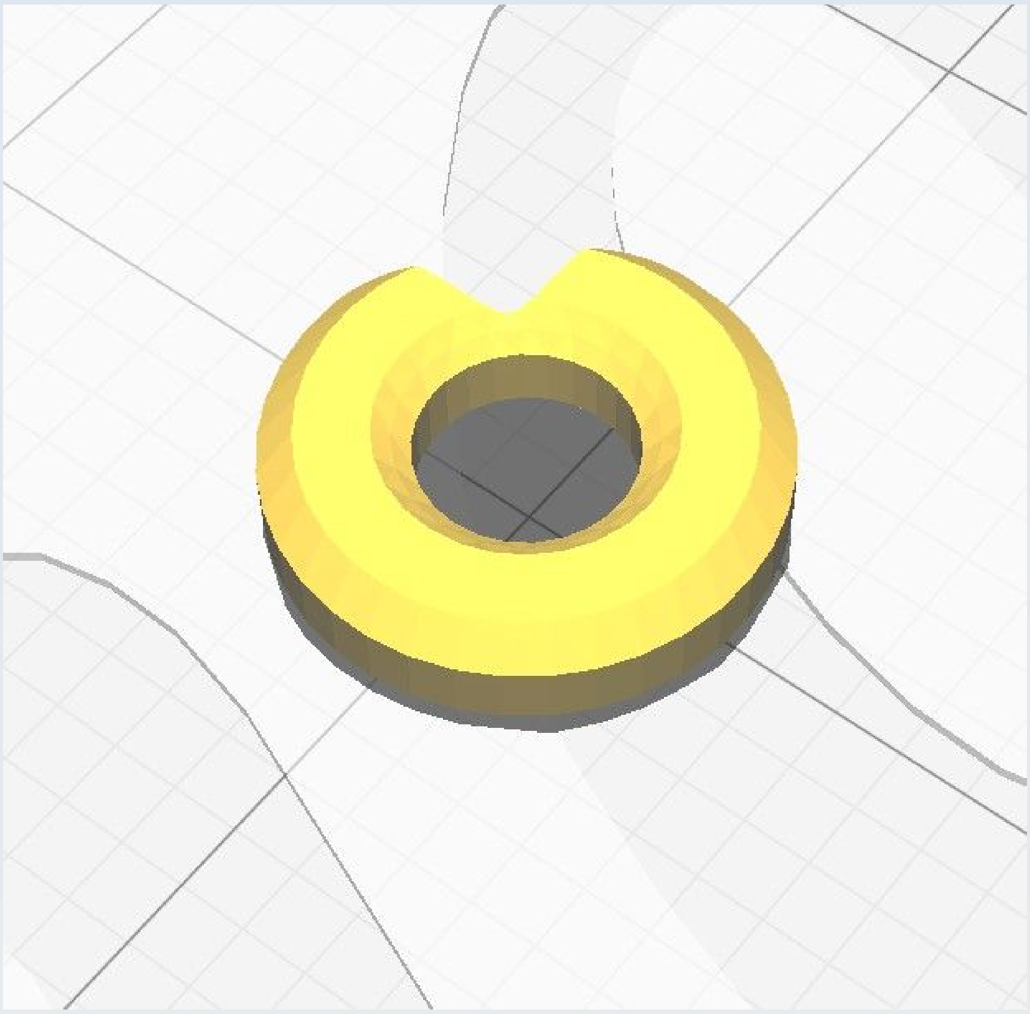


CN_Ardu_Bus_Clip_set



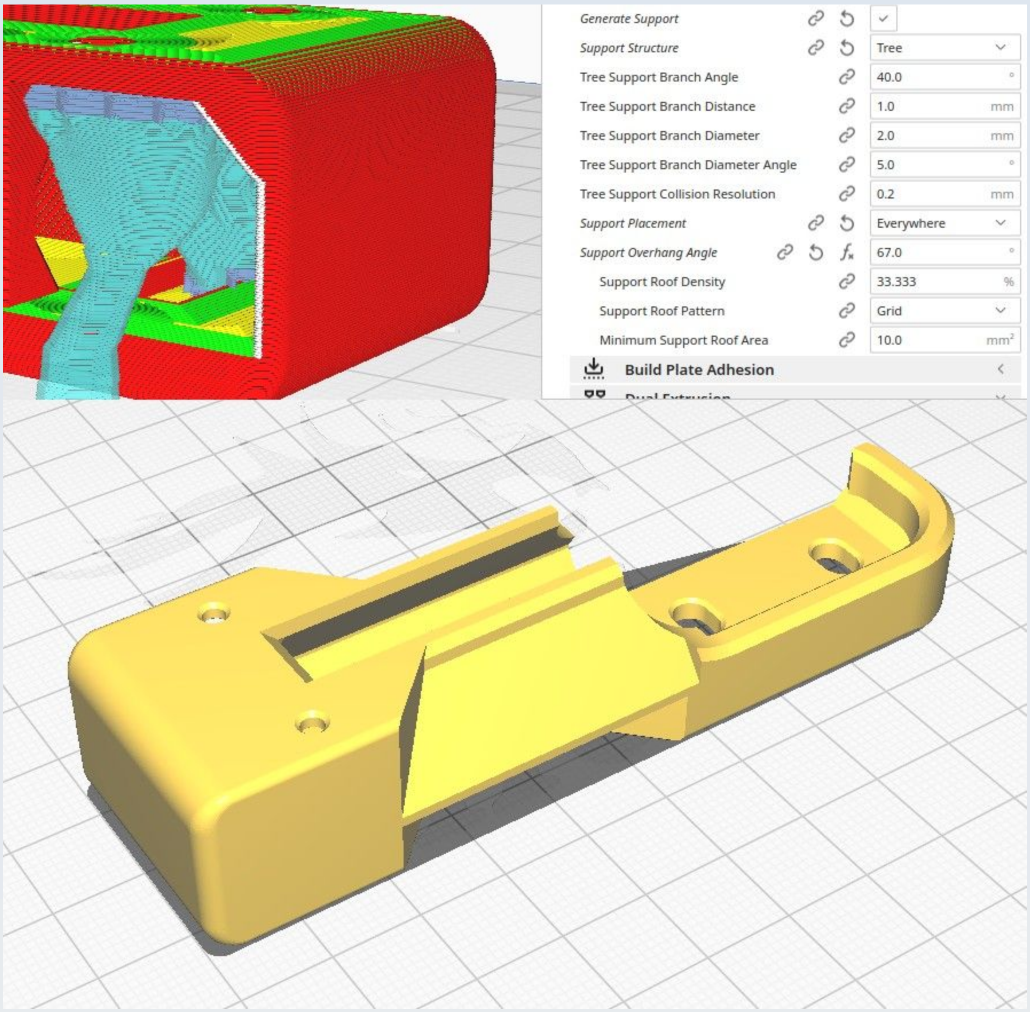
Note: Printing these as a set is convenient, time-saving and allows for better print-bed adhesion but you could print the individual clips in this set separately if you want to. They must be orientated on the print bed on their 'side' as shown in this image, even if only printing one alone.

CN_Ardu_M3_Washer



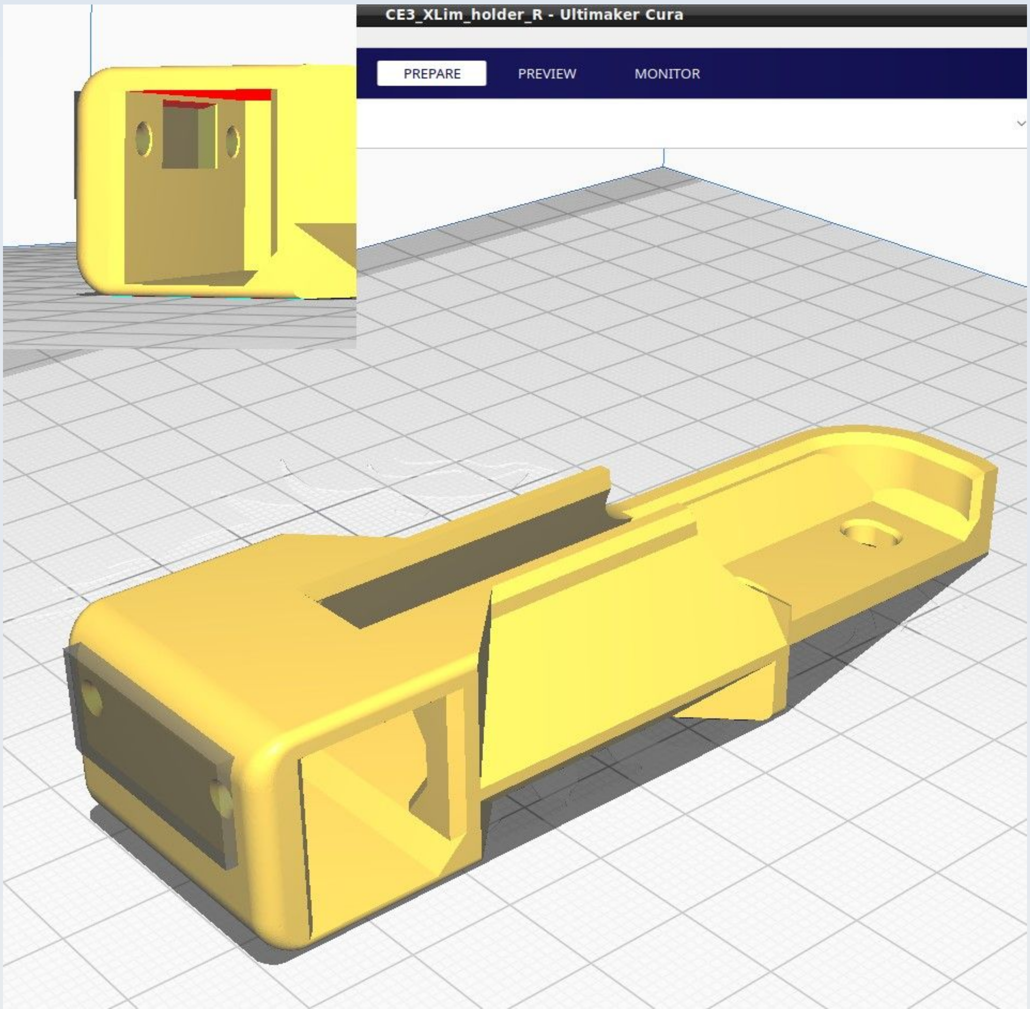
Use ‘Concentric’ for Top/bottom pattern.

CN_X_Lim_Sarcoph_L



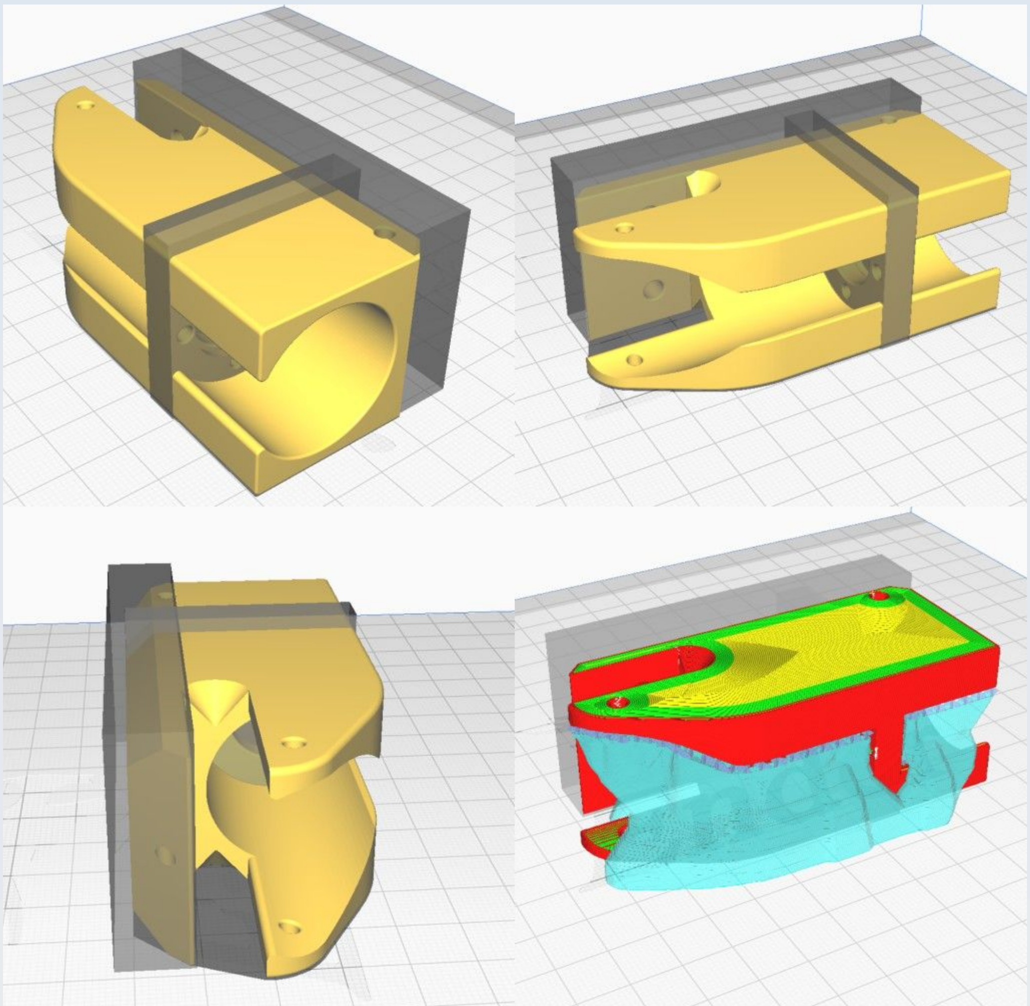
This uses tree supports ‘everywhere’ as shown in the top inset.

CN_X_Lim_Sarcoph_R



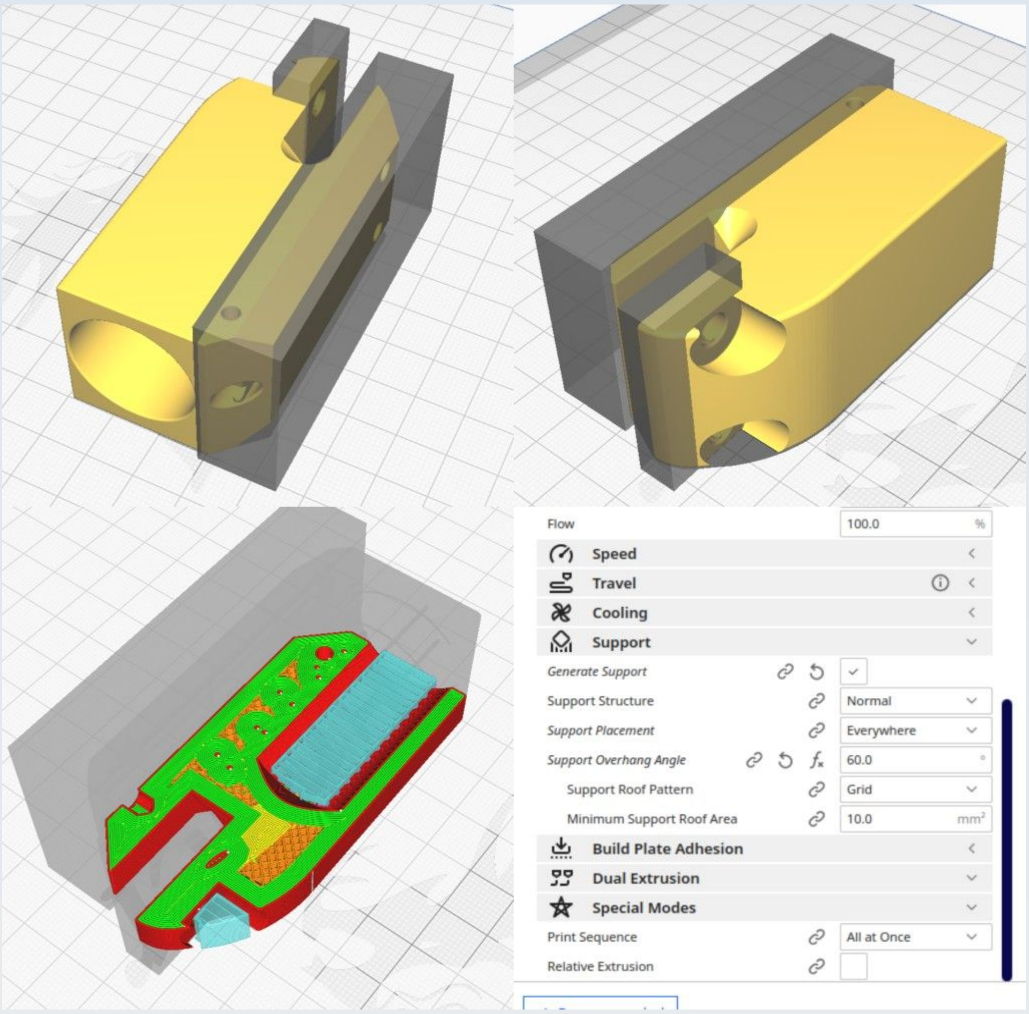
This also uses tree supports (as for CN_X_Lim_Sarcoph_L) but, in addition, there is a support blocker stopping the supports going in the M2 holes and limit switch alcove, as shown.

CN_X_NEMA11_Bracket



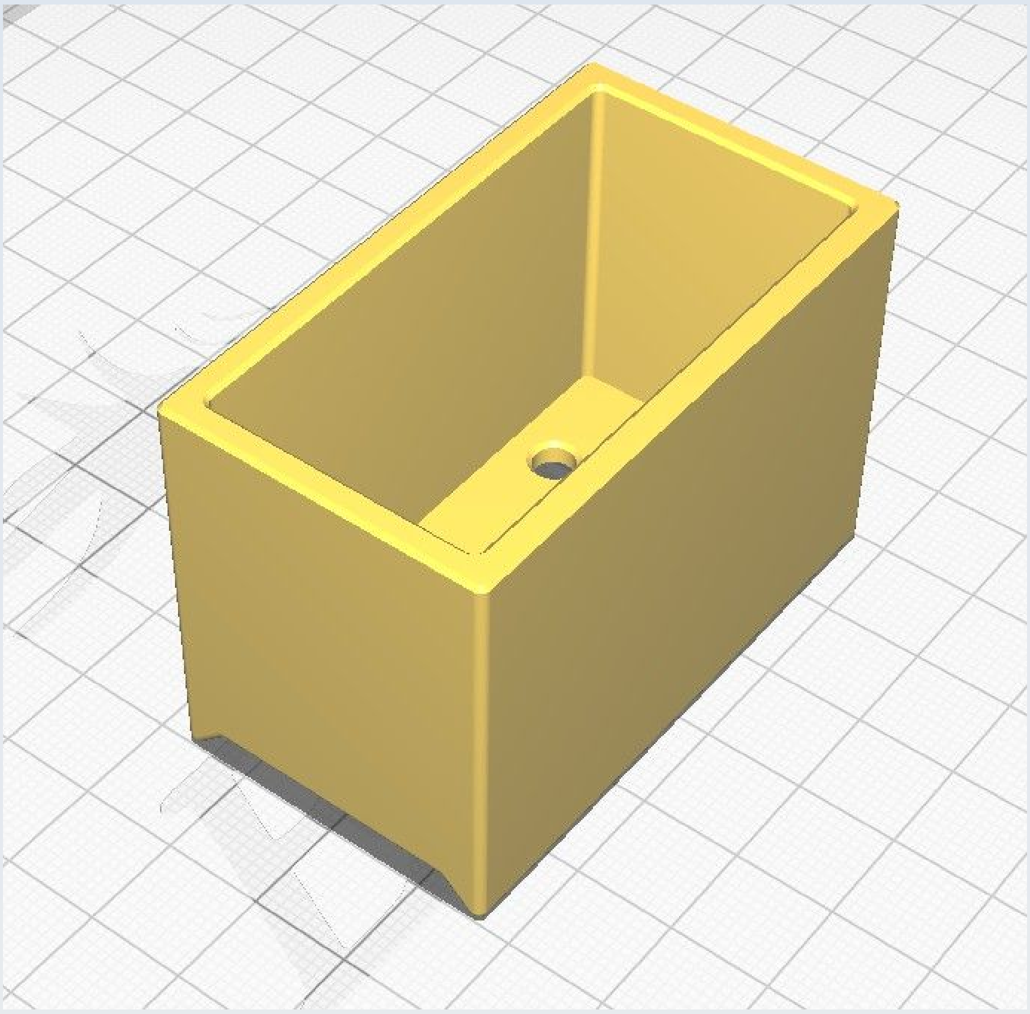
This must be printed on its ‘side’, as shown, in order to achieve the correct strength in the correct directions. Note the position of the support blockers. This uses tree supports ‘everywhere’ with a support overhang angle of 60 degrees. This also uses the concentric pattern for top and bottom layers and zig-zag infill pattern with an infill density of 25%.

CN_X_NEMA11_Counter_weight



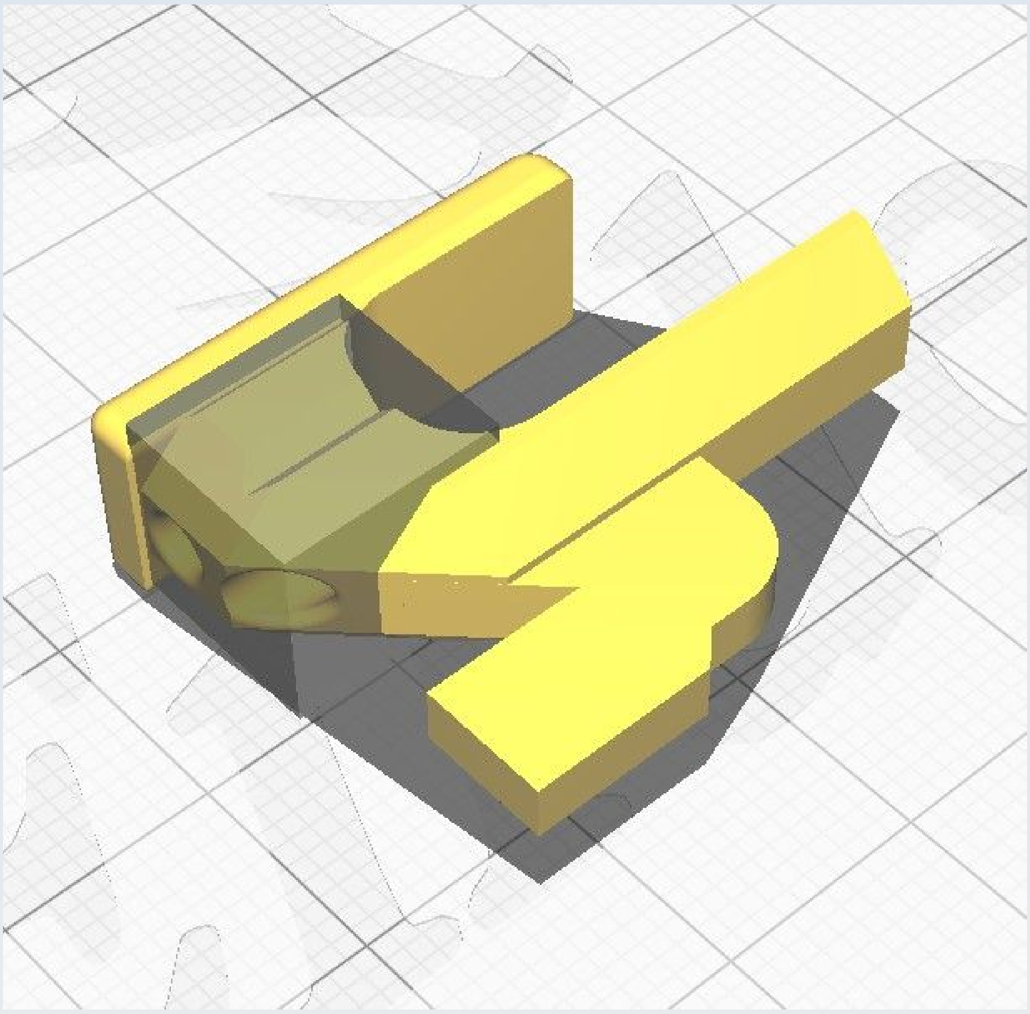
This must be printed on its 'side', as shown, in order to achieve the correct strength in the correct directions. Note the position of the support blockers. This uses normal supports as shown.

CN_X_NEMA11_CW_Hopper



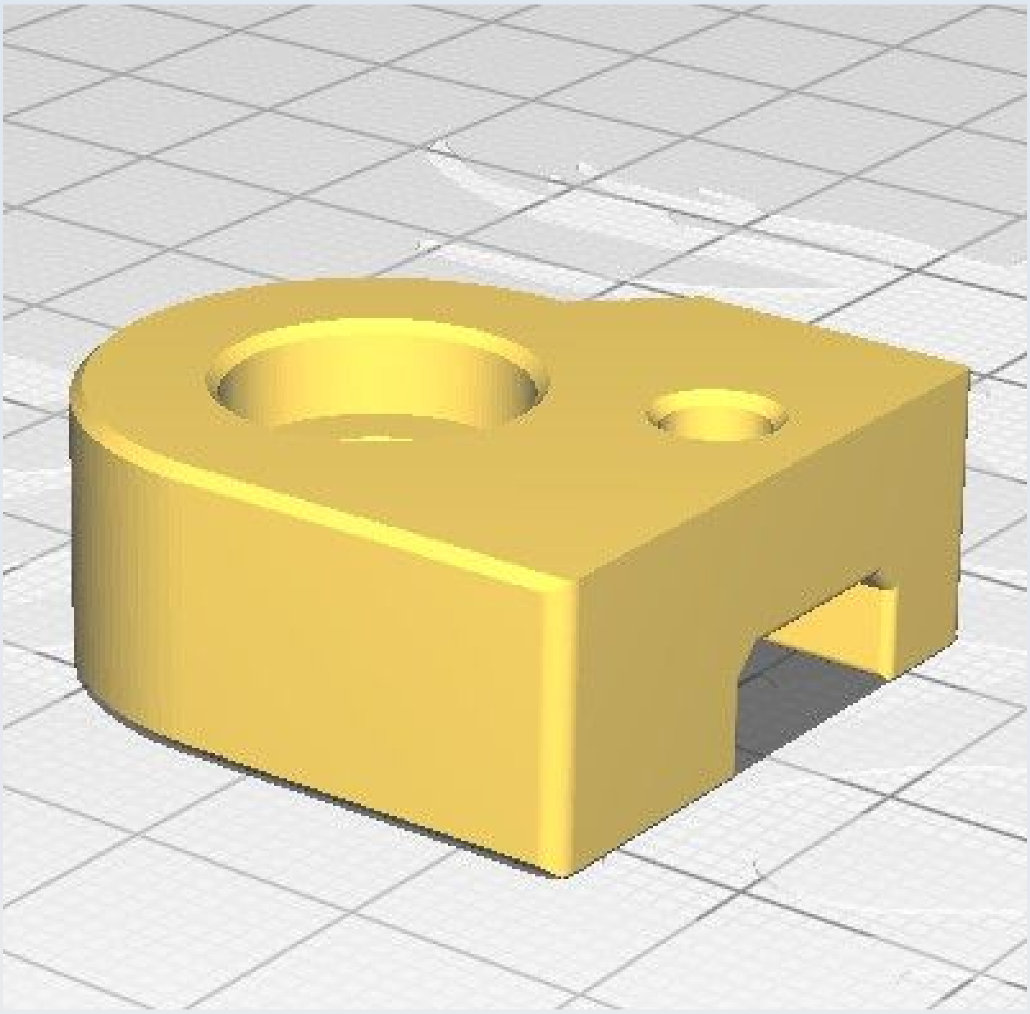
This uses normal supports ‘touching buildplate only’ with a 67 degree overhang limit.

CN_X_Probe



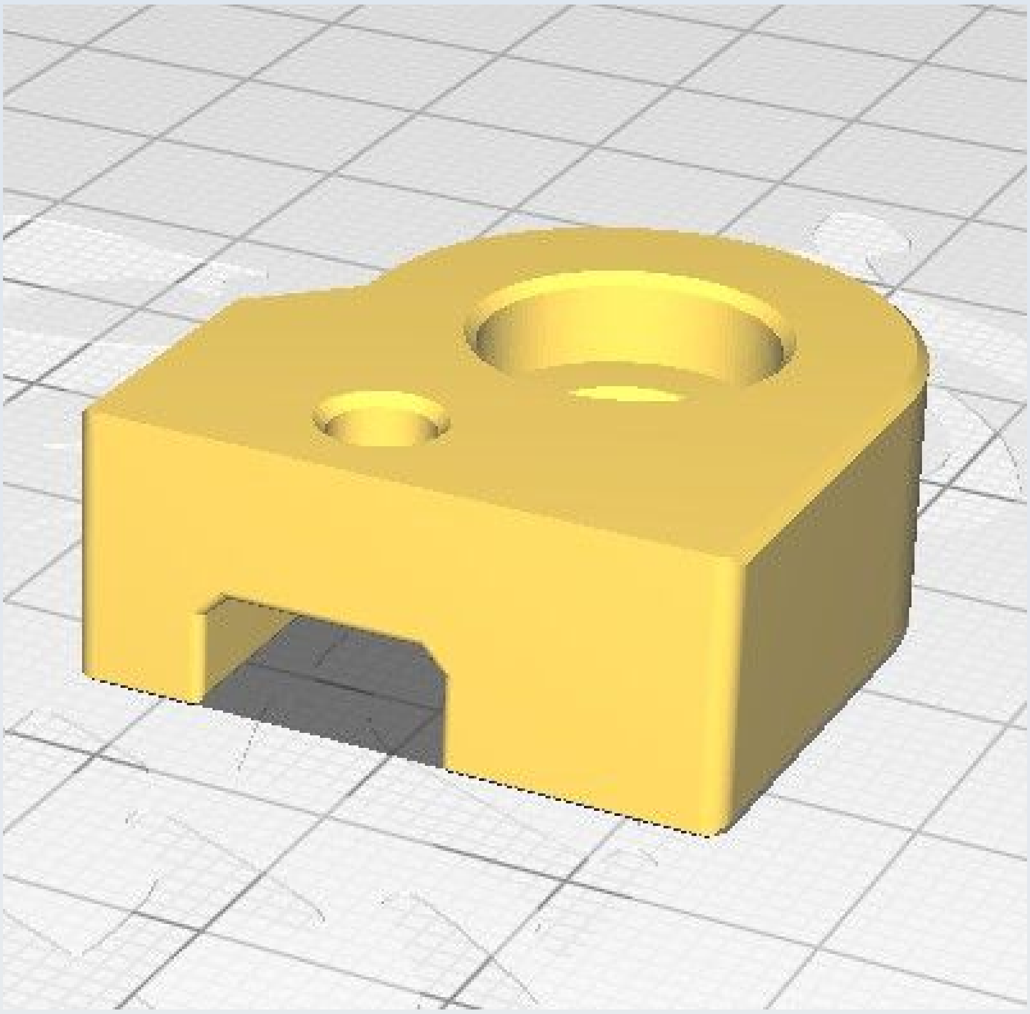
This uses normal supports upto 67 degrees ‘touching buildplate only’. Note the support blocker in the holes.

CN_X_Probe_Housing_L



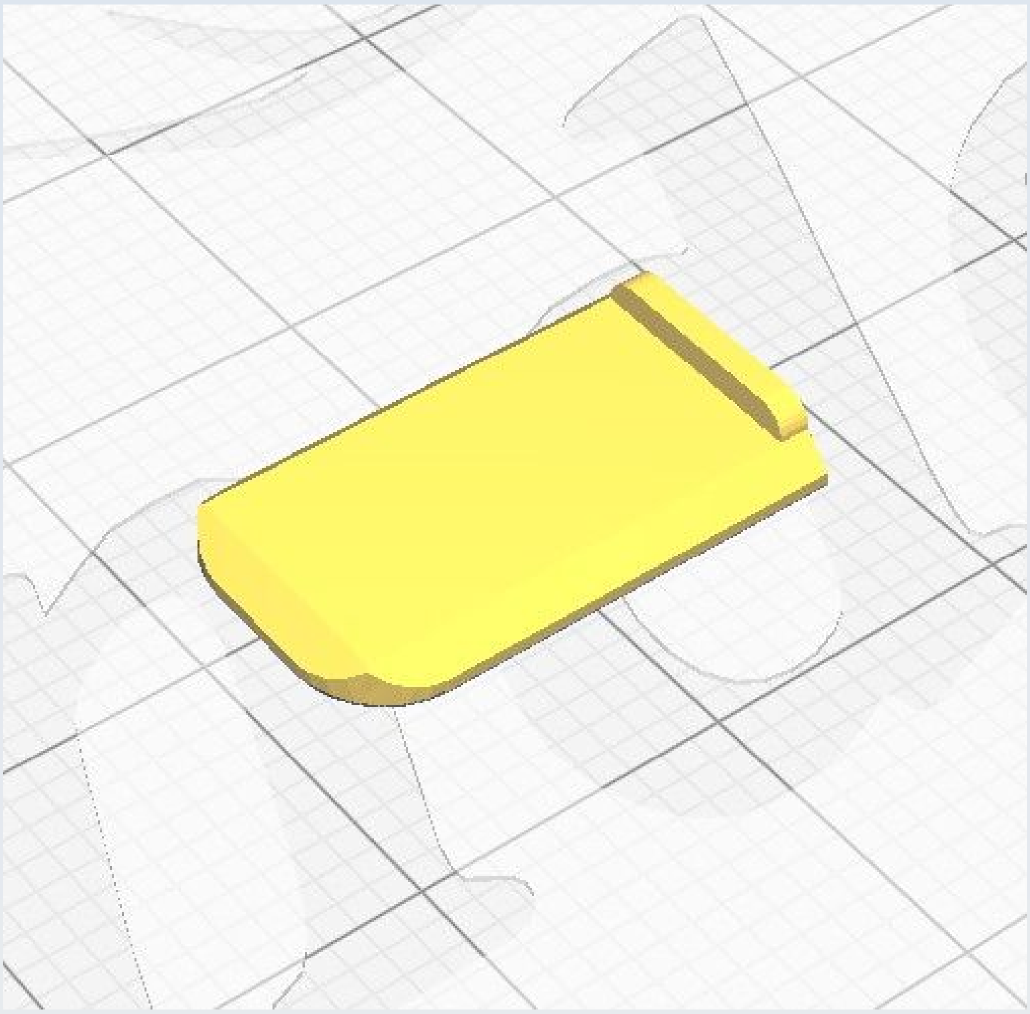
This uses normal supports upto 67 degrees ‘touching buildplate only’.

CN_X_Probe_Housing_R

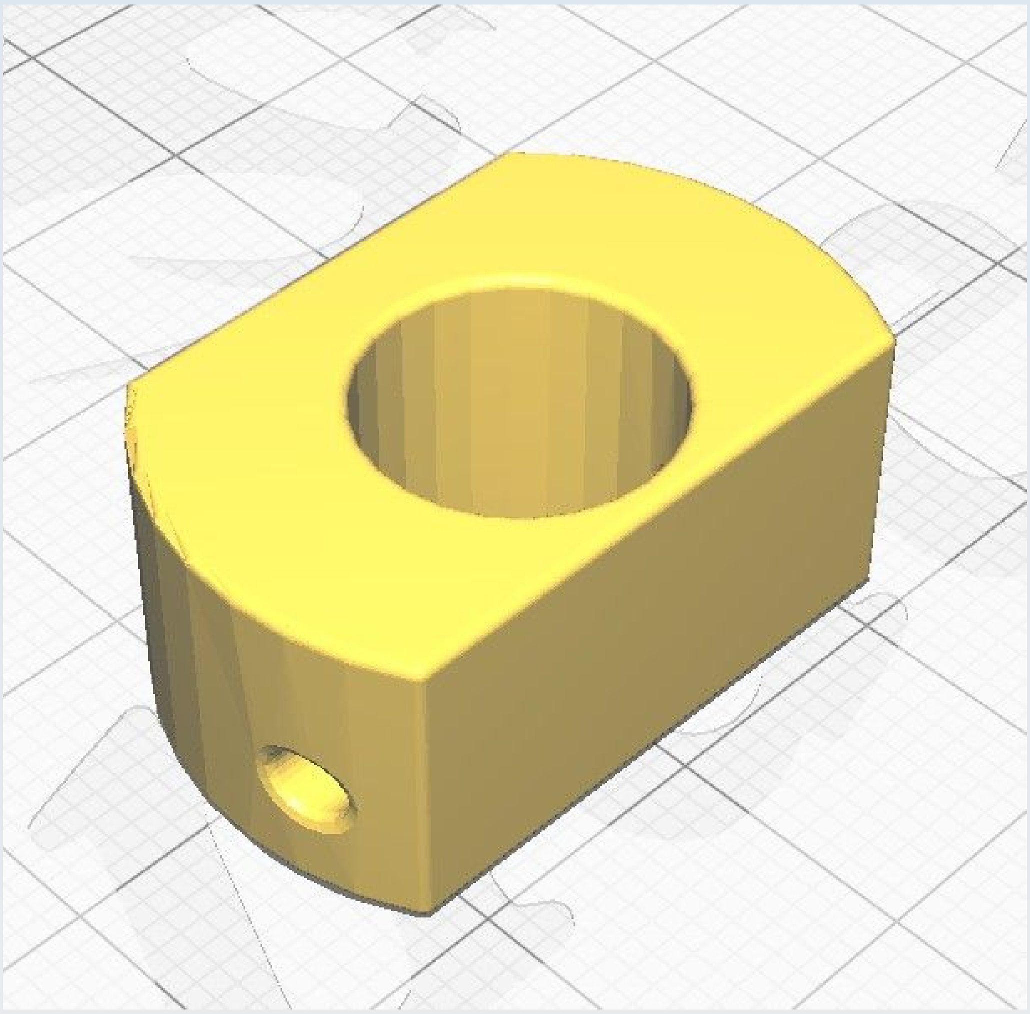


This uses normal supports upto 67 degrees ‘touching buildplate only’.

CN_X_Probe_shim

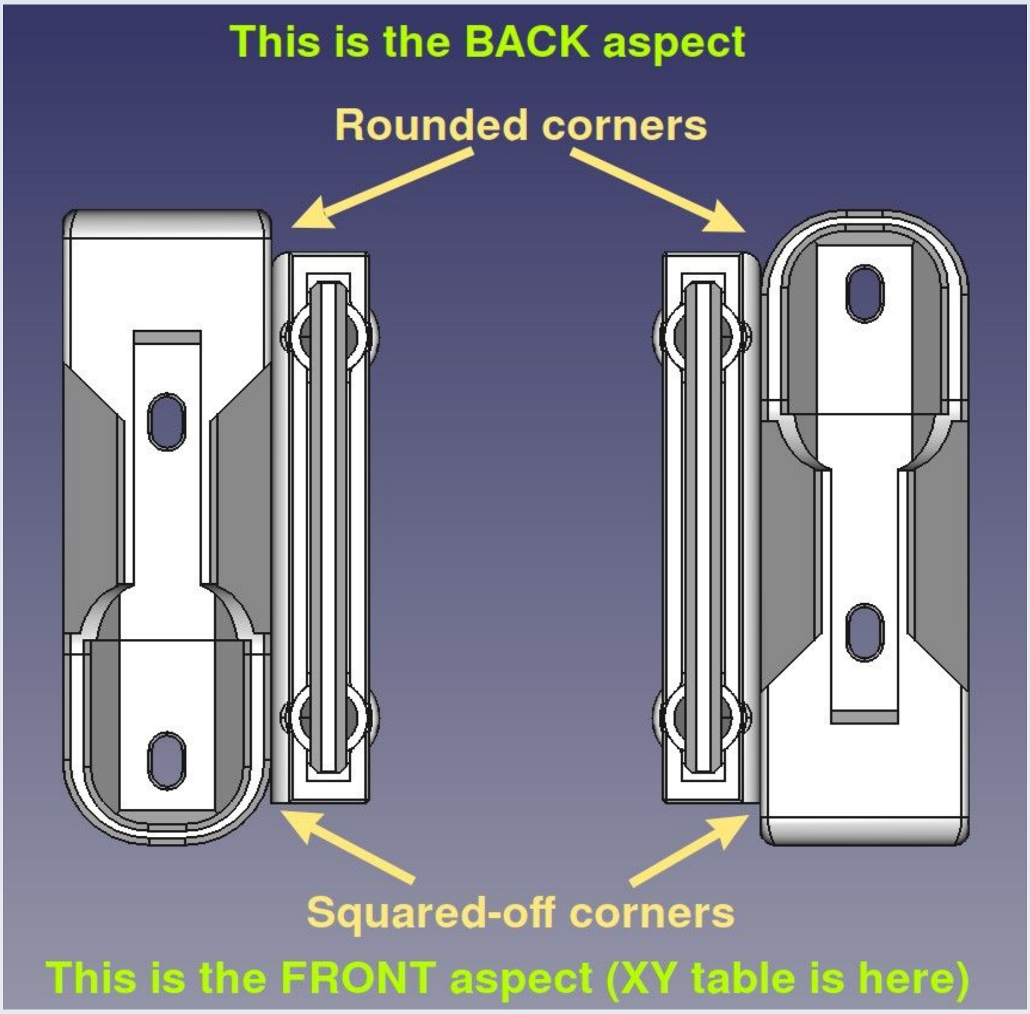


CN_XY_NEMA11_Undertable_Support



Use a ‘Top/bottom Pattern’ of ‘Concentric’.

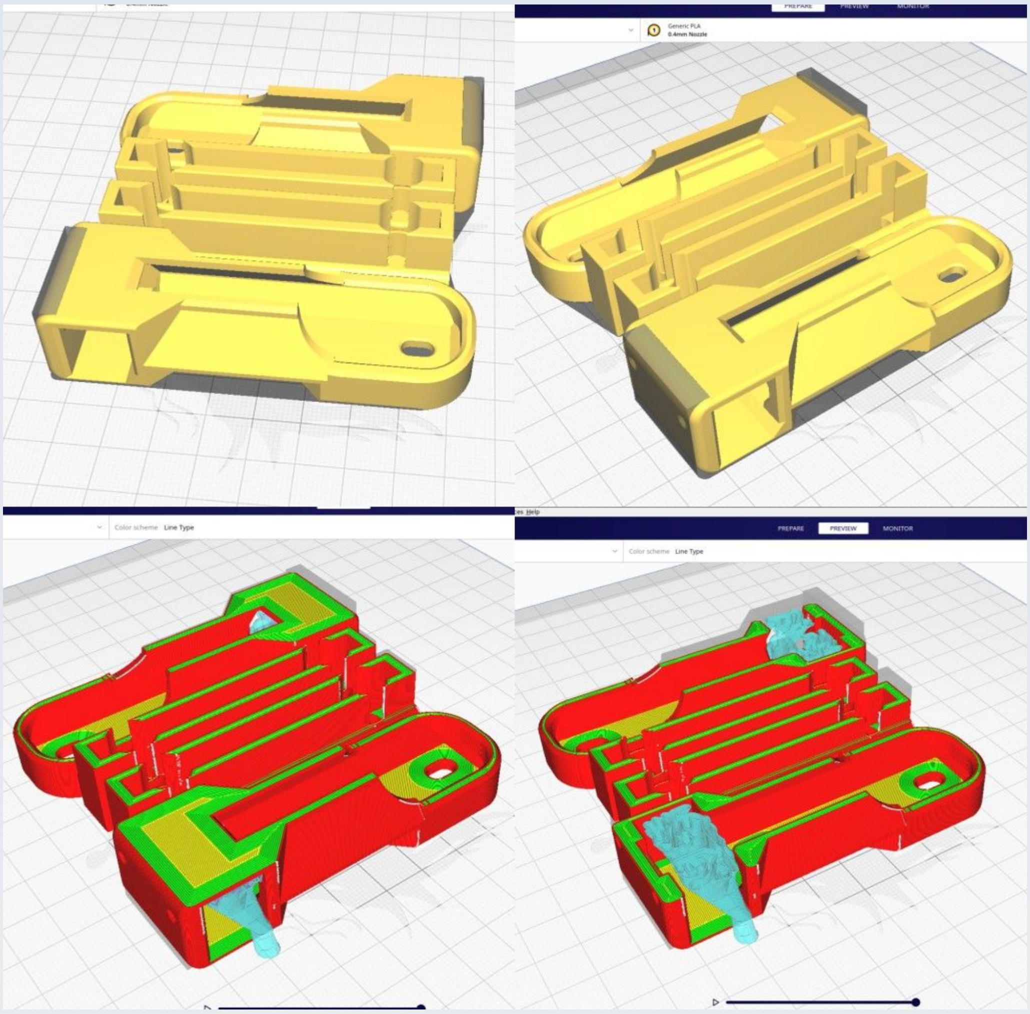
CN_Y_Lim_Sarcoph_Susp_B



This is best printed together with the CN_Y_Lim_Sarcoph_Susp_F (which see for illustration of print bed orientation). Use tree supports and support blockers in the M2 holes just as described for the CN_X_Lim_Sarcoph_R model (which see for details).

The figure illustrates the orientation of the models for fitting on the stage base board. See the section on the CN_Y_Lim_Sarcoph_Susp_F for details.

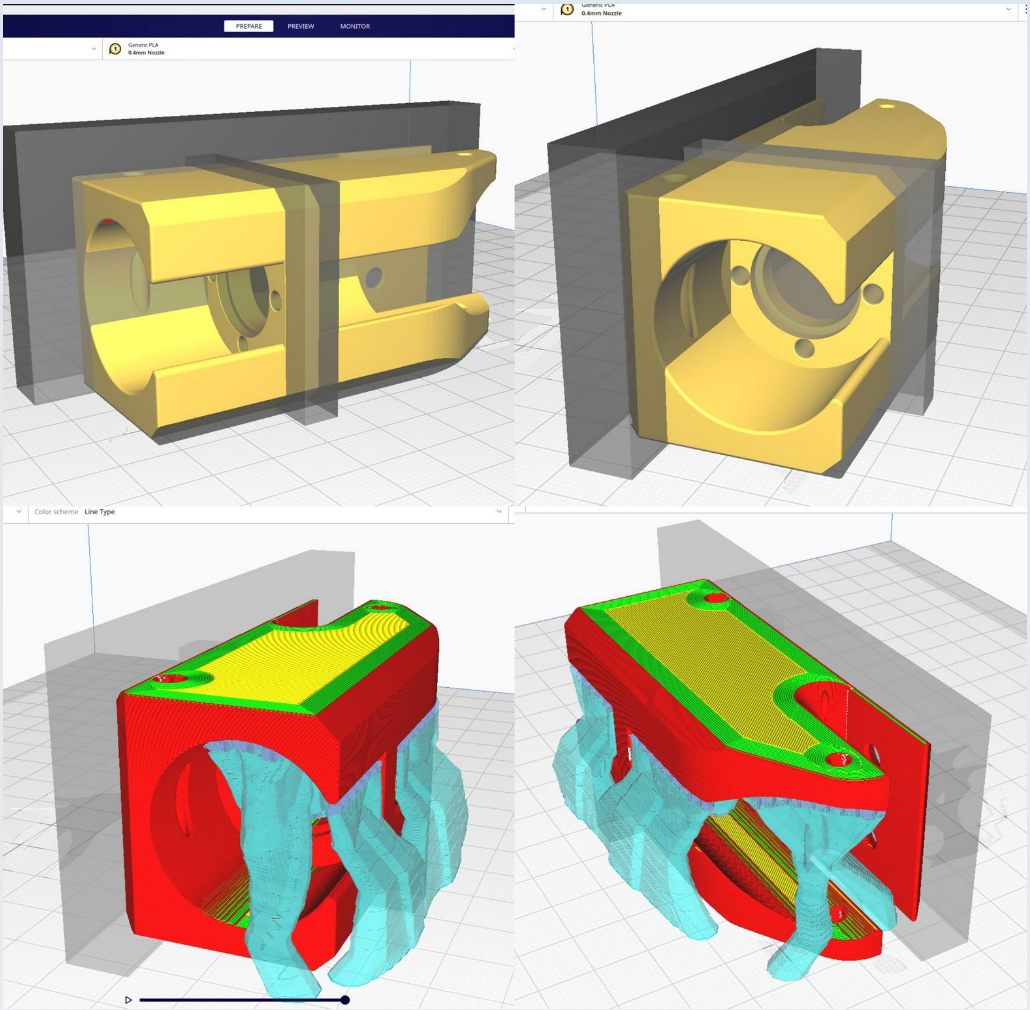
CN_Y_Lim_Sarcoph_Susp_F



This is best printed together with the CN_Y_Lim_Sarcoph_Susp_B as shown. Use tree supports and support blockers in the M2 holes just as described for the CN_X_Lim_Sarcoph_R model (which see for details).

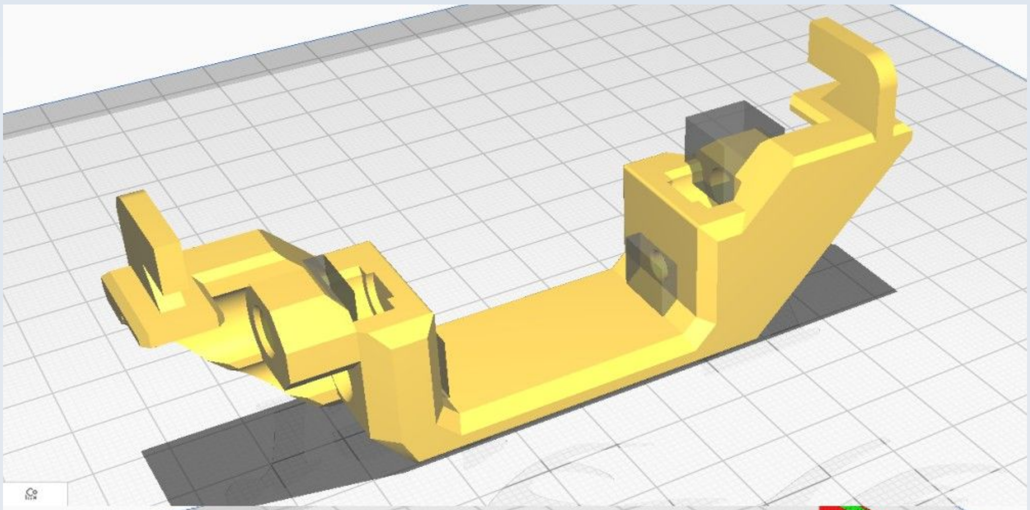
Note on orientation of the printed models: The suspension side-car has a rounded corner adjacent to its sarcophagus at the back and a squared off corner connection to its sarcophagus at the front. This is illustrated in the CN_Y_Lim_Sarcoph_Susp_B section (which see). The front is where the XY table is siutated.

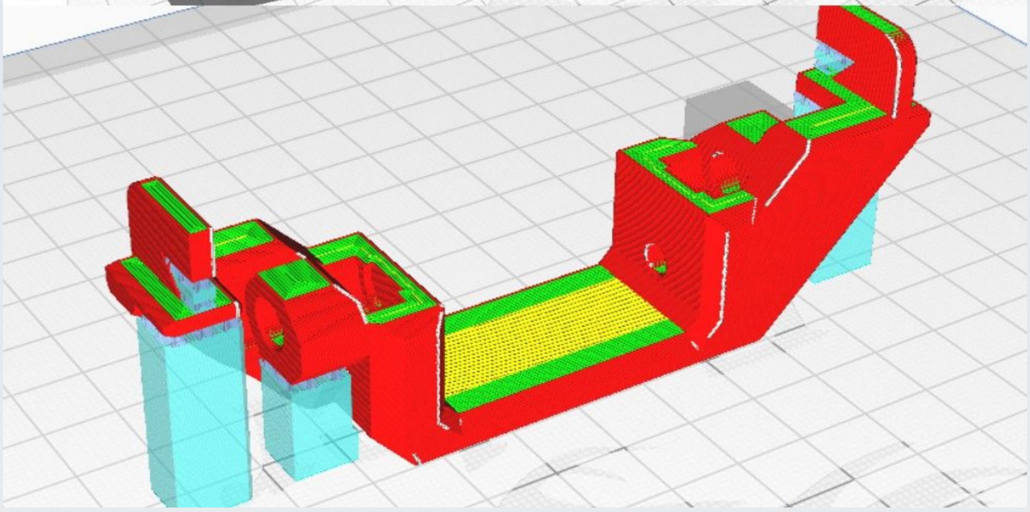
CN_Y_NEMA11_Bracket



This is printed on its ‘side’ with support blockers as shown and using tree supports. This is similar to the CN_X_NEMA11_Bracket (which see for more detail).

CN_Y_Probe_Susp_Nemesh



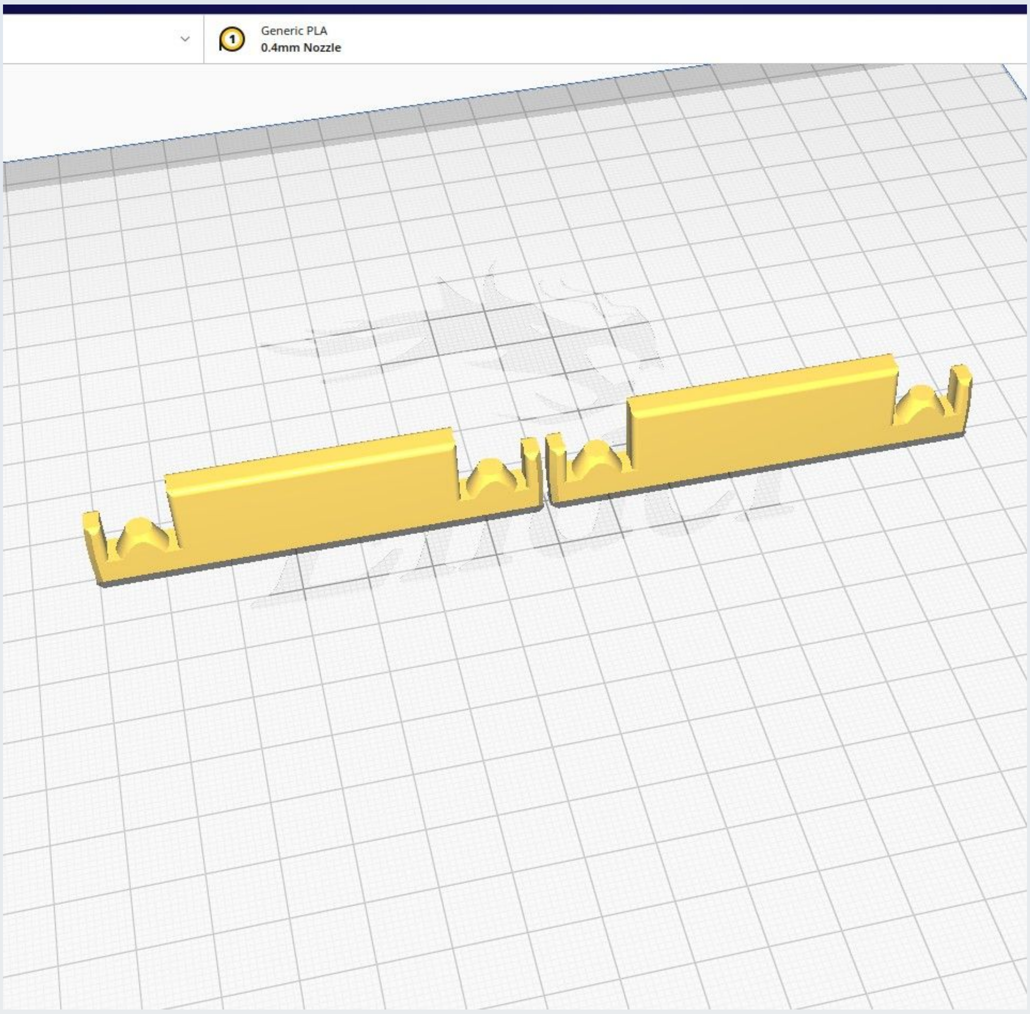


This is printed with normal supports ‘everywhere’ with a 67 degree overhand angle and with support blockers as shown.

CN_Y_Suspension_platform_B

This is the same as the CN_Y_Suspension_platform_F model and the two are best printed together as shown in the illustration below.

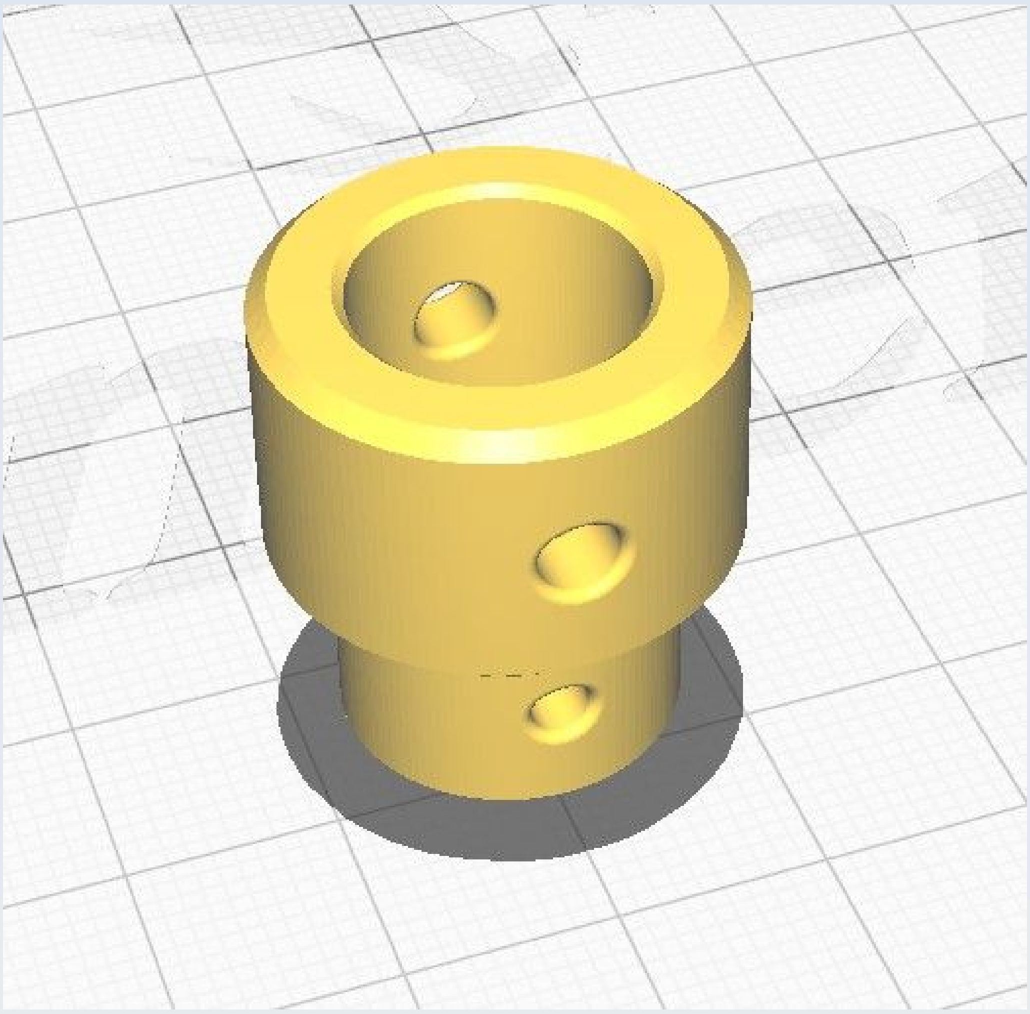
CN_Y_Suspension_platform_F



This is best printed with the CN_Y_Suspension_platform_B, as shown. The two models are actually identical, separation into ‘F’ and ‘B’ types is purely for admin purposes.

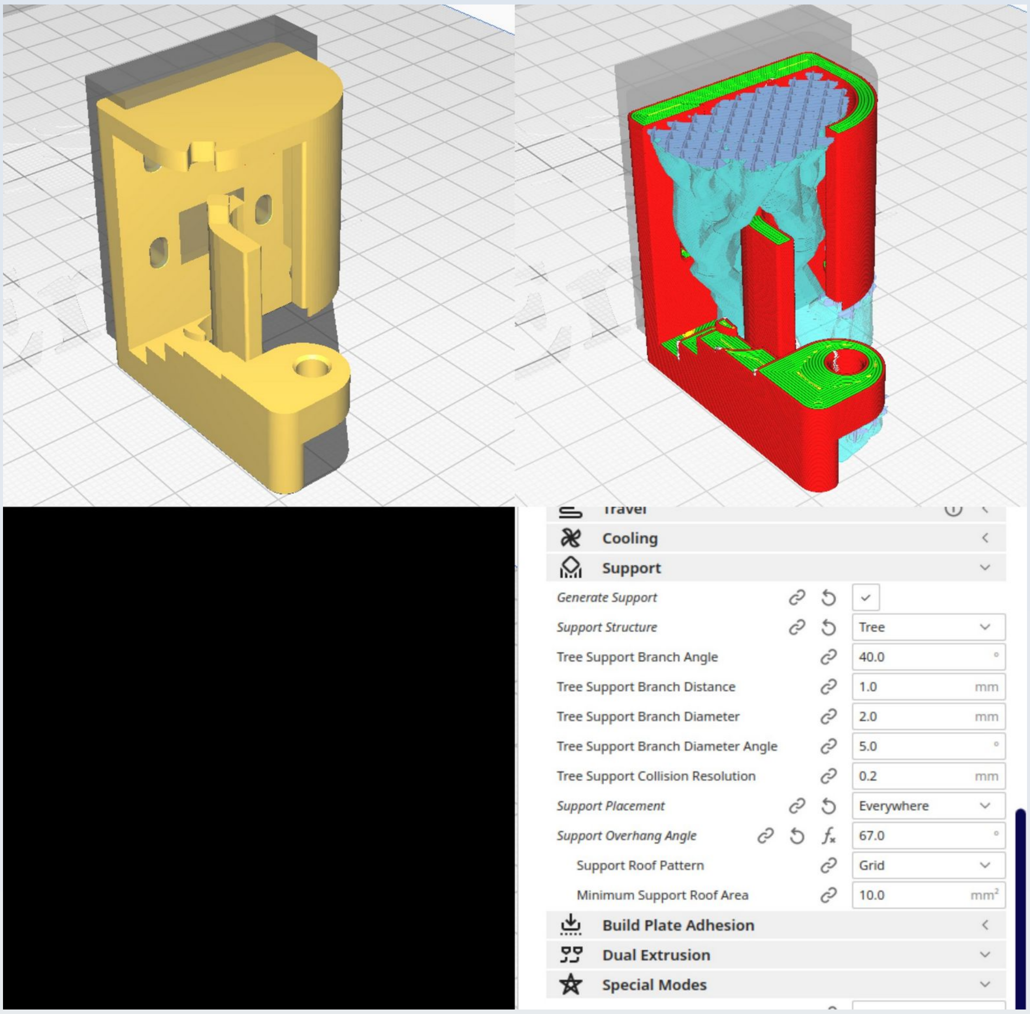
The orientation may not seem optimal (and it is not optimal for part strength in the thin end-parts) but it is optimal for producing a flat surface for the suspension rollers to traverse (the surface that is applied to the print bed) and hence for producing a ‘smooth ride’ for the precision mechanism. The thin end parts will not be under strain when fully fitted into their suspension side-cars so optimal strength is not needed here and so strength can be sarcrificed for the benefit of precision – hence the preferred build plate orientation is as shown.

CN_Z_Coupler



Use ‘concentric’ for both the Top/bottom pattern and the infill pattern. No supports are used.

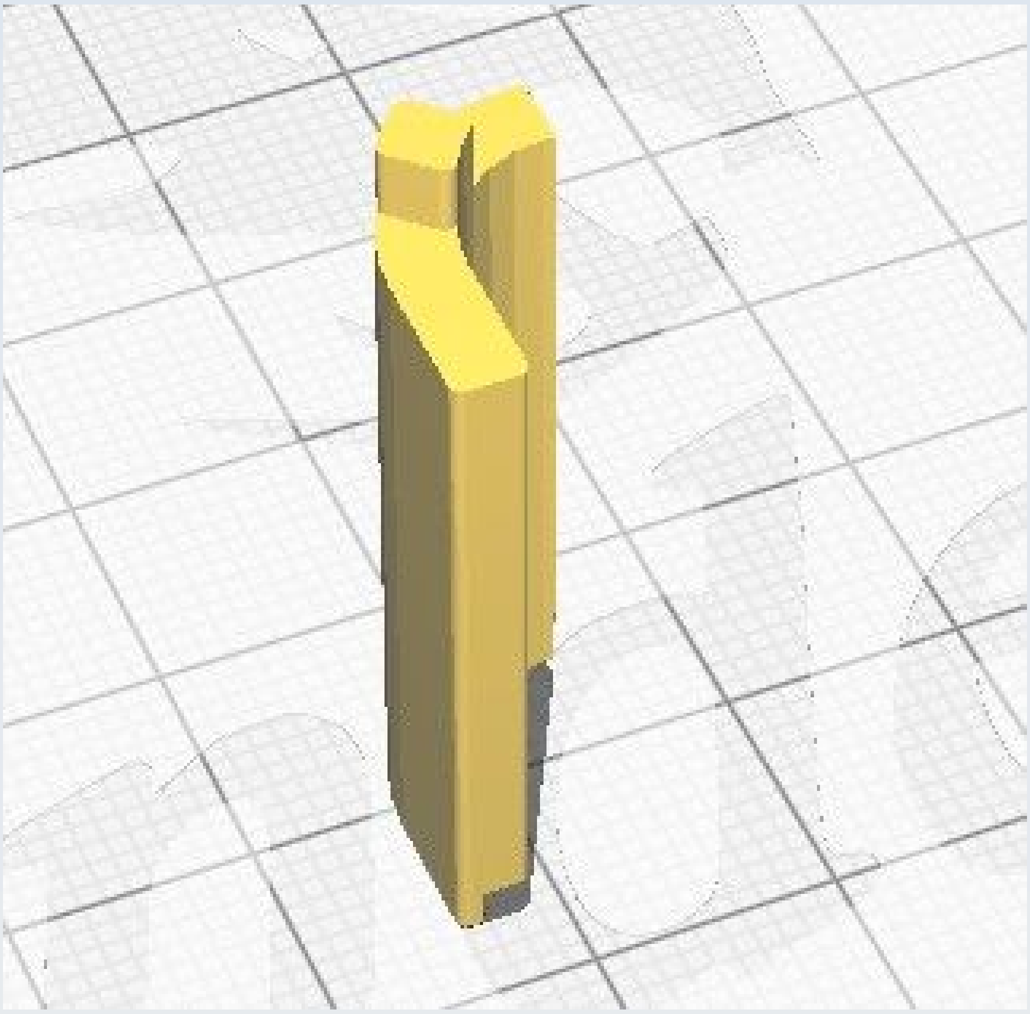
CN_Z_Lim_Attachment



Use tree supports and support blockers as shown.

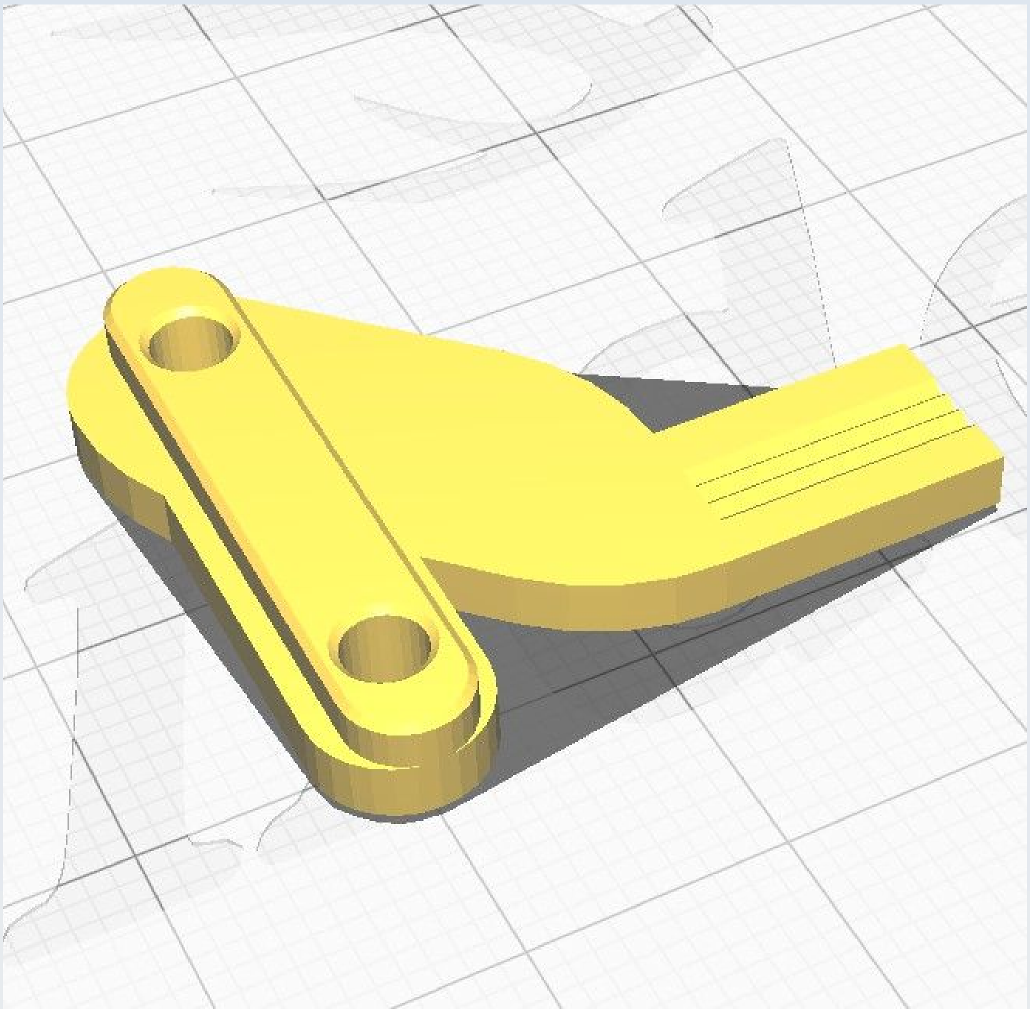
Note that I am also printing the CN_Z_Lim_Back_baffle model in here to save time. You can print it separately if you wish (see CN_Z_Lim_Back_baffle).

CN_Z_Lim_Back_baffle

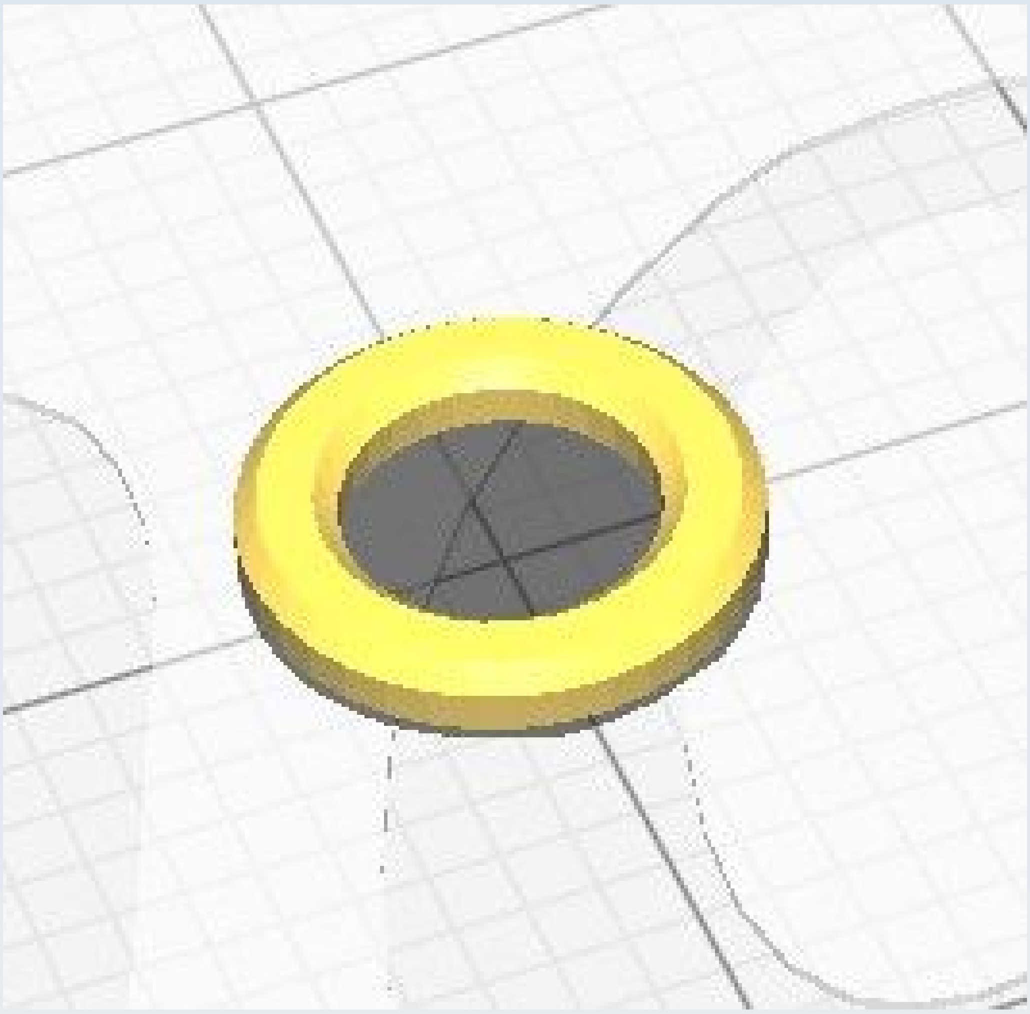


Some form of supports must be used. Note that you could either print it separately as shown here or you could print it altogether with the CN_Z_Lim_Attachment model – as is illustrated in the figure in the section for that model.

CN_Z_Lim_Probe



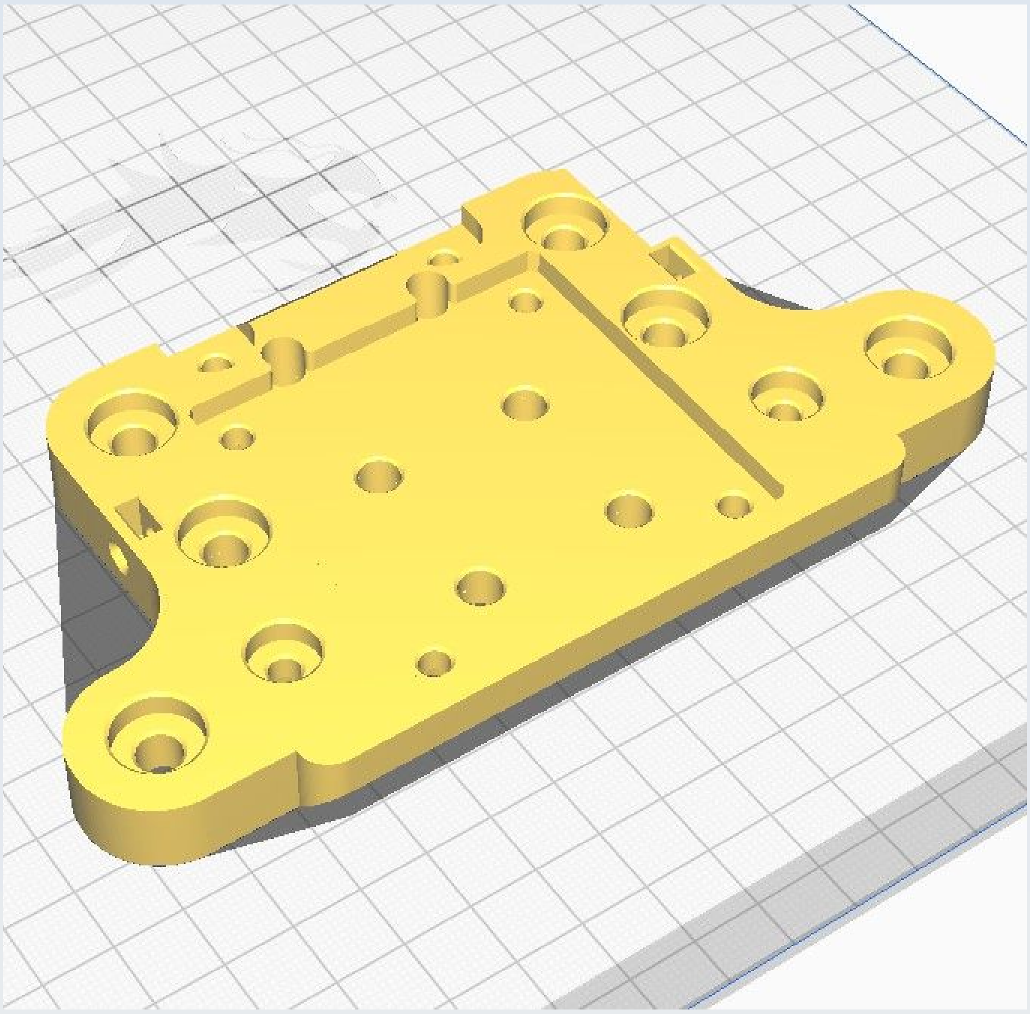
CN_Z_M4_small_washer



Use ‘concentric’ for ‘Top/bottom pattern’.

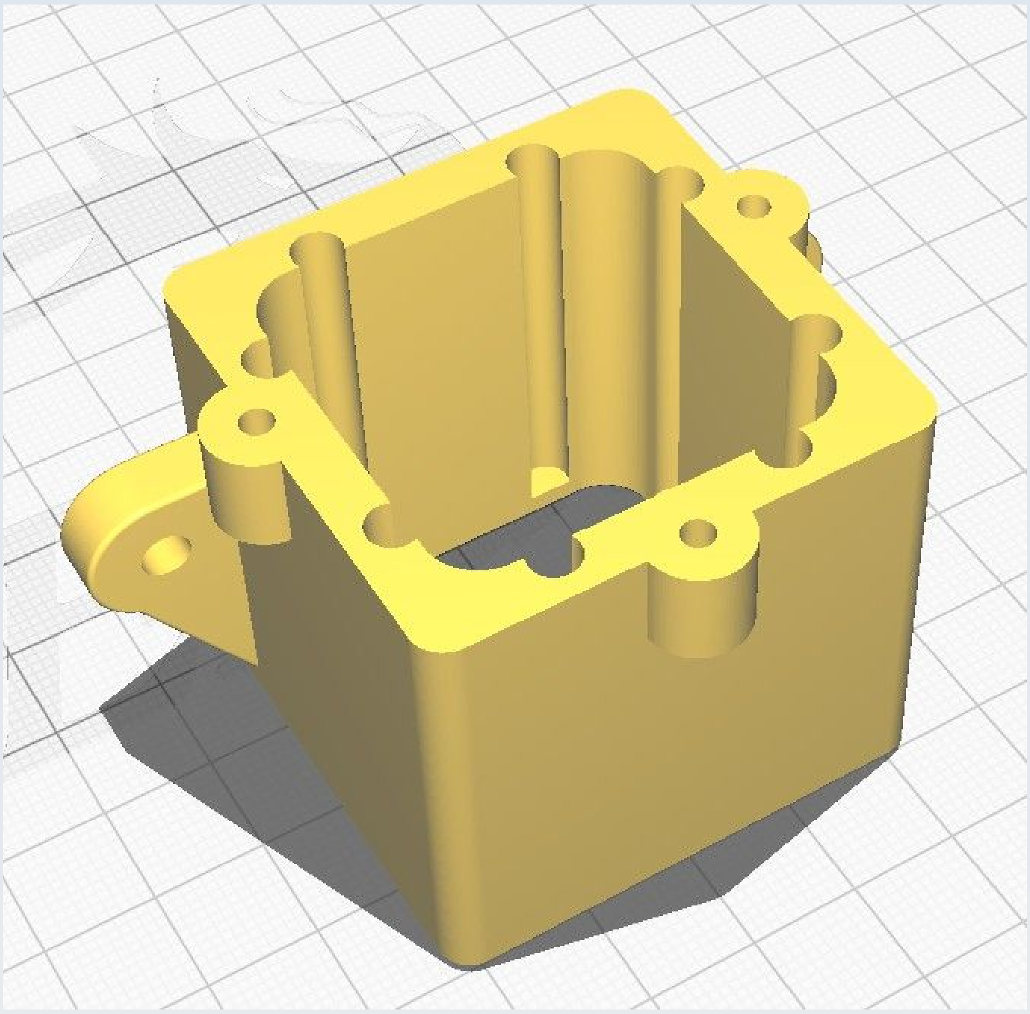
Might as well print multiple of these all at once because it is very quick to print and you will need at least 4.

CN_Z_Mount

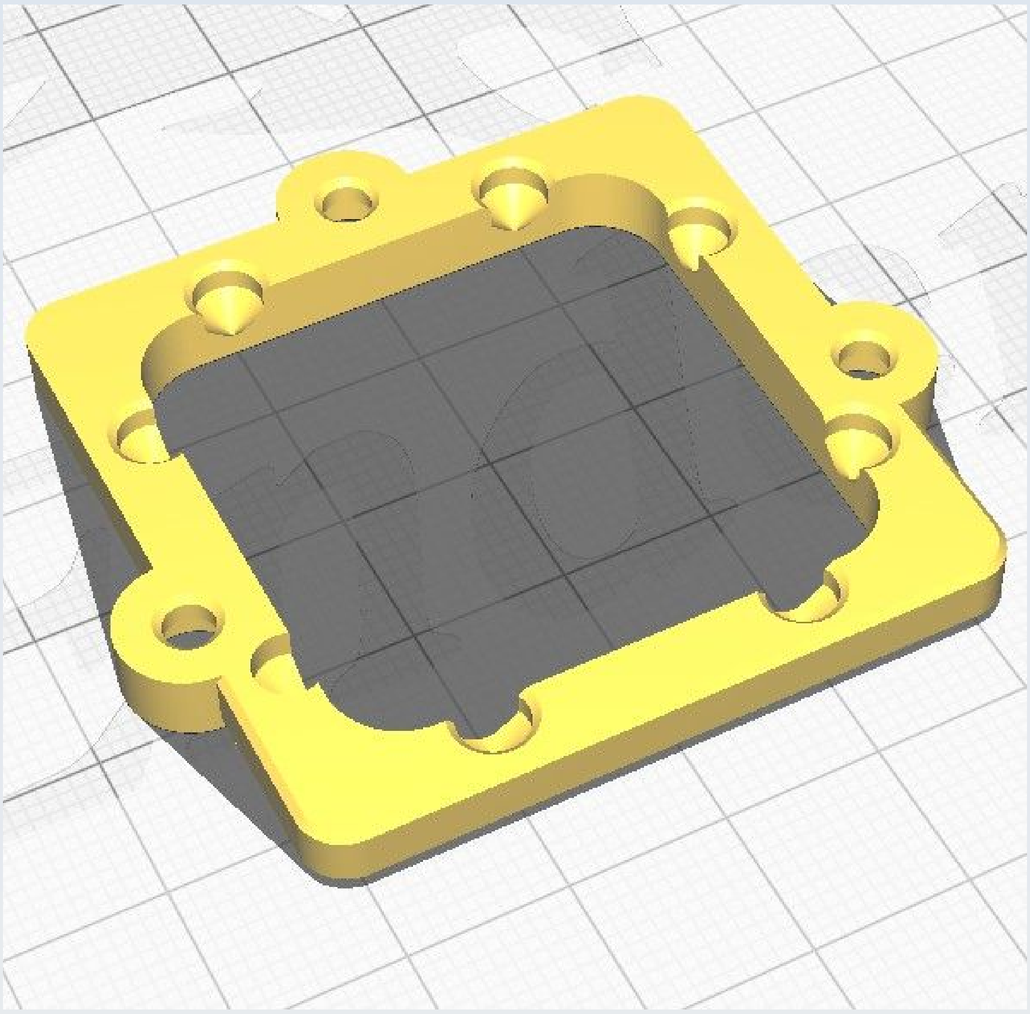


Use ‘Normal’ supports ‘touching buildplate only’ with an overhang angle of 67 degrees.

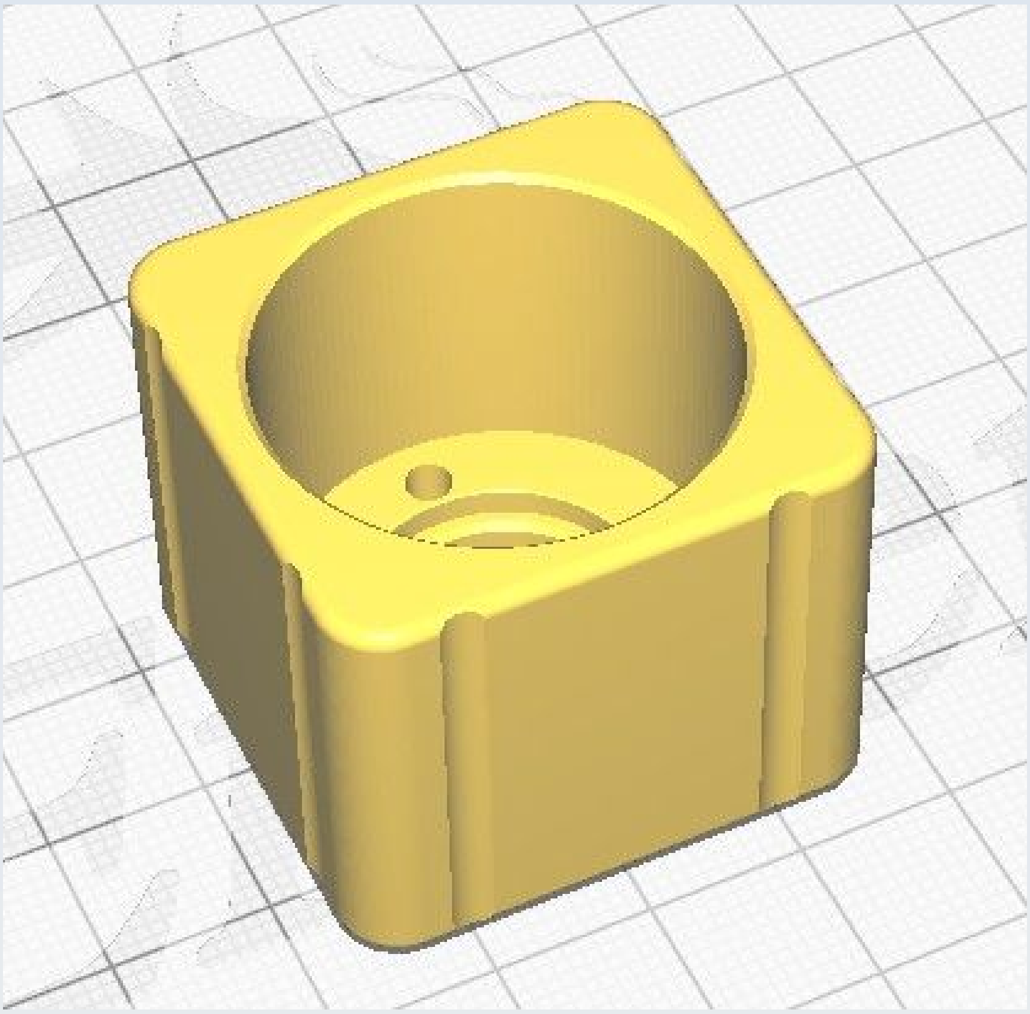
CN_Z_N11_Syringe_body



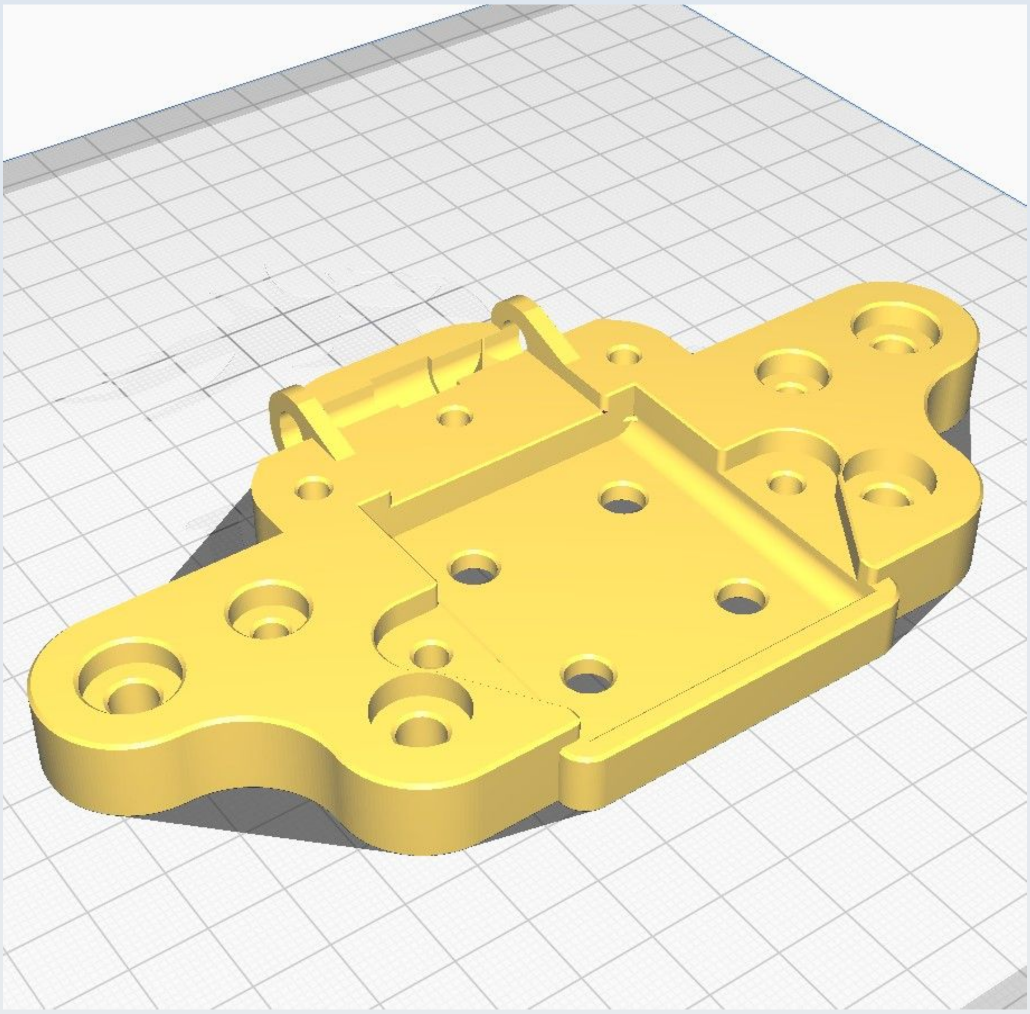
CN_Z_N11_Syringe_cover



CN_Z_N11_Syringe_Gearbox_plunger

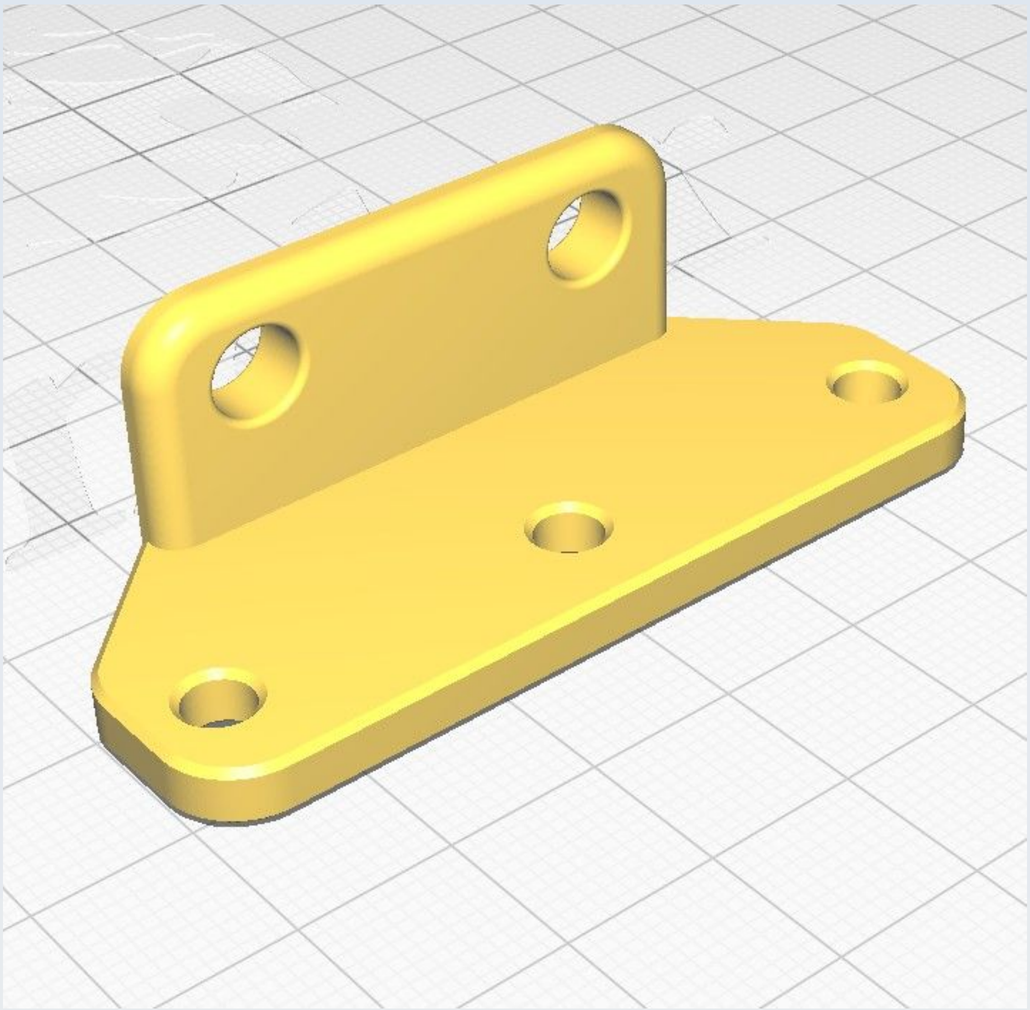


CN_Z_N11_Syringe_mount



Use ‘Normal’ supports ‘touching buildplate only’ with an overhang angle of 67 degrees.

CN_Sam_Counter_weight



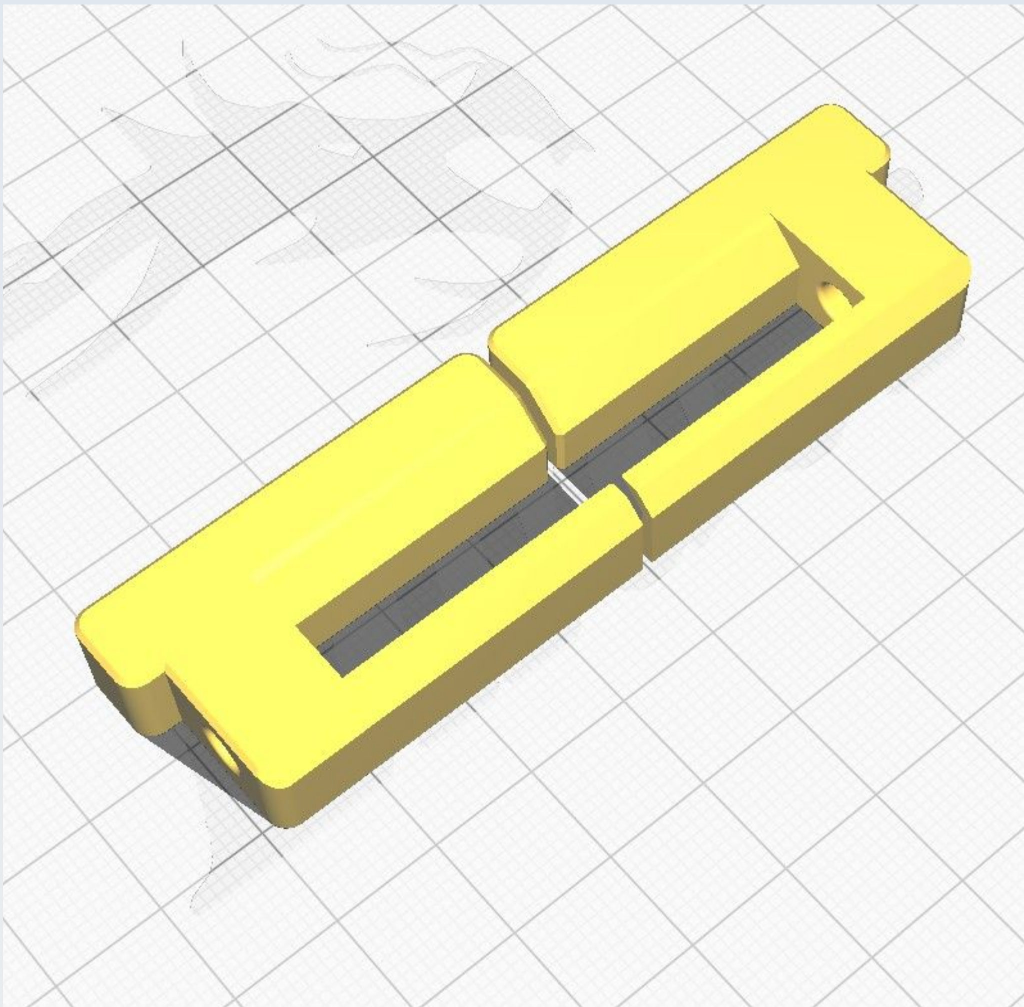
Use ‘Normal’ supports ‘everywhere’ with a 67 degree overhang angle.

CN_Sam_Pincer_Extn1_L

This will usually be printed together with the R version, as shown below.

CN_Sam_Pincer_Extn1_R

This will usually be printed with the L version, as shown below.

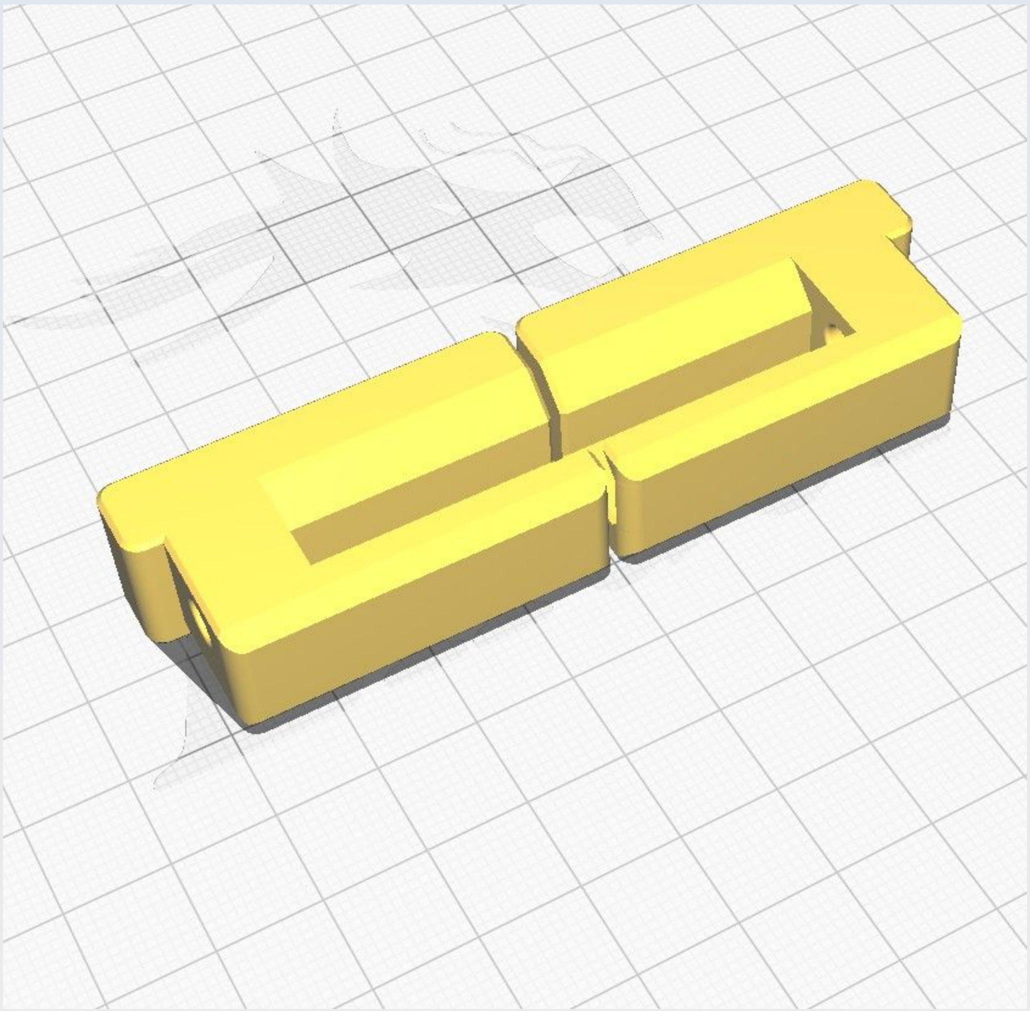


CN_Sam_Pincer_Extn2_L

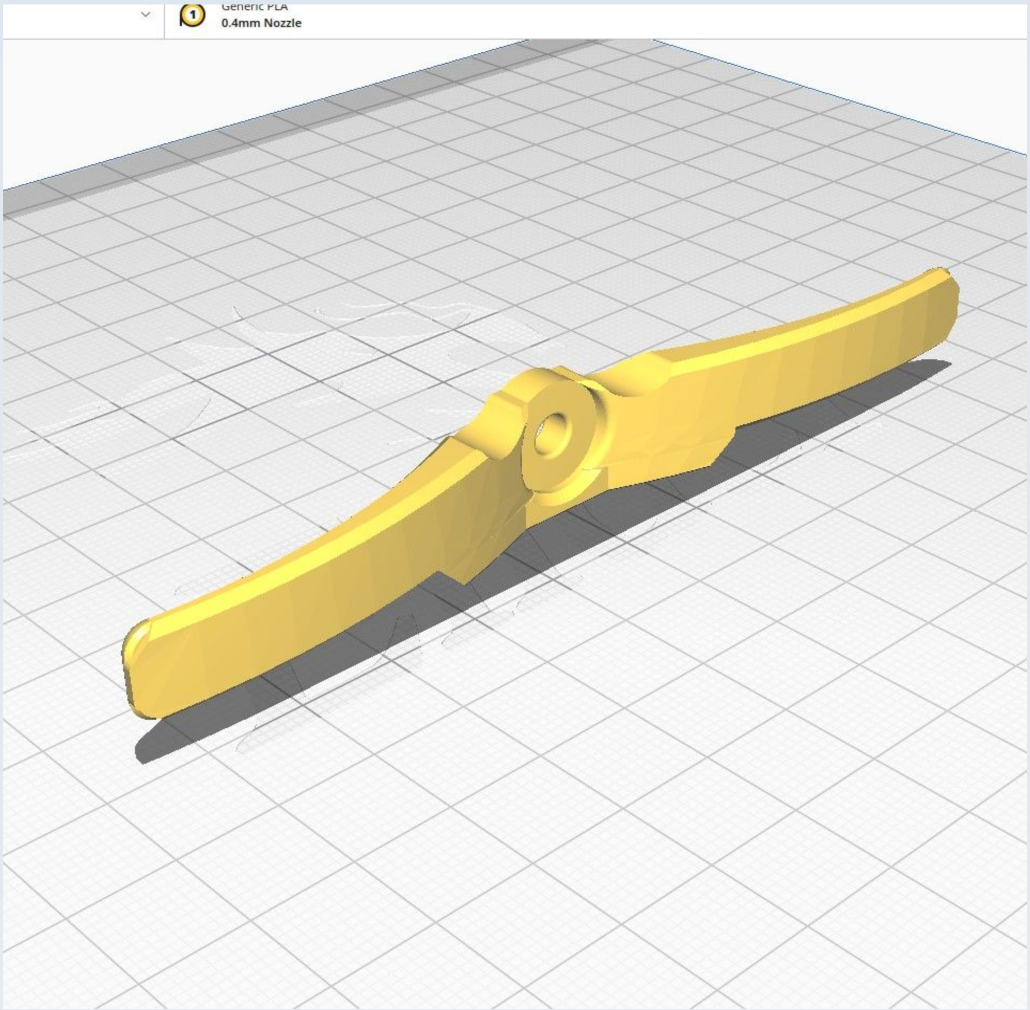
This will usually be printed together with the R version, as shown below.

CN_Sam_Pincer_Extn2_R

This will usually be printed together with the L version, as shown below.

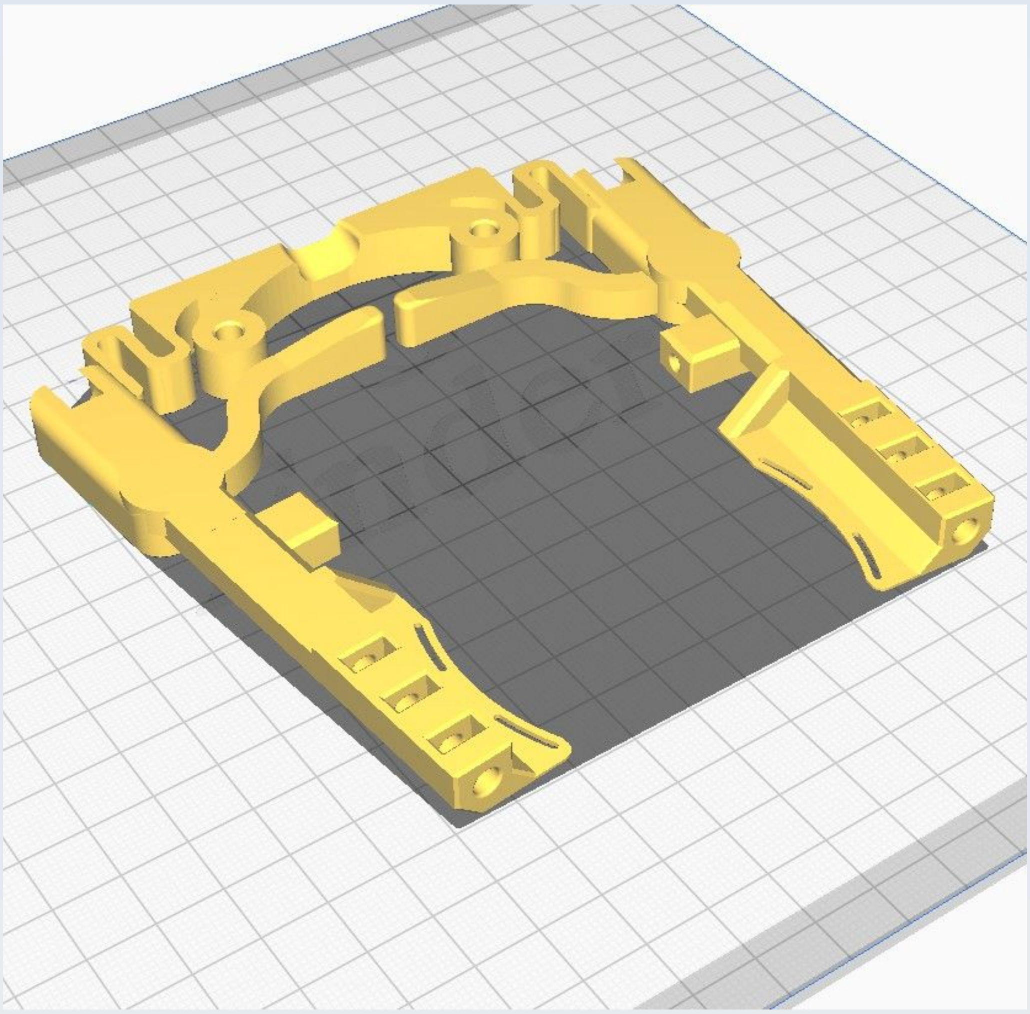


CN_Sam_Presser_wings

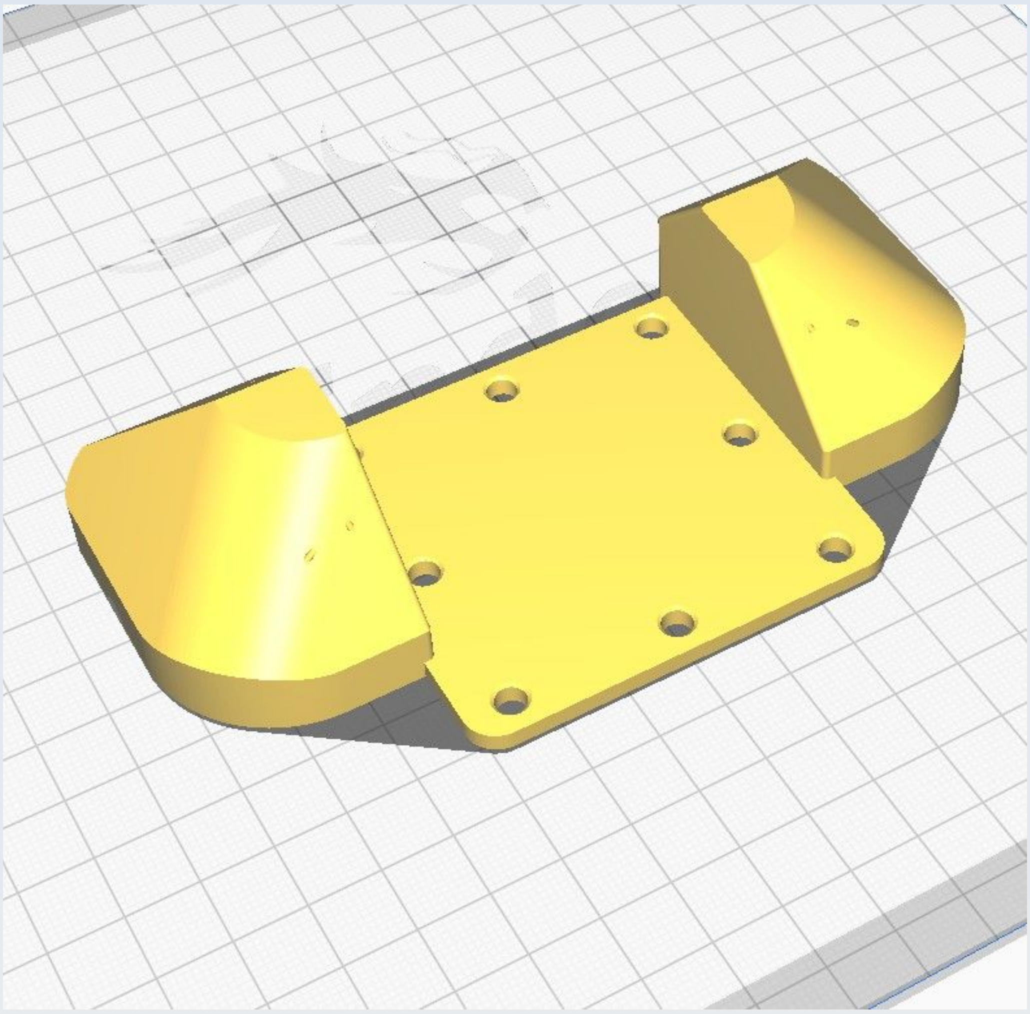


Use ‘Normal’ supports at 67 degrees and ‘Touching buildplate only’

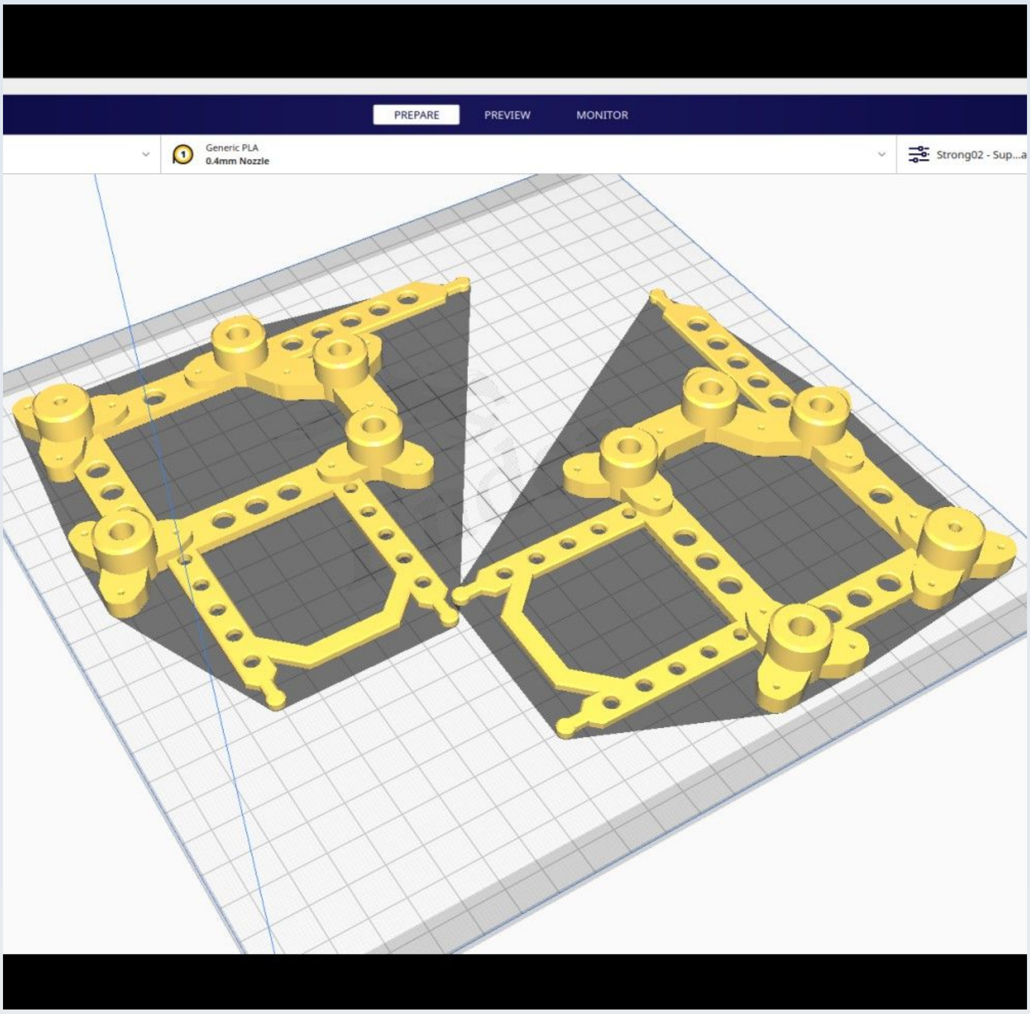
CN_Sam_Spring_arm_assy



CN_Sam_Stage_Top

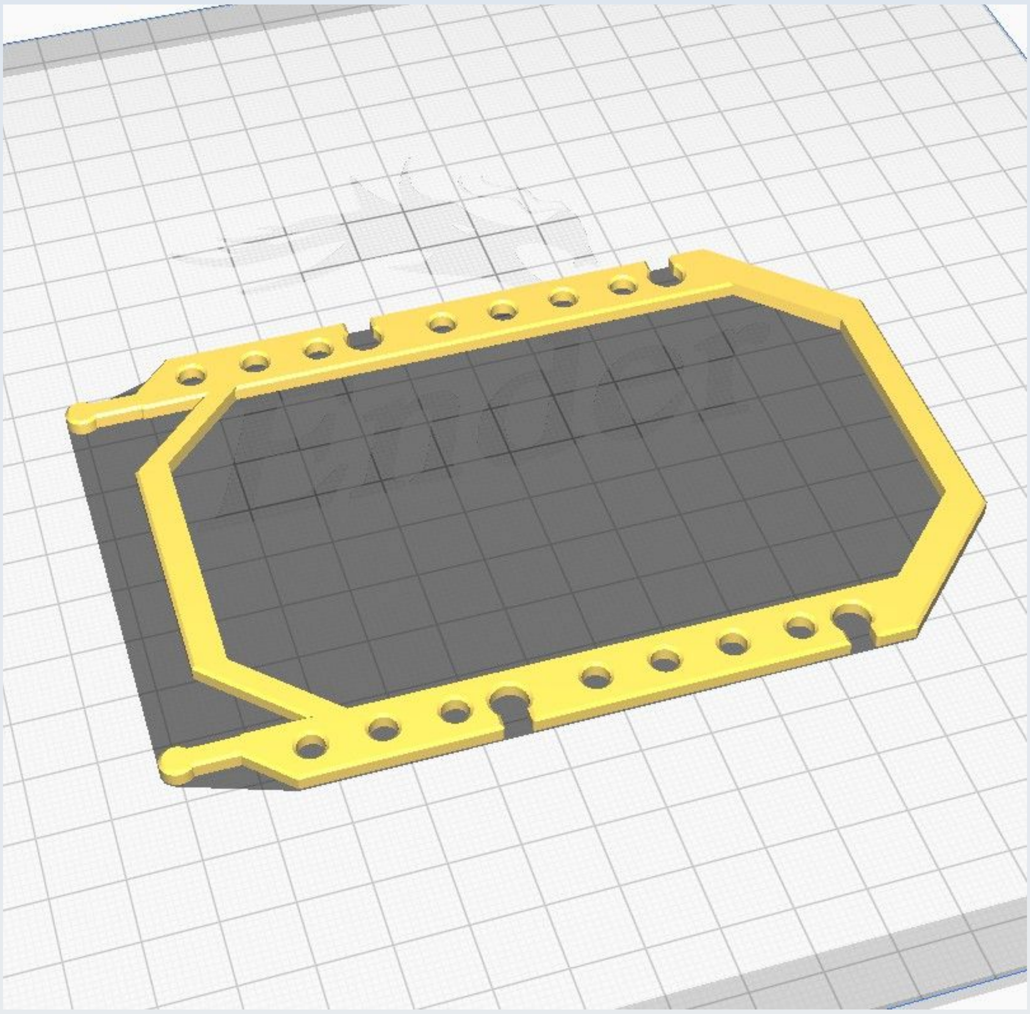


CN_BB_Jig_Back_Left



This shows the arrangement for printing both the left and right ‘Jig_Back’ components together.

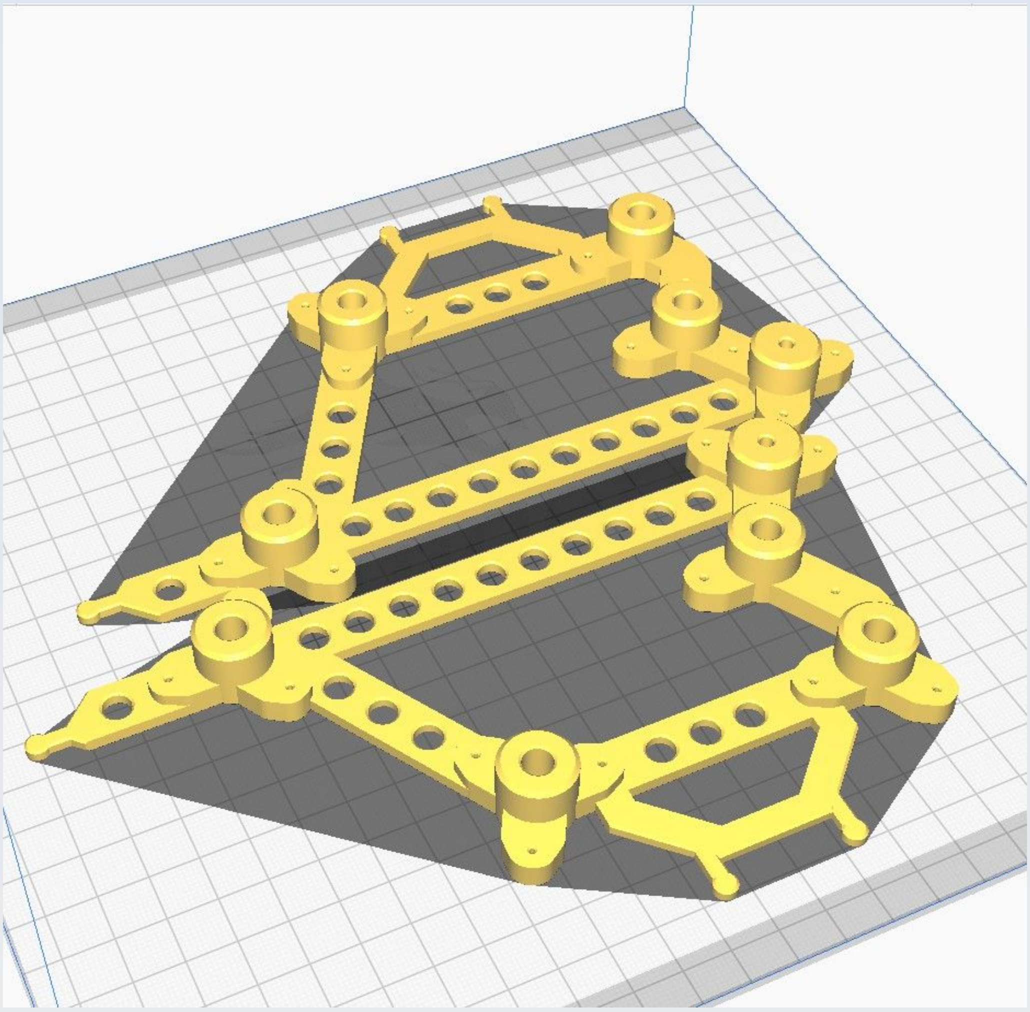
CN_BB_Jig_Back_Measure



CN_BB_Jig_Back_Right

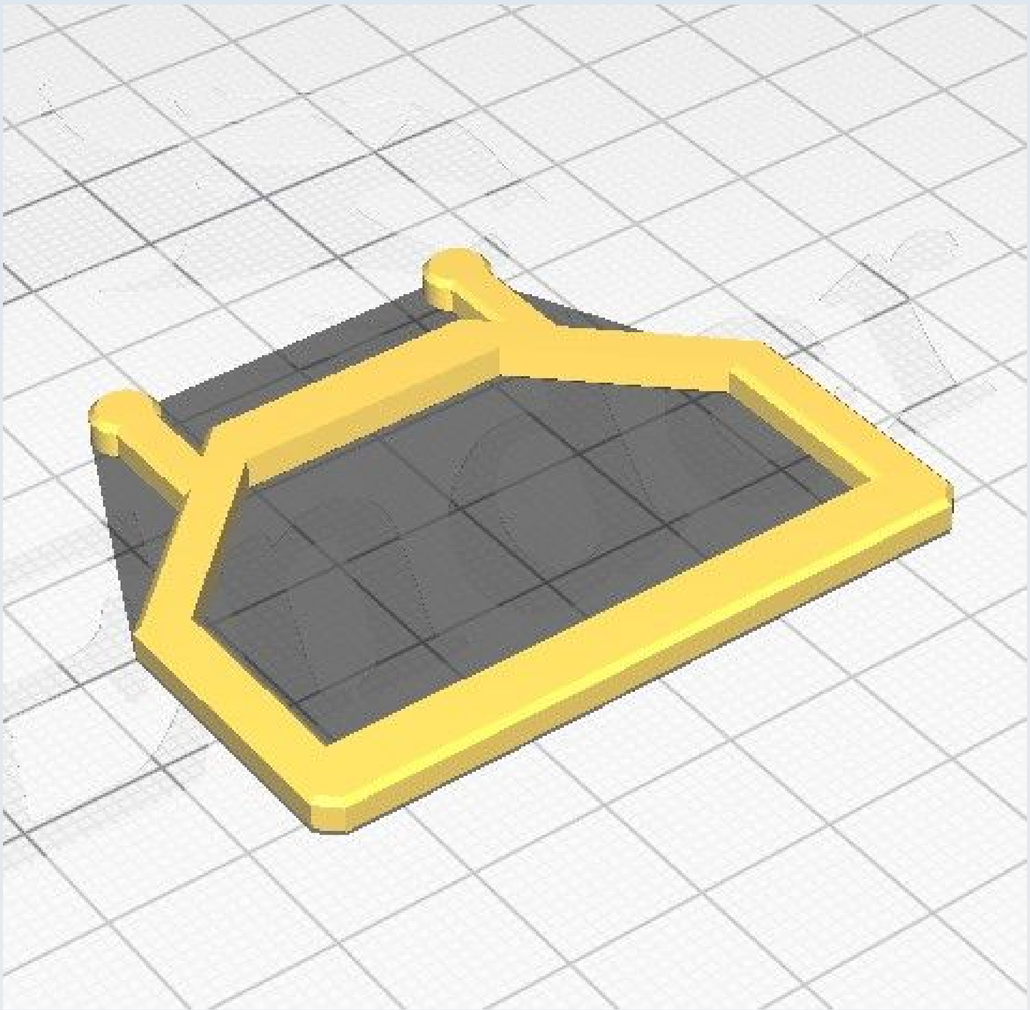
See the section for ‘CN_BB_Jig_Back_Left’

CN_BB_Jig_Front_Left



This shows the arrangement for printing both the left and right ‘Jig_Front’ components together.

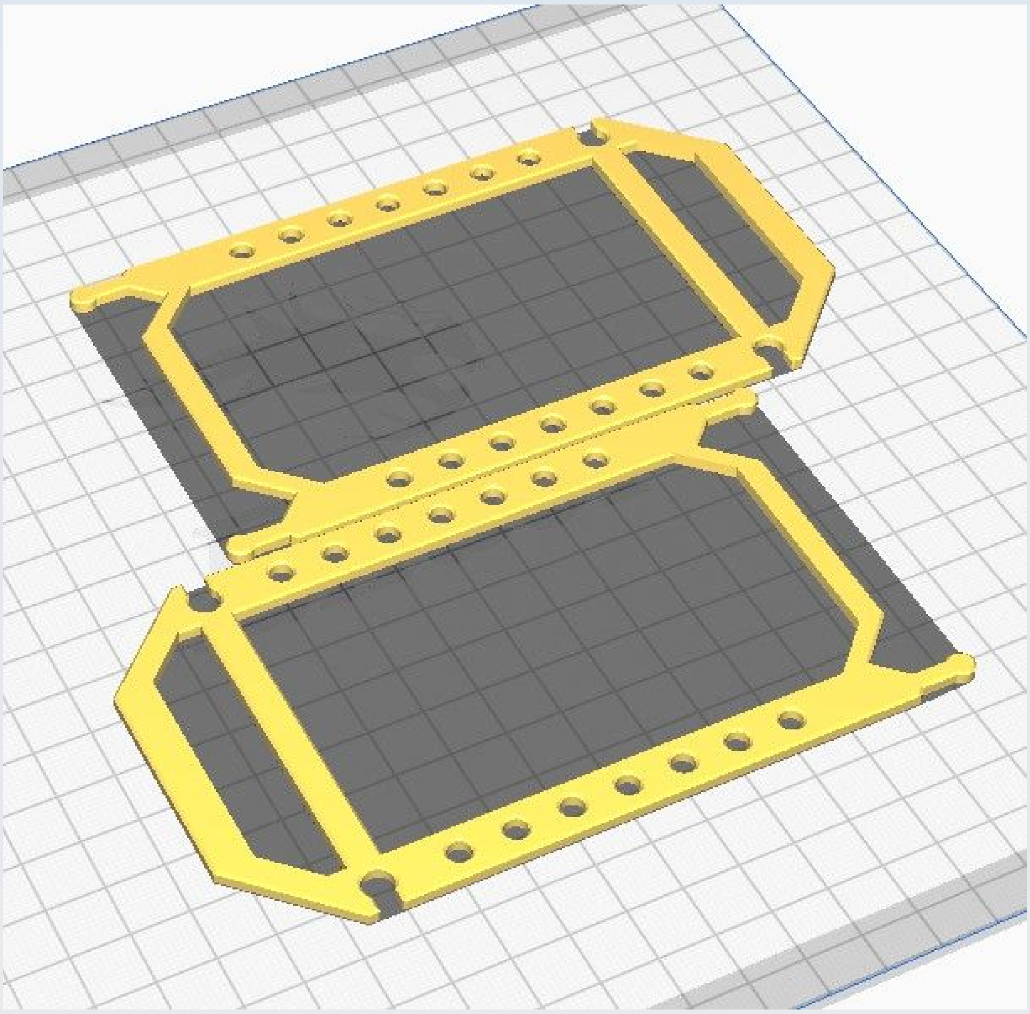
CN_BB_Jig_Front_Measure



CN_BB_Jig_Front_Right

See the section for ‘CN_BB_Jig_Front_Left’

CN_BB_Jig_Left_Measure

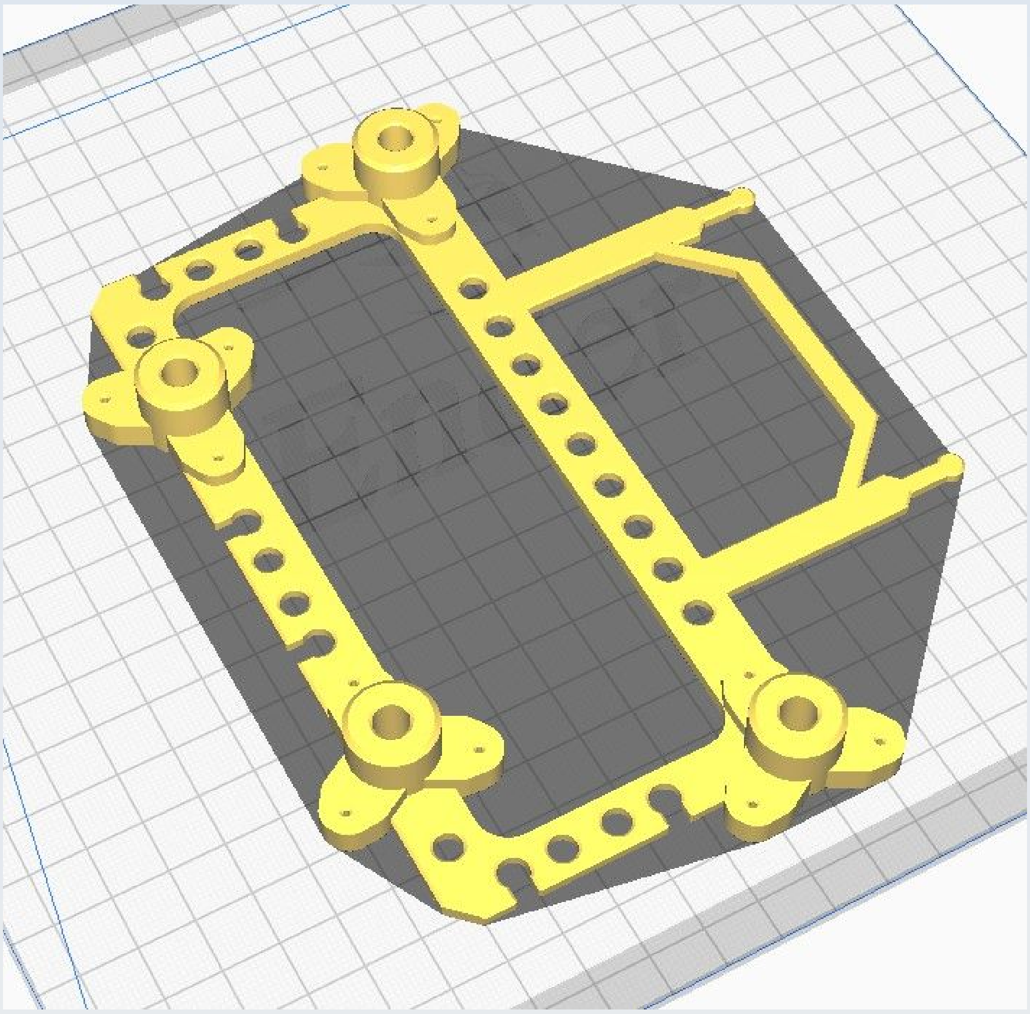


This shows the arrangement for printing both the left and right components together.

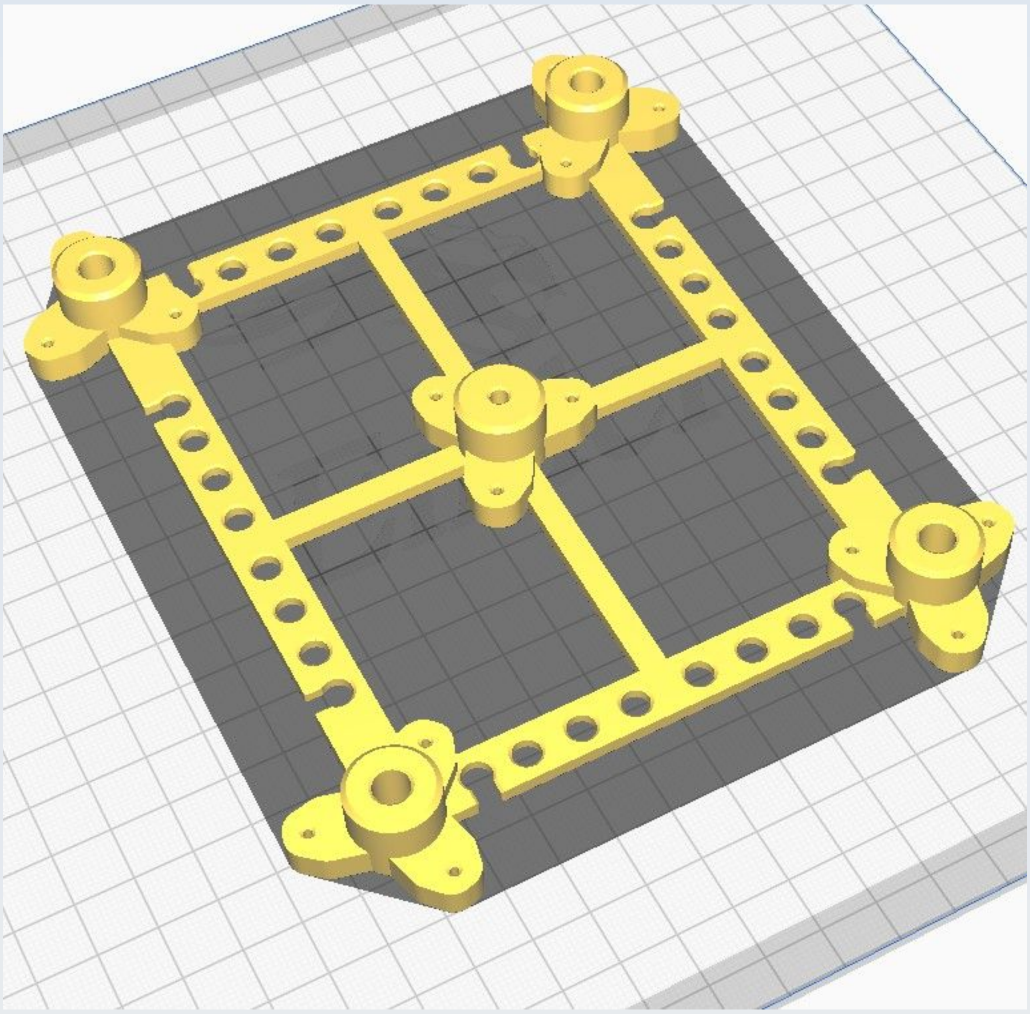
CN_BB_Jig_Right_Measure

See the section on ‘CN_BB_Jig_Left_Measure’

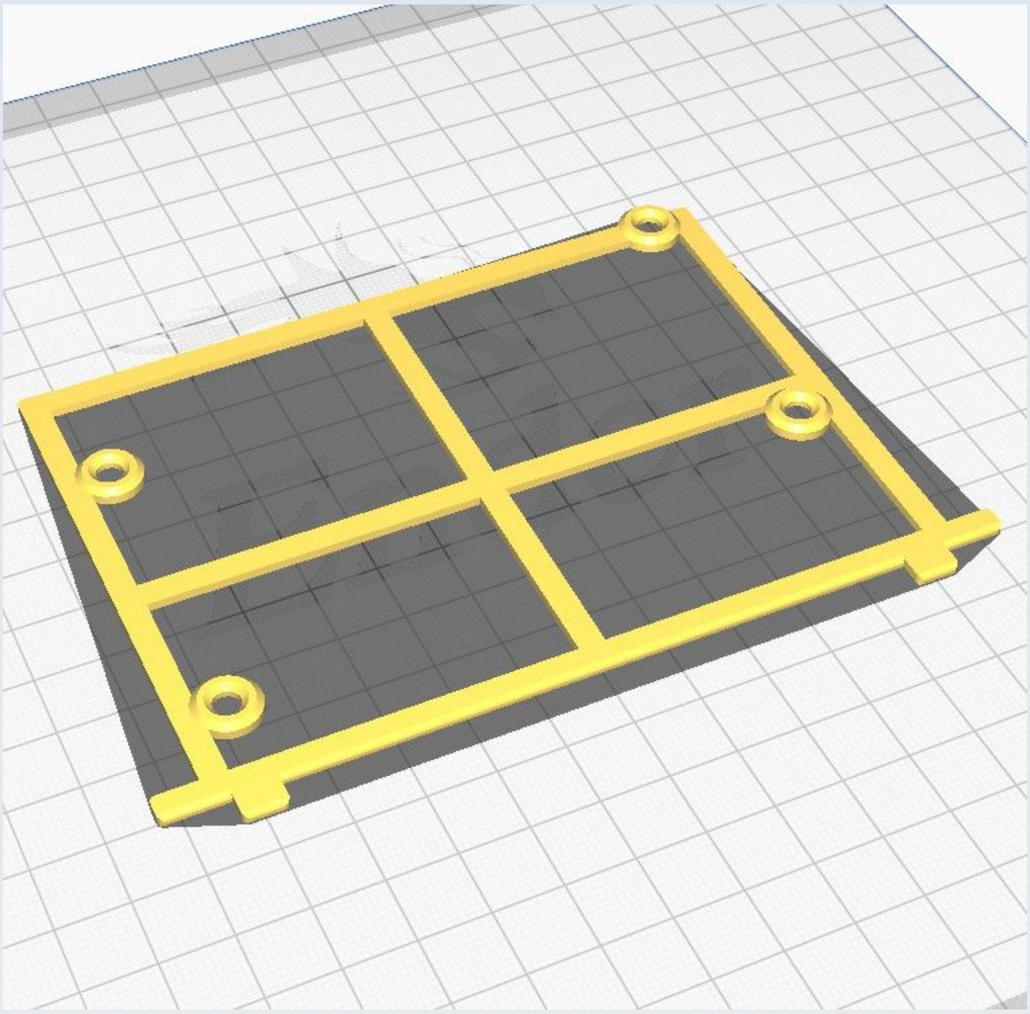
CN_BB_Jig_Undercarriage



CN_BB_Jig_XYTable



CN_BB_Jig_Y_Lim



CN_F_Ardu_strut_BL

These are best printed all togerher as shown in the section on ‘CN_F_Ardu_strut_TR’.

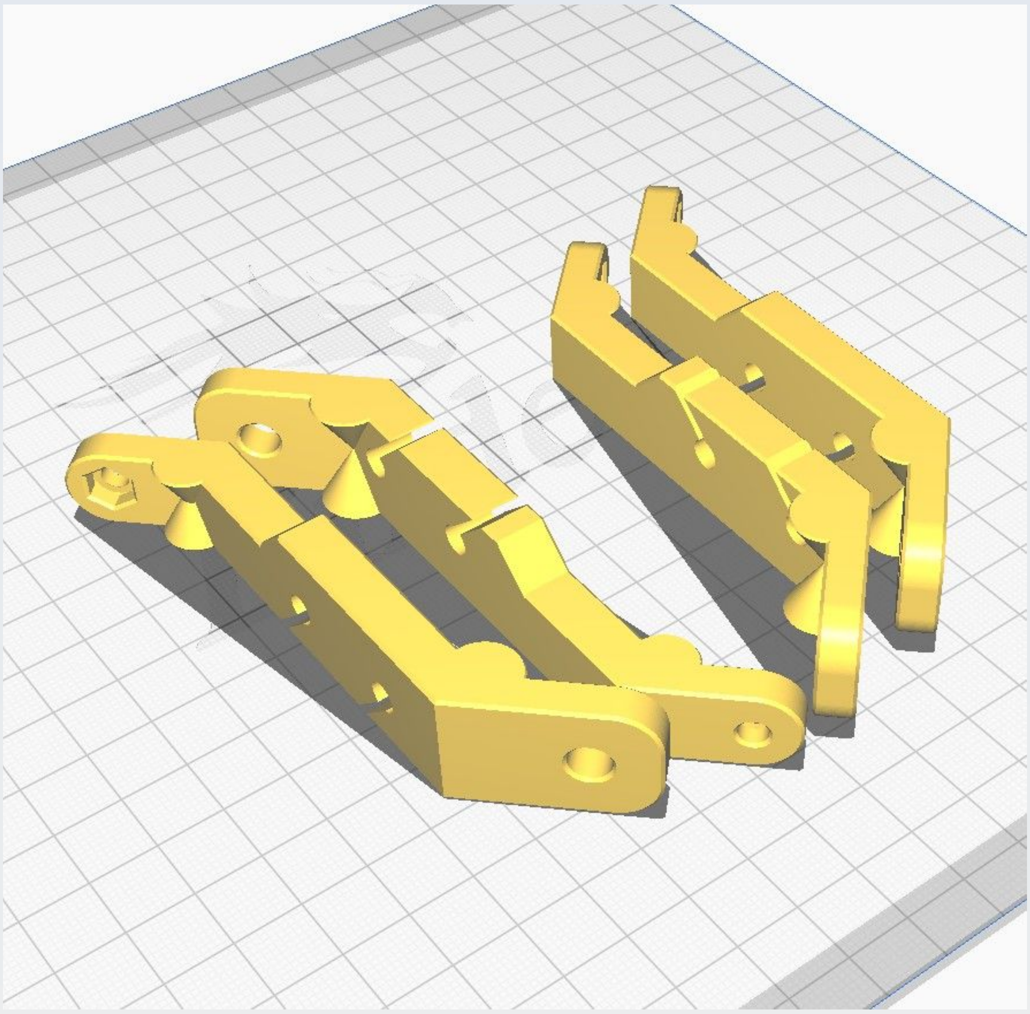
CN_F_Ardu_strut_BR

These are best printed all togerher as shown in the section on ‘CN_F_Ardu_strut_TR’.

CN_F_Ardu_strut_TL

These are best printed all togerher as shown in the section on ‘CN_F_Ardu_strut_TR’.

CN_F_Ardu_strut_TR

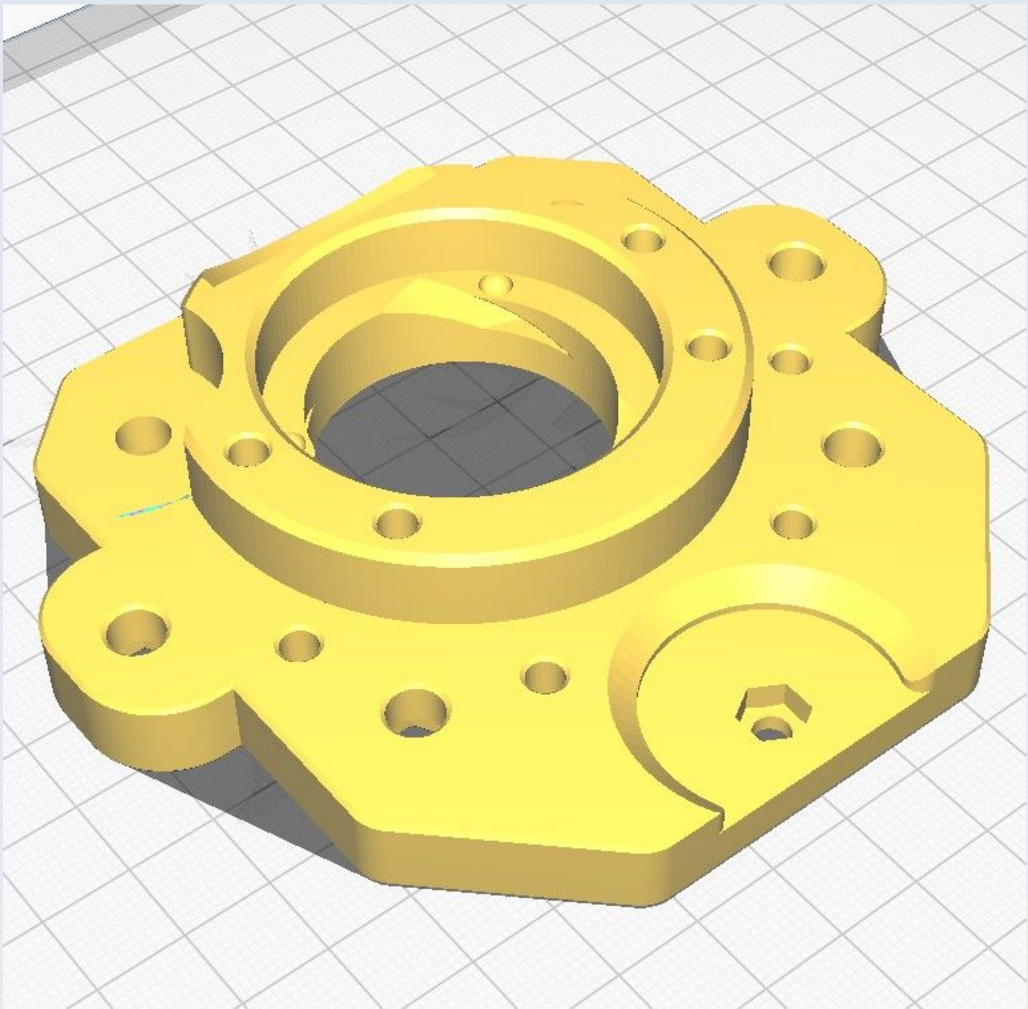


Note that this shows all the Ardu struts (not just the TR) because it is recommended to print them all togetherm as shown. Note also that each of these struts has a unique shape, none of them are duplicates or mirror images of any other (so don’t try to just load one then do ‘multiply-model’).

CN_F_DM3_Mount

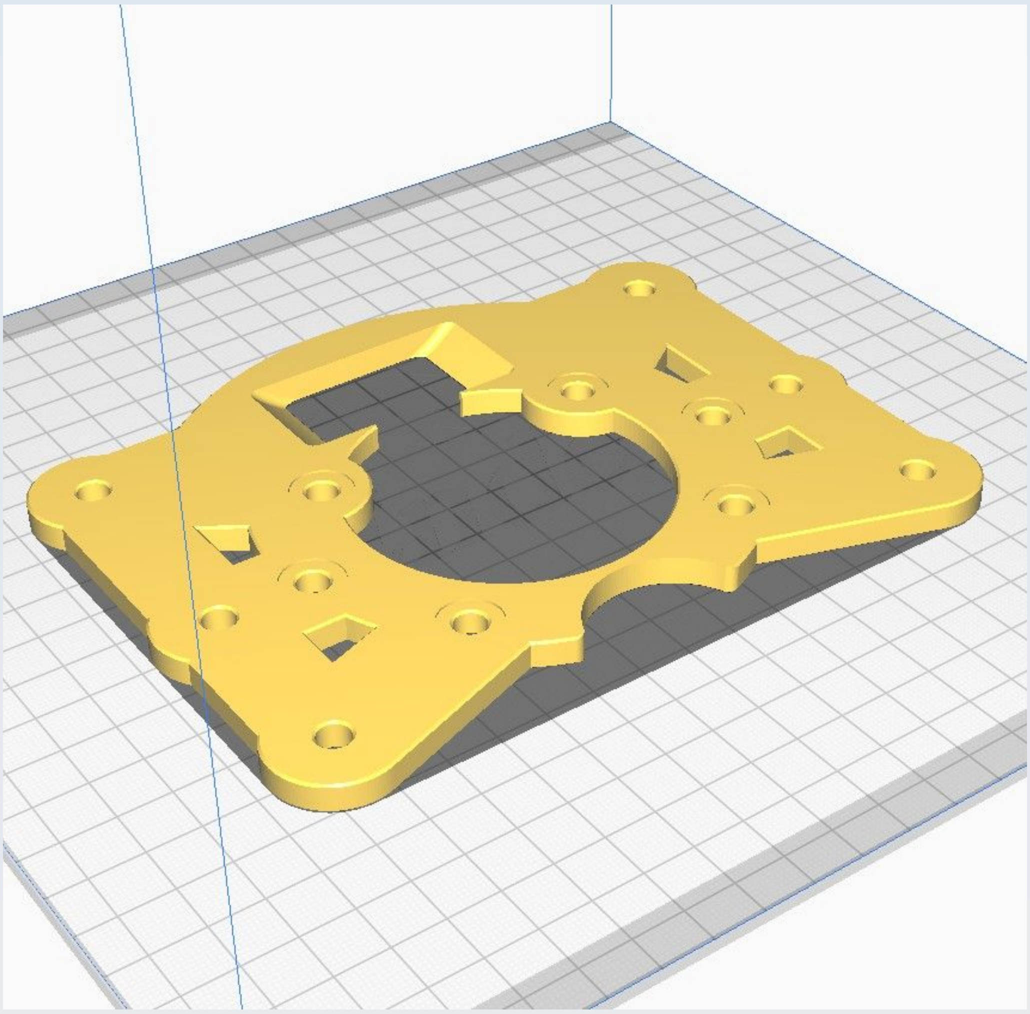
Note that this shows 3 copies of the DM3_Mount printed all together. This is recommended if you are using one DM320T (or DM320T form-factor compatible) digital microstepper driver for each of the three axes. If you are using a different form factor driver or CNC motherboard then these models will not be needed and it will be up to you to design appropriate mounts for your electronics.

CN_F_OM_QR_Plate

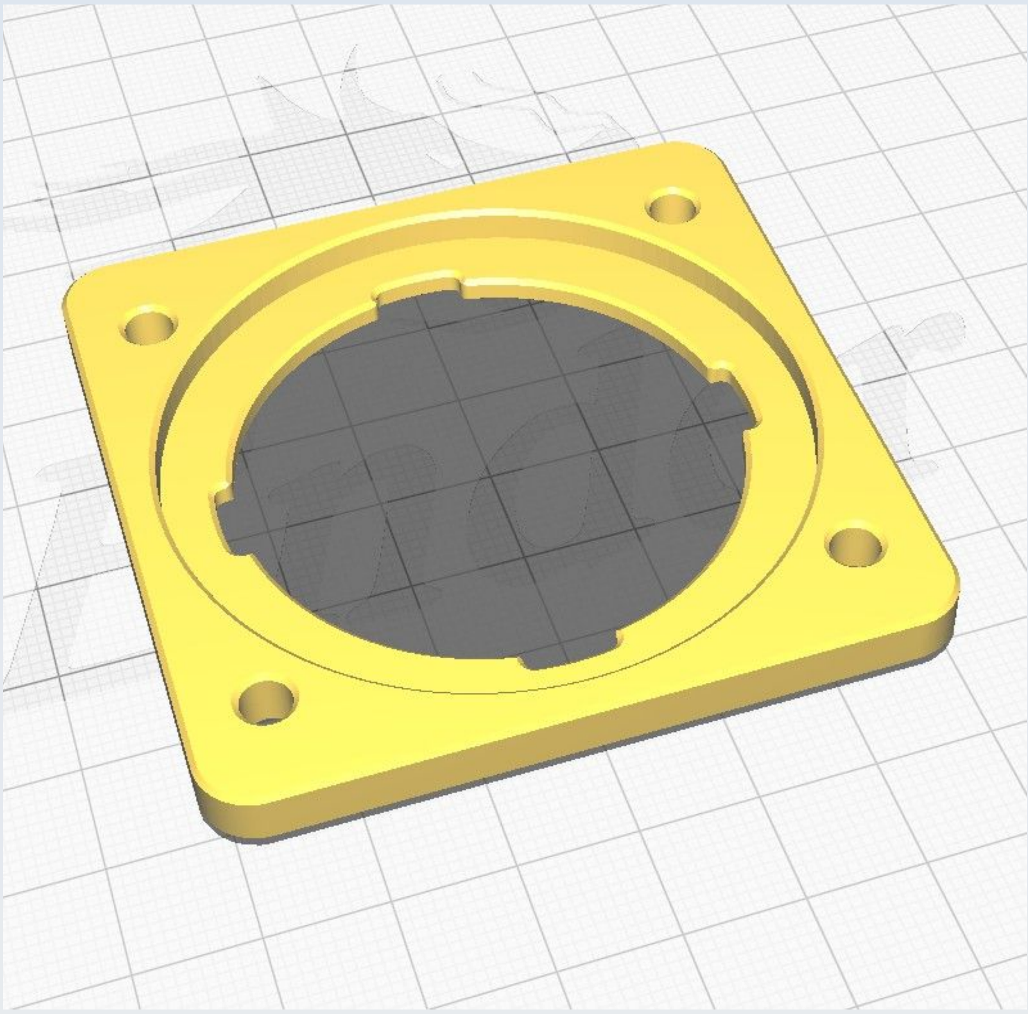


This uses ‘Normal’ supports ‘touching buildplate only’ with an overhang of 67 degrees.

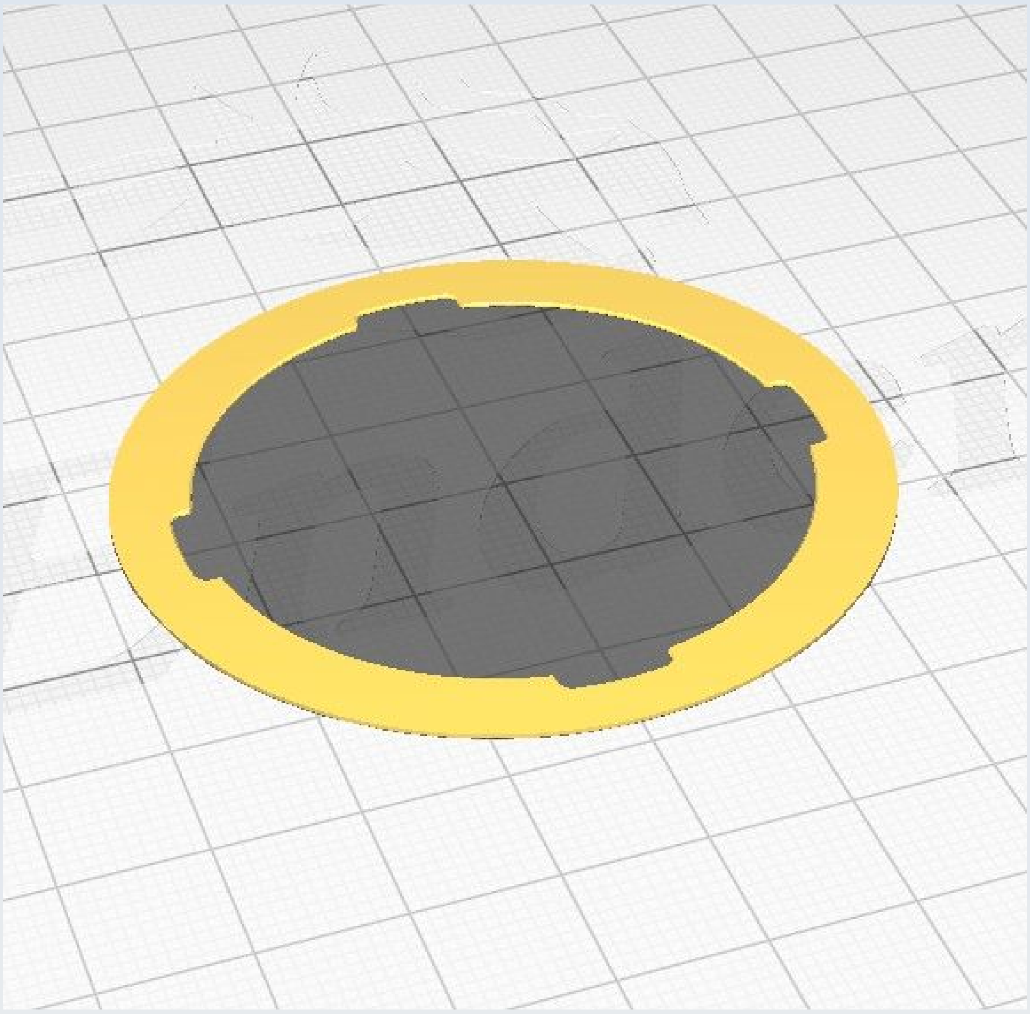
CN_F_Overmount



CN_F_UM_Opt_gripper

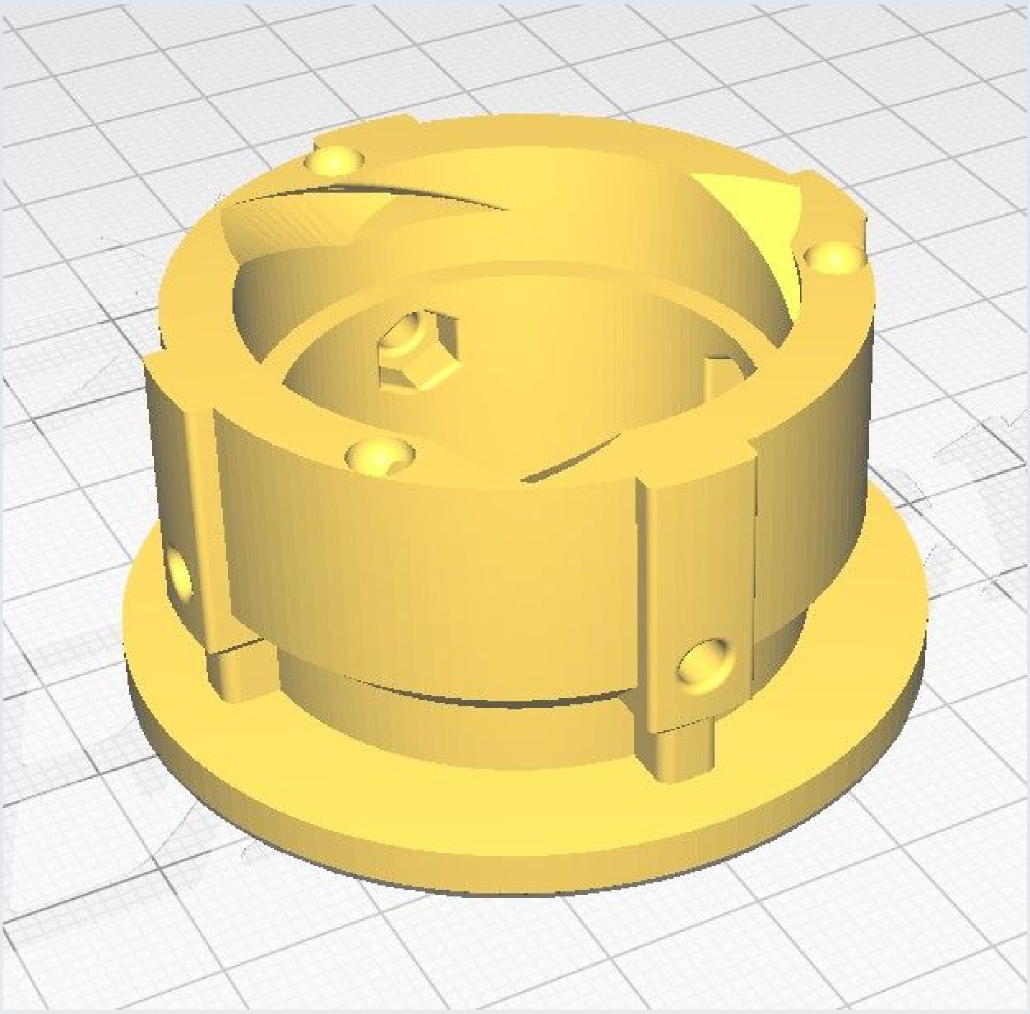


CN_F_UM_Opt_Gripper_washer



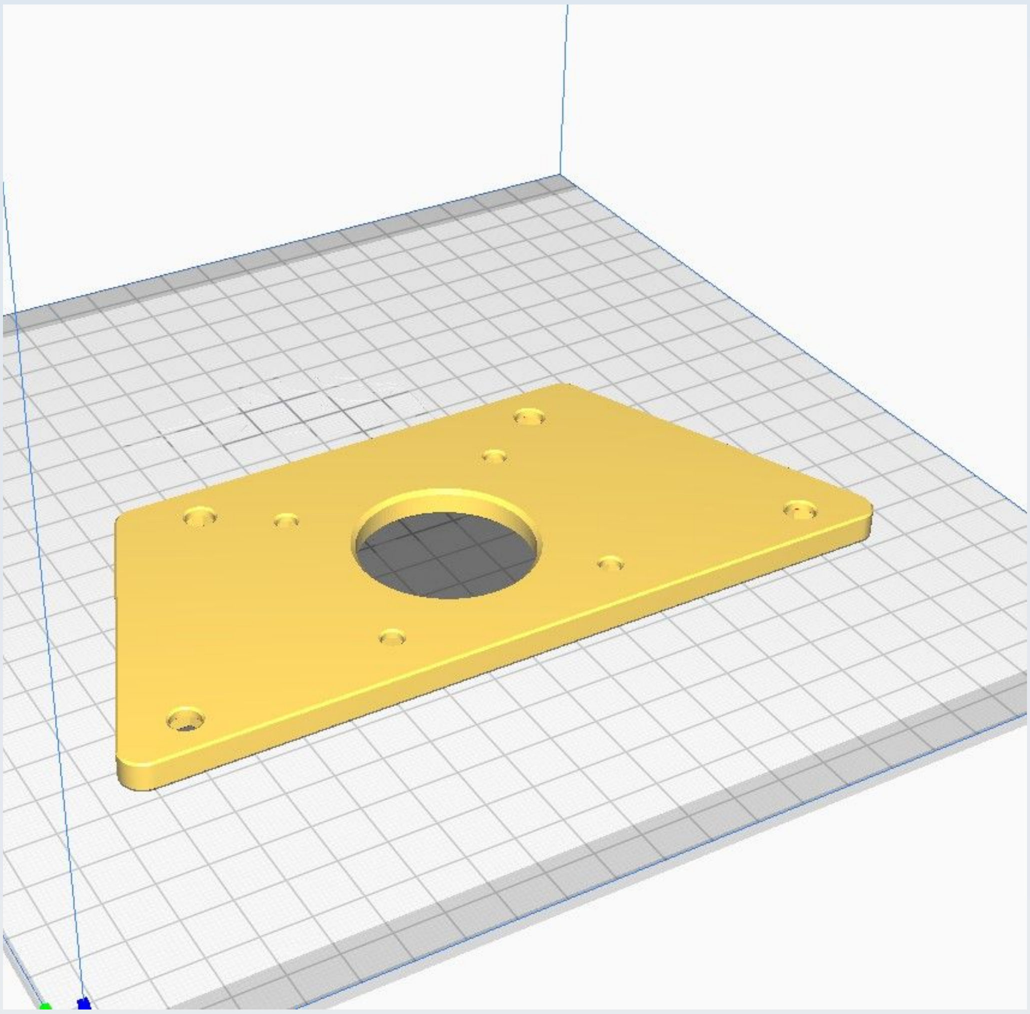
Use ‘Concentric’ for ‘Top/Bottom Pattern’.

CN_F_UM_Opt_to_QR_F



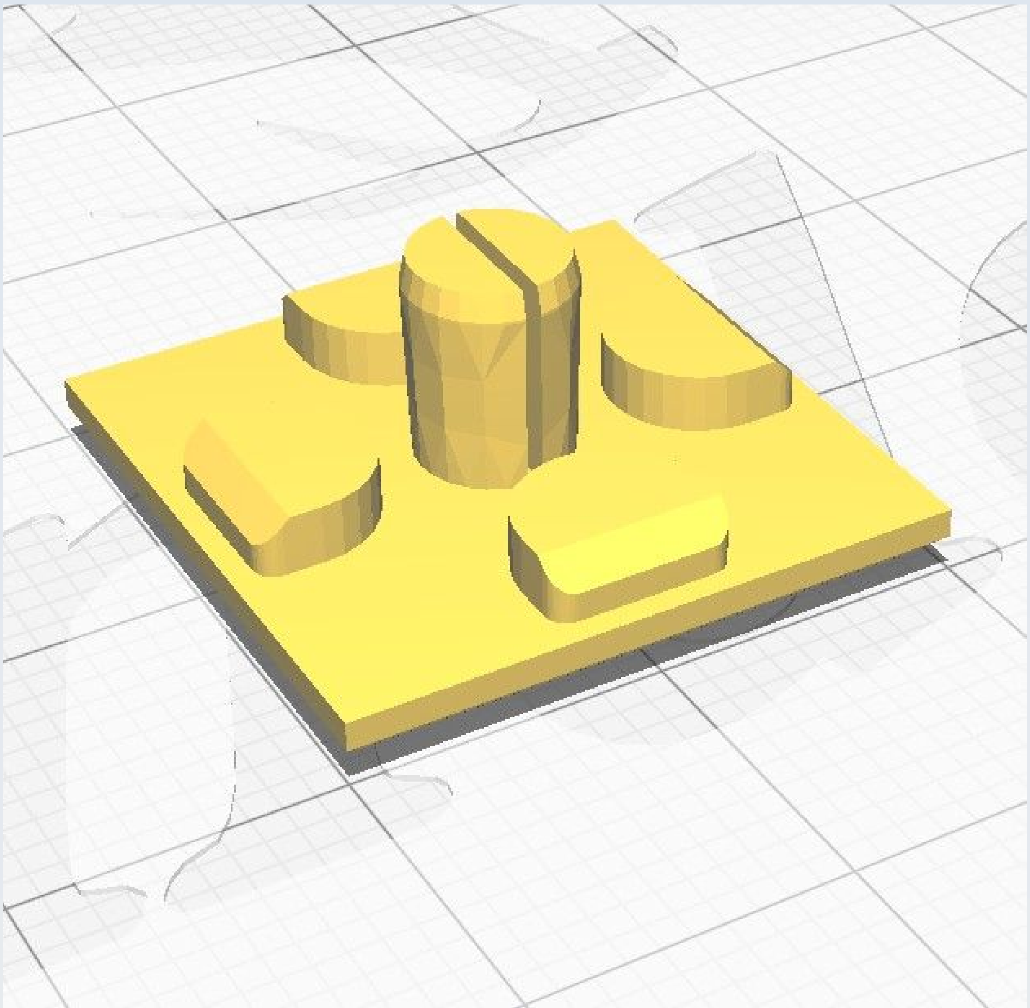
Use ‘Concentric’ for ‘Top/Bottom Pattern’.

CN_F_Undercarriage_platform

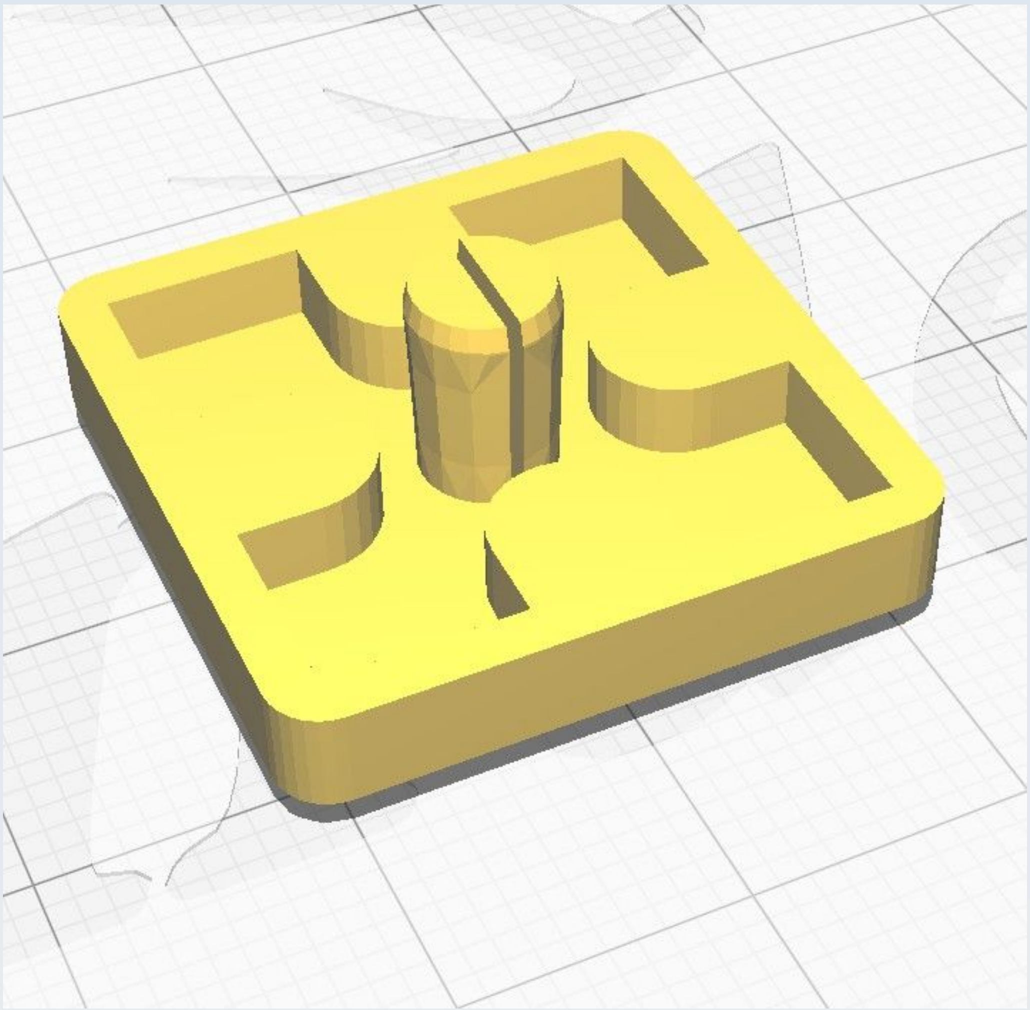


This uses ‘Normal’ supports ‘touching buildplate only’ with an overhang of 67 degrees.

CN_SD_2020_End_cap



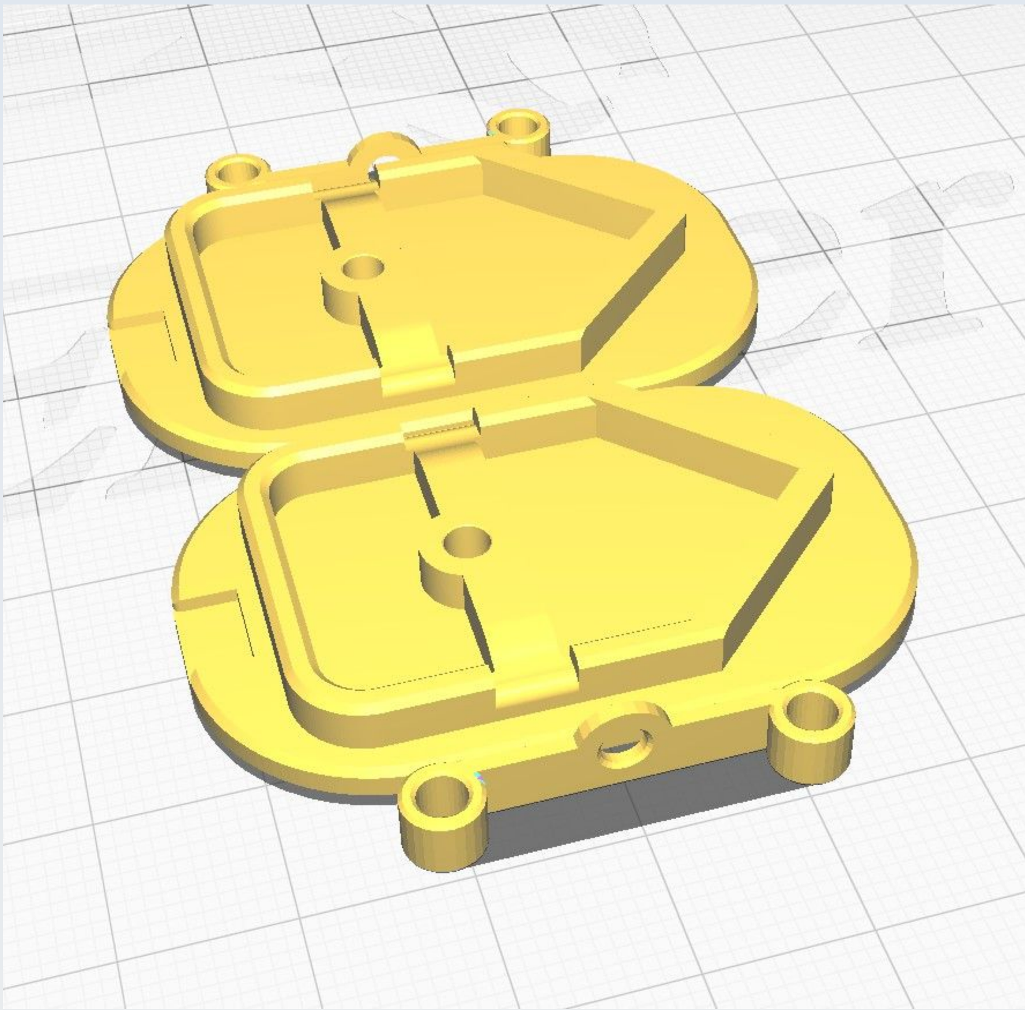
CN_SD_2020_Protector



CN_SD_Aft_clip

It is recommended to print two of these together with two of the 'CN_SD_Aft_Hole_cover' model (see below).

CN_SD_Aft_Hole_cover

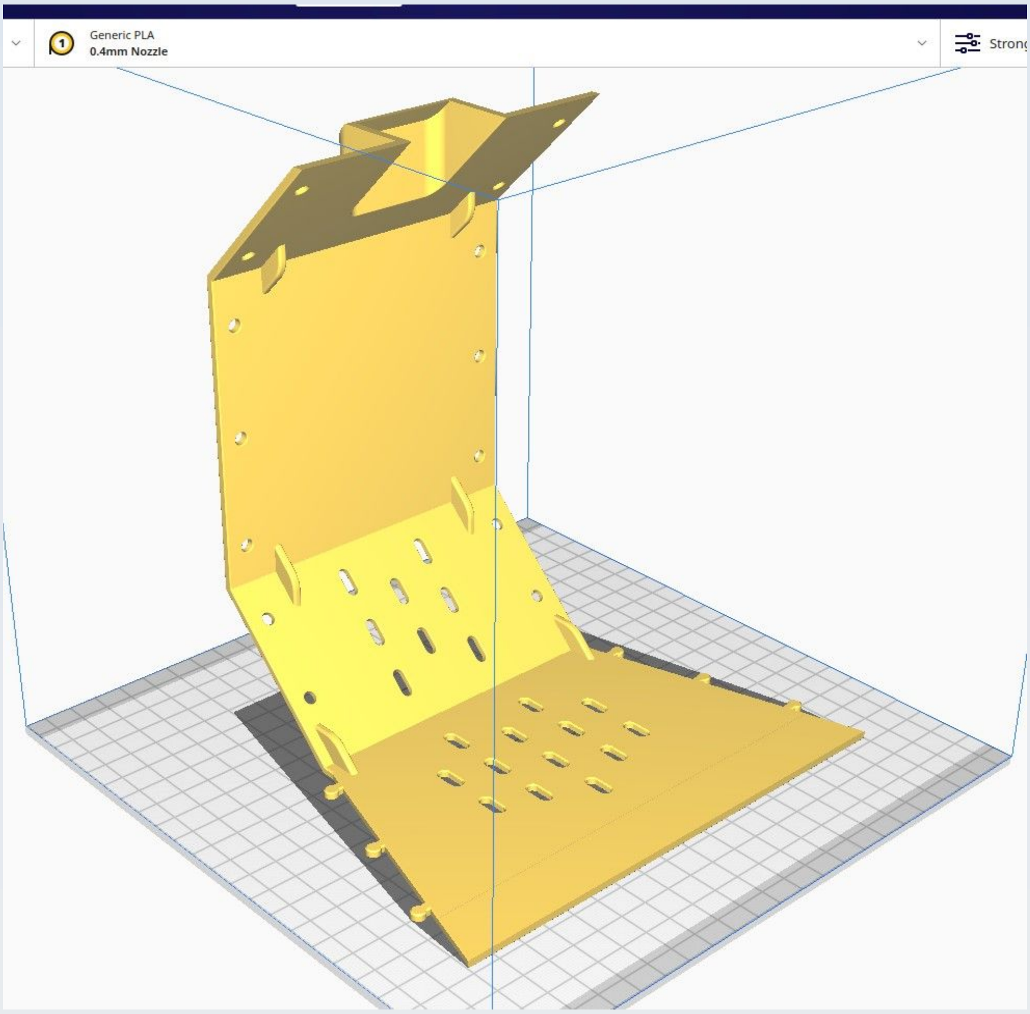


The image shows two of this model together with two of the '' model all printed together.

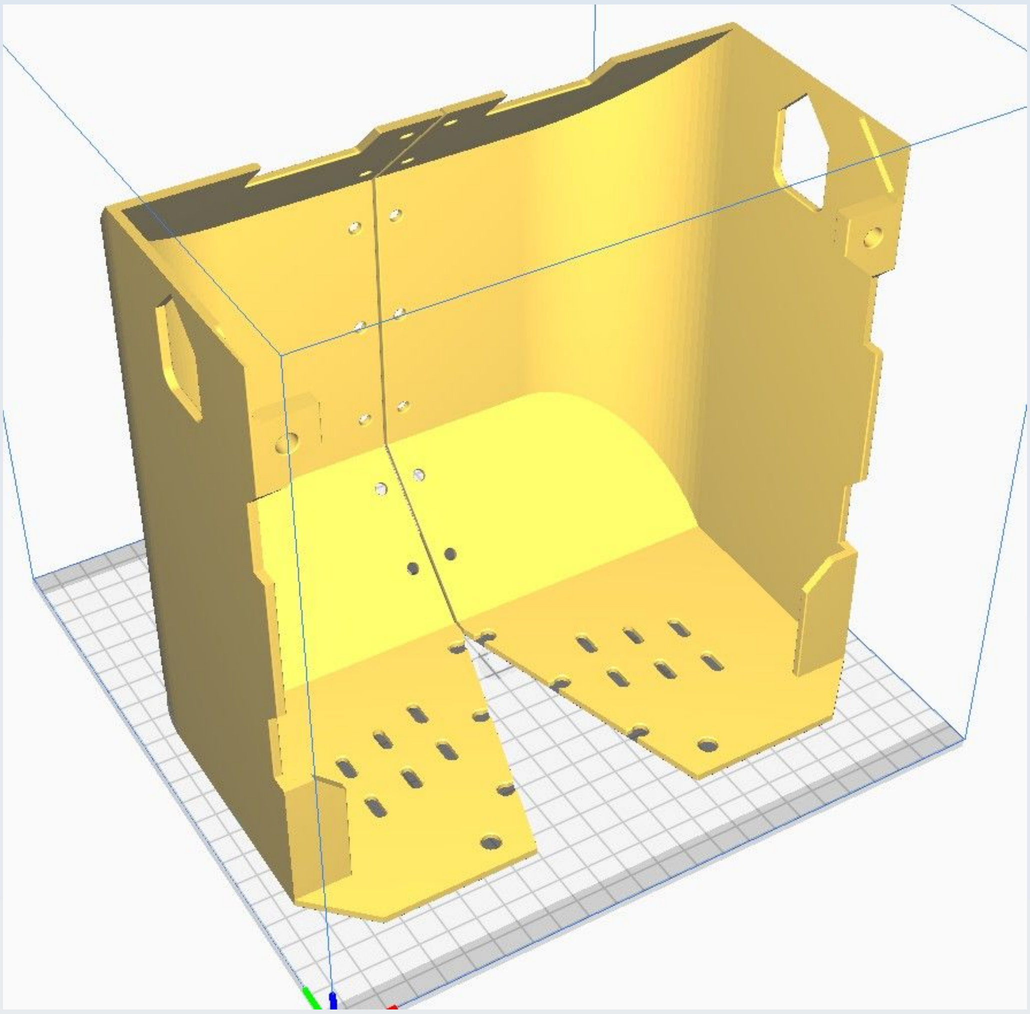
CN_SD_Aft_Left

It is recommended to print this together with the ‘CN_SD_Aft_Right’ model. See the section on ‘CN_SD_Aft_Right’ for the build-plate orientation image and further information.

CN_SD_Aft_Mid

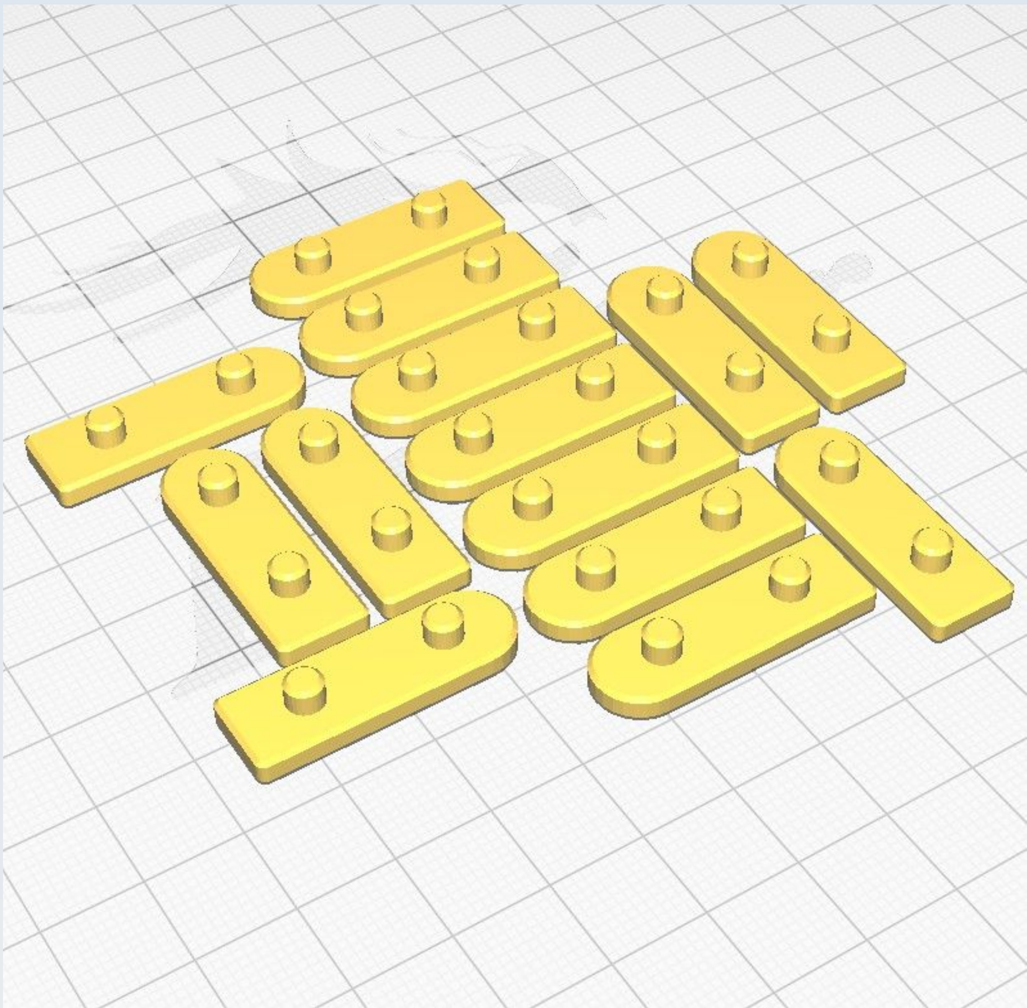


CN_SD_Aft_Right



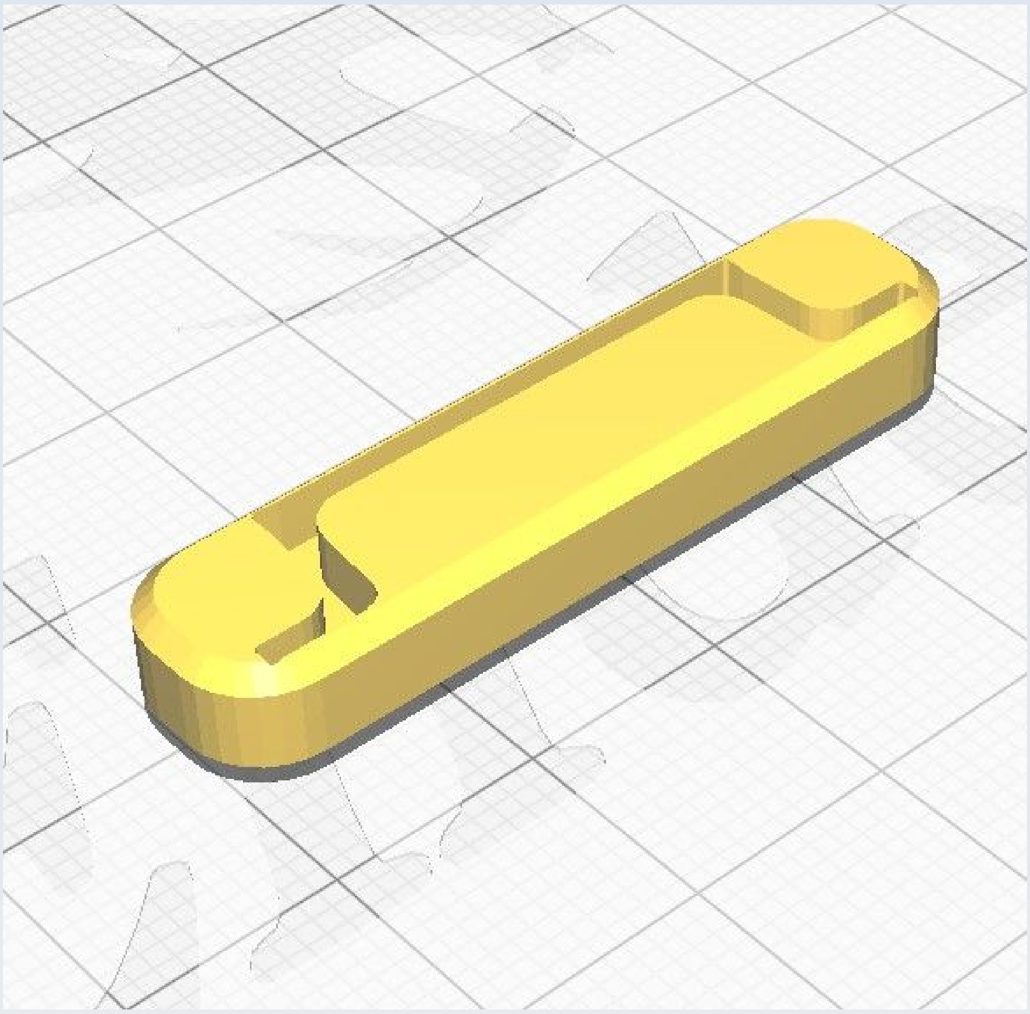
The image shows both this model and the ‘CN_SD_Aft_Left’ model on the build plate together (which is the recommended way to print these in order to save time and energy). They are separated by just 1 mm. No supports are needed.

CN_SD_Aft_Rivet_block

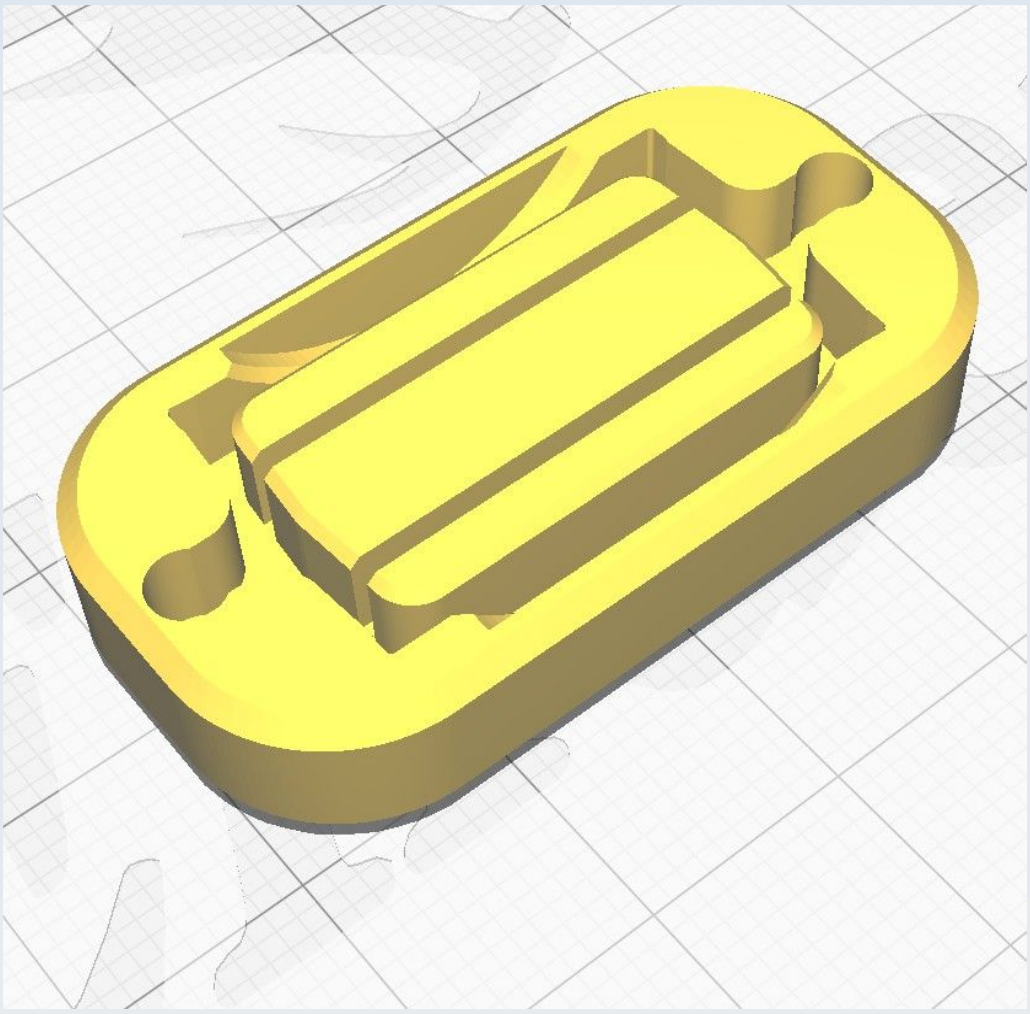


The illustration shows 14 copies of this model laid out for printing in one job (you will need 14 of them).

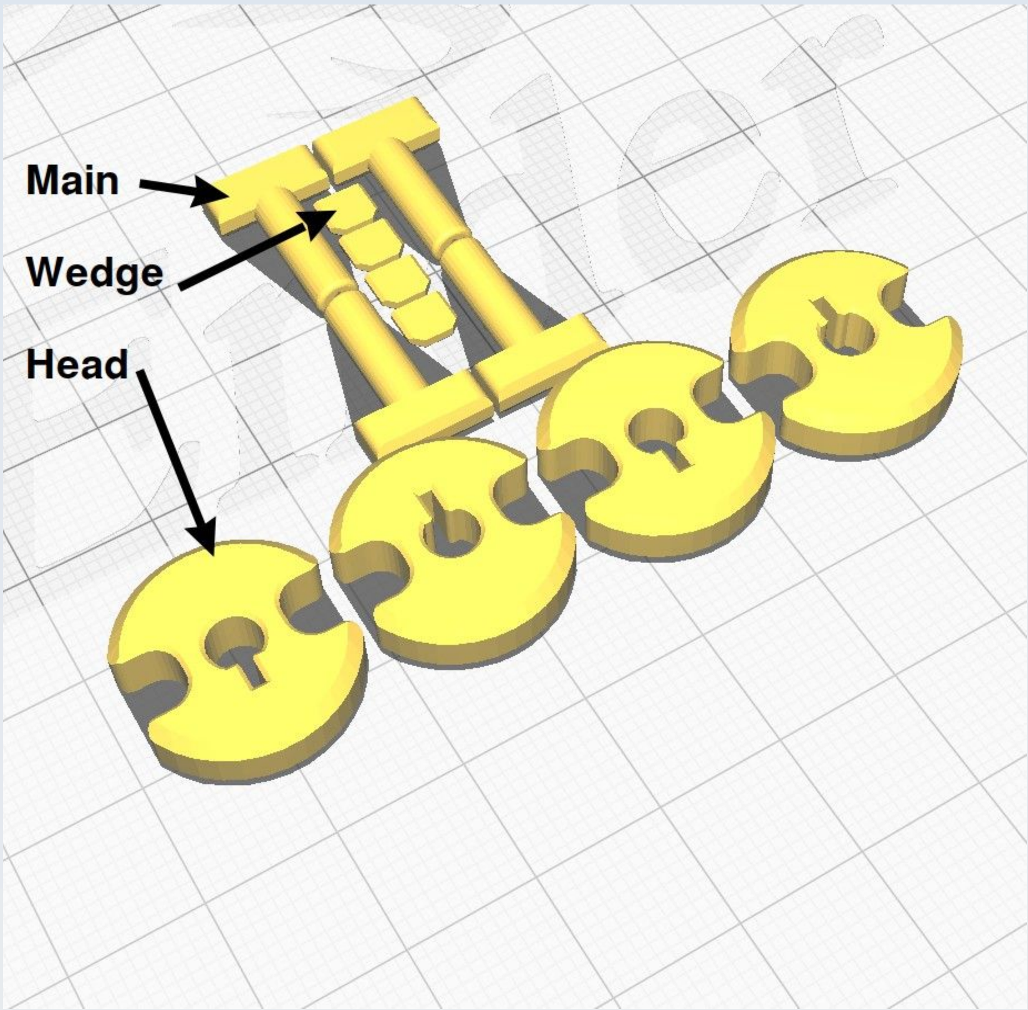
CN_SD_DIN_End_Protector



CN_SD_DIN_Foot_Protector

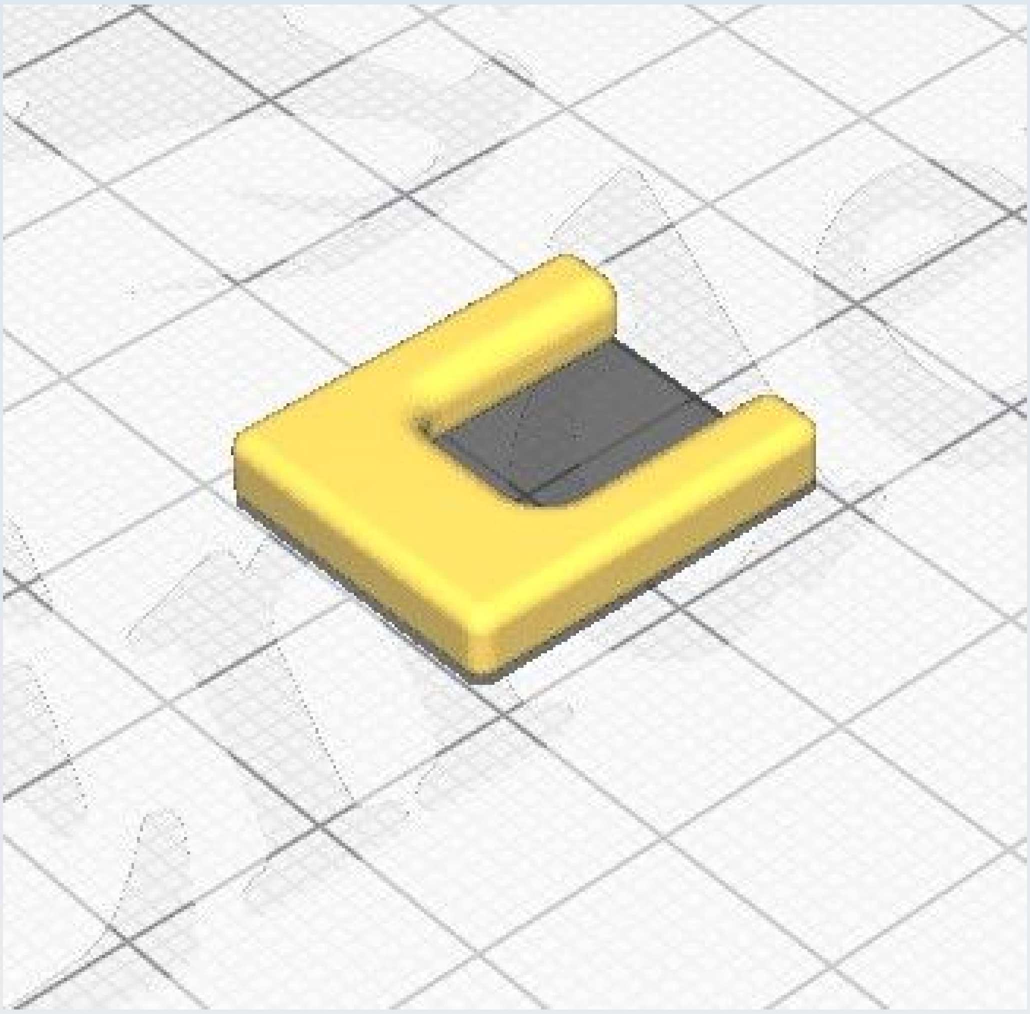


CN_SD_Dorsal_Key_head



This is best printed as a set of 3 models ‘CN_SD_Dorsal_Key_main’, ‘CN_SD_Dorsal_Key_wedge’ and ‘CN_SD_Dorsal_Key_head’ as shown. Note that the ‘CN_SD_Dorsal_Key_main’ model is orientated with the flattened part of its shaft facing the print bed.

CN_SD_Dorsal_Key_key



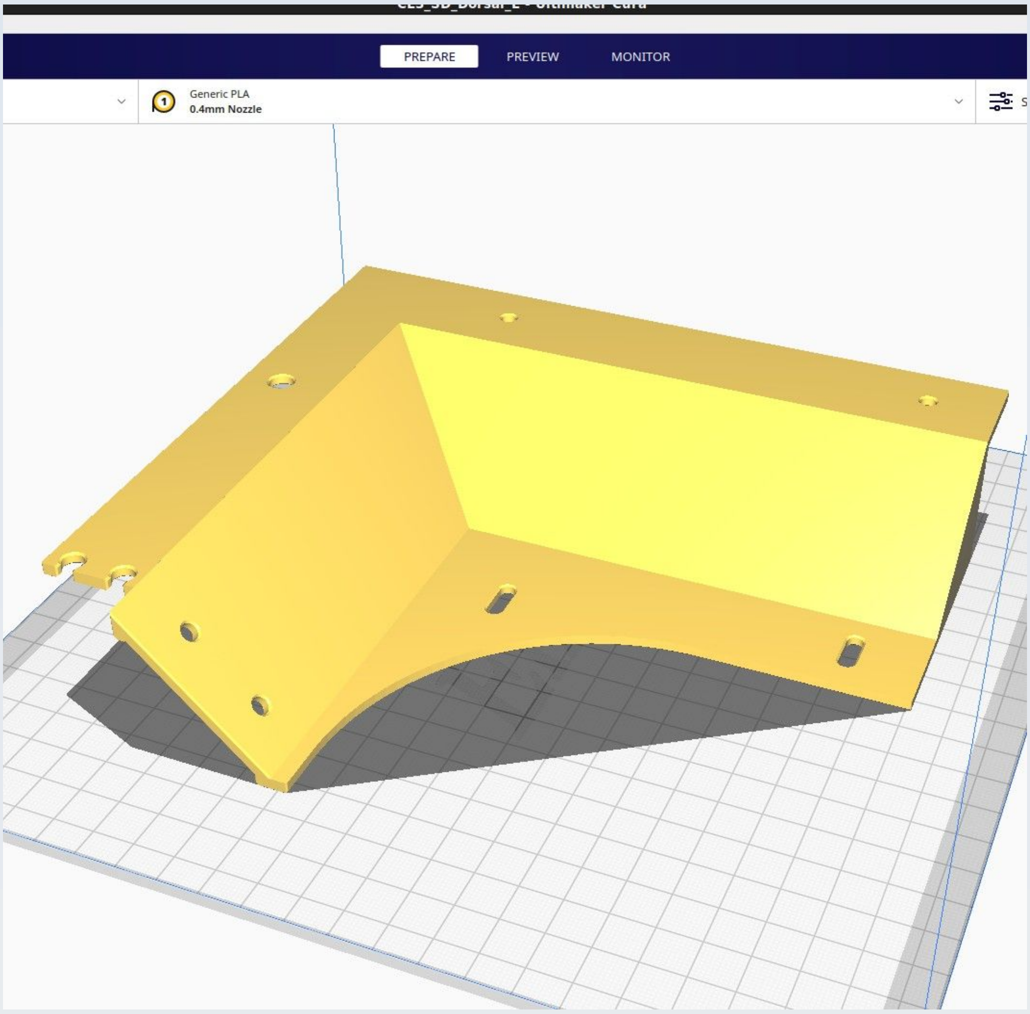
CN_SD_Dorsal_Key_main

This is best printed as a set of 3 models ‘CN_SD_Dorsal_Key_main’, ‘CN_SD_Dorsal_Key_wedge’ and ‘CN_SD_Dorsal_Key_head’ as shown in the illustration in the section on ‘CN_SD_Dorsal_Key_head’ (which, see).

CN_SD_Dorsal_Key_wedge

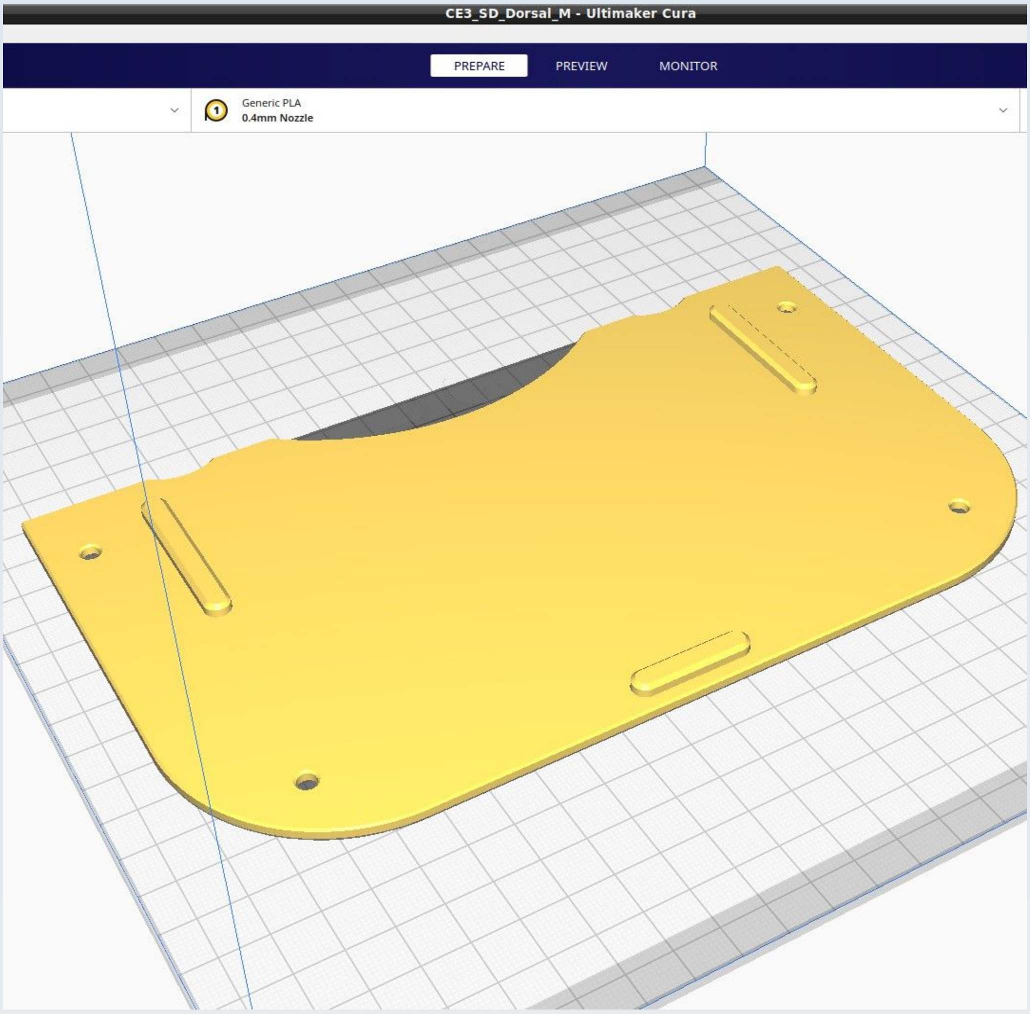
This is best printed as a set of 3 models ‘CN_SD_Dorsal_Key_main’, ‘CN_SD_Dorsal_Key_wedge’ and ‘CN_SD_Dorsal_Key_head’ as shown in the illustration in the section on ‘CN_SD_Dorsal_Key_head’ (which, see).

CN_SD_Dorsal_L

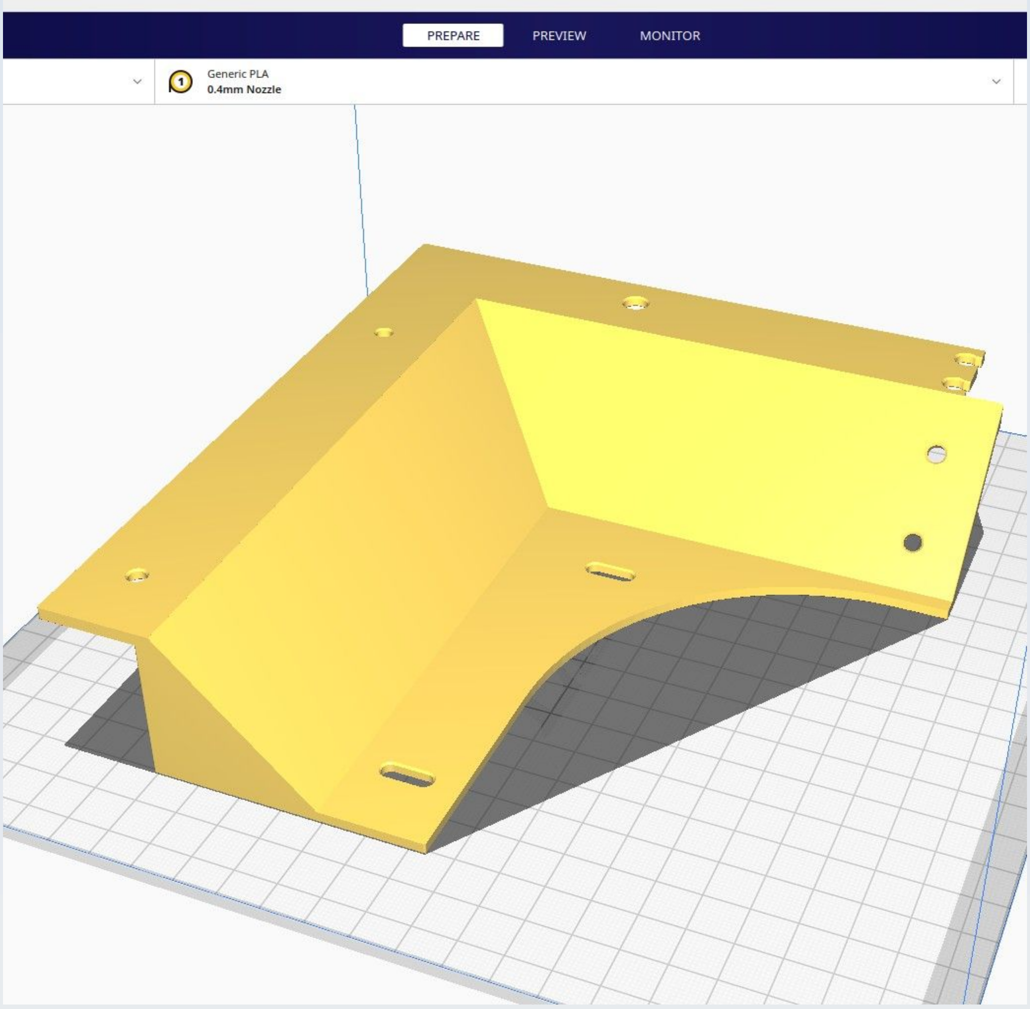


Use ‘Tree’ supports ‘touching buildplate only’.

CN_SD_Dorsal_M

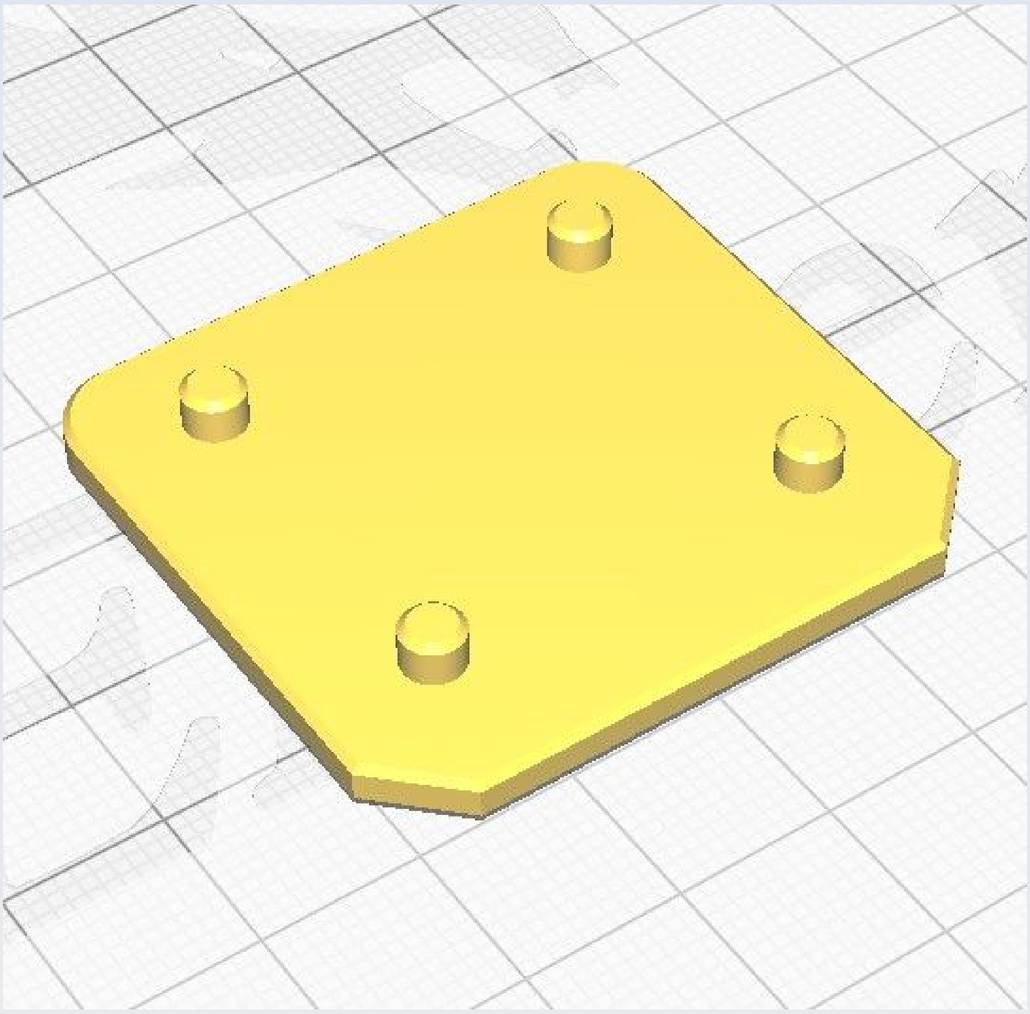


CN_SD_Dorsal_R

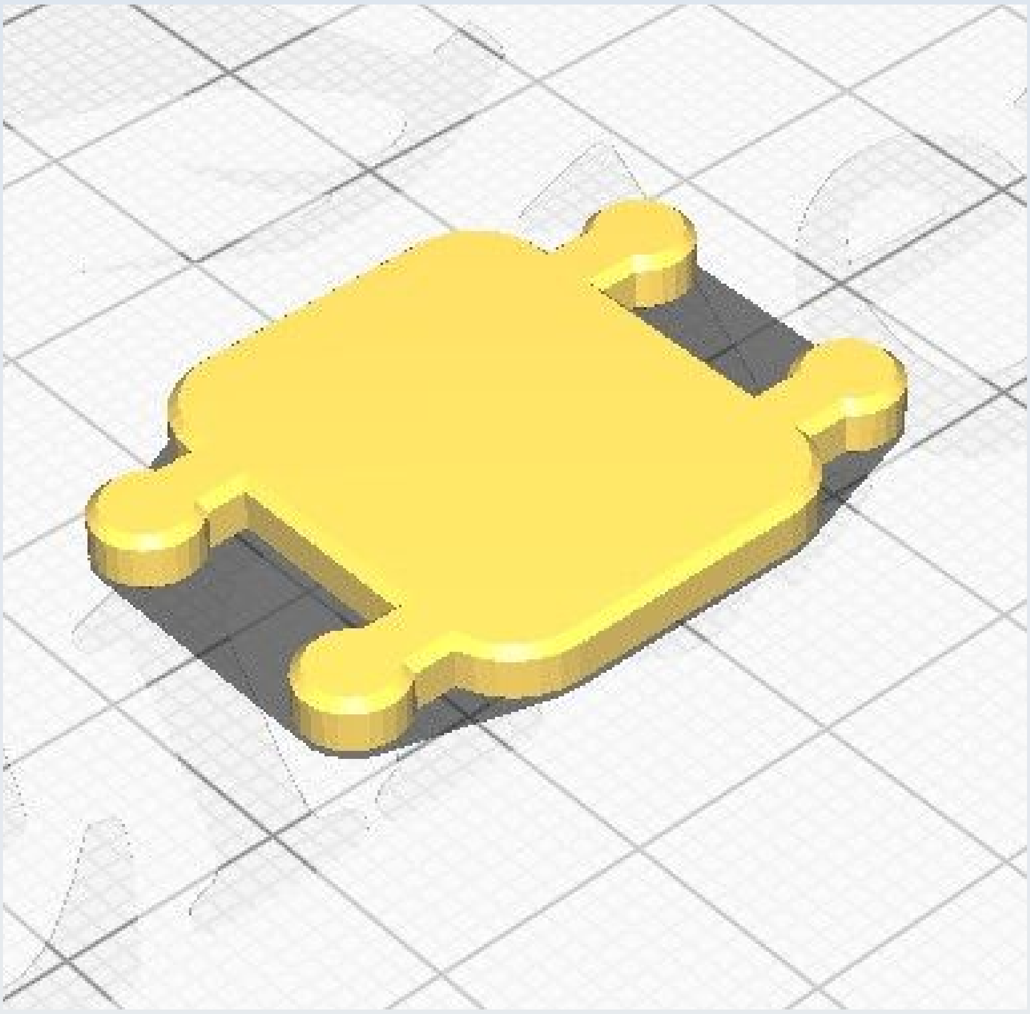


Use ‘Tree’ supports ‘touching buildplate only’.

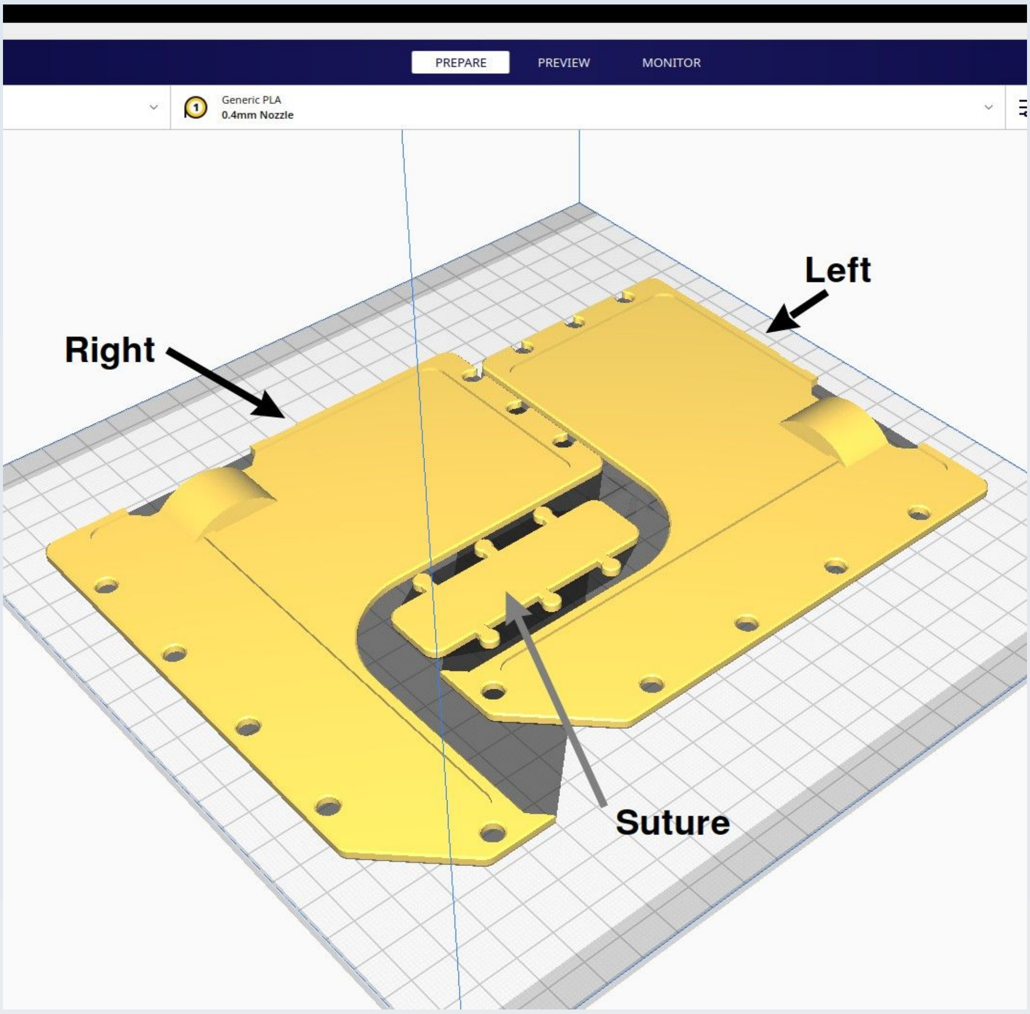
CN_SD_Dorsal_Rivet_plate



CN_SD_Dorsal_suture



CN_SD_Forward_L

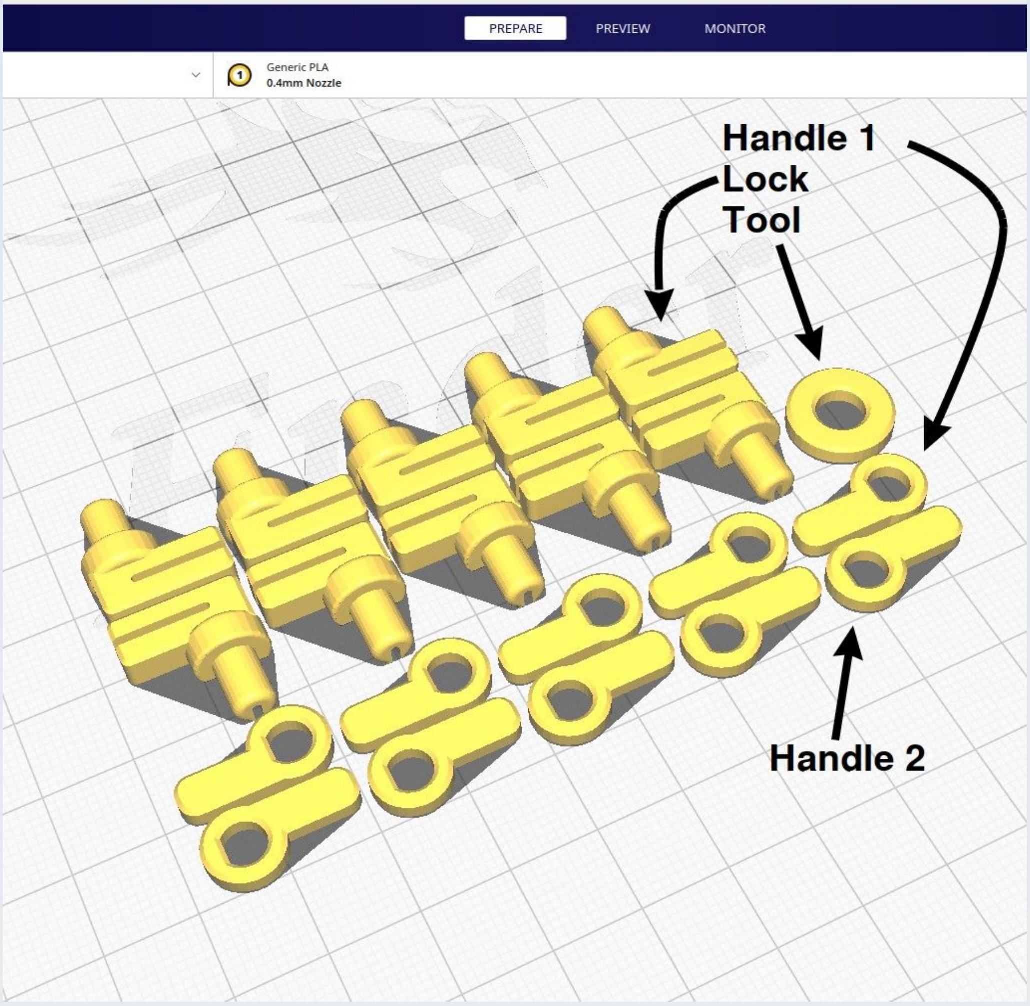


The left and right forward shields may be printed together with the forward suture, as shown. You will need to enable ‘Normal’ supports at an overhang angle of 67 degrees for the shields (the suture does not need this).

CN_SD_Forward_R

See the section on ‘CN_SD_Forward_L’.

CN_SD_Forward_Rivet_handle_1



The ‘rivet-lock’ system for the forward shields are best printed as a set, as shown in the illustration. The system consists in one ‘Tool’ and 10 lots of handled rivet locks, each rivet lock paired with one handle but 5 of the handles are of type 1 (with the flattened part of the aperture closest to the handle) and the other 5 handles are of type 2 (the flat part of the aperture faces away from the handle).

CN_SD_Forward_Rivet_handle_2

See ‘CN_SD_Forward_Rivet_handle_1’.

CN_SD_Forward_Rivet_lock

See ‘CN_SD_Forward_Rivet_handle_1’.

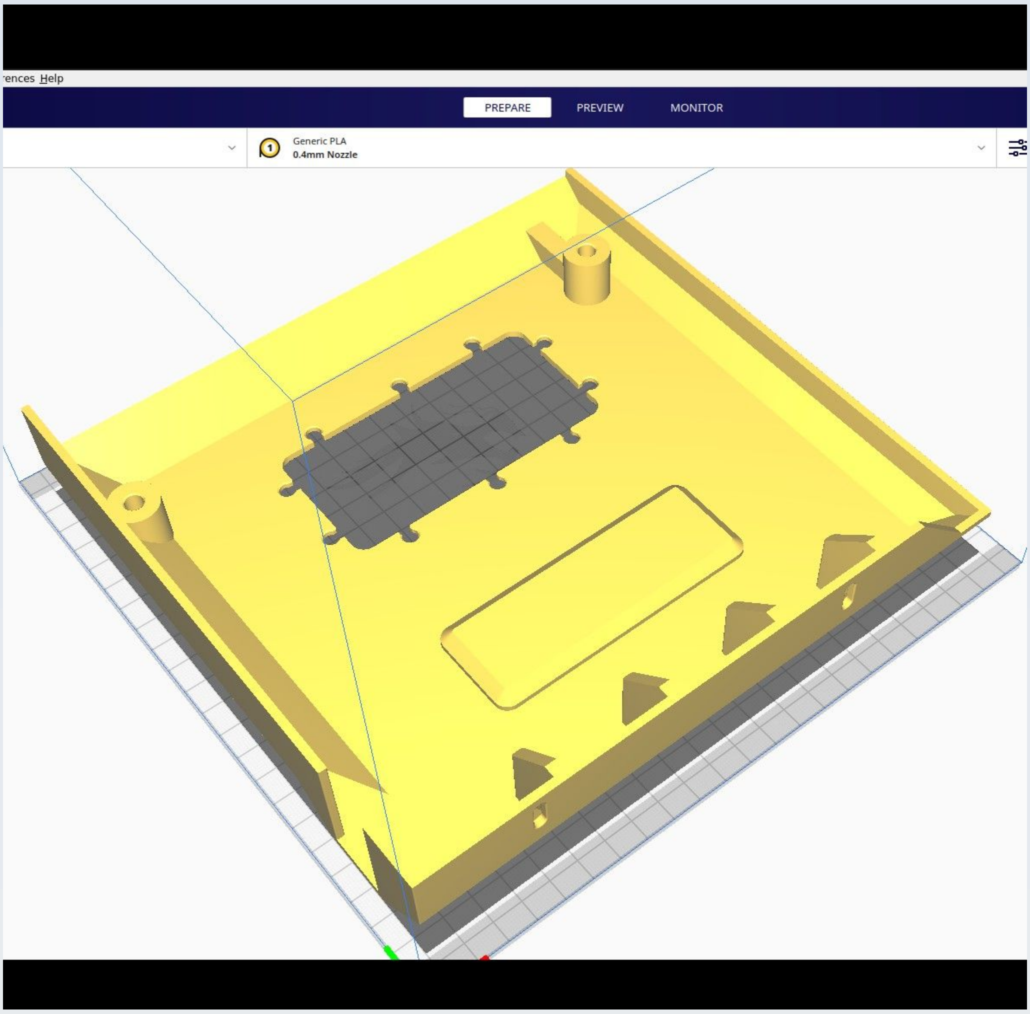
CN_SD_Forward_Rivet_tool

See ‘CN_SD_Forward_Rivet_handle_1’.

CN_SD_Forward_suture

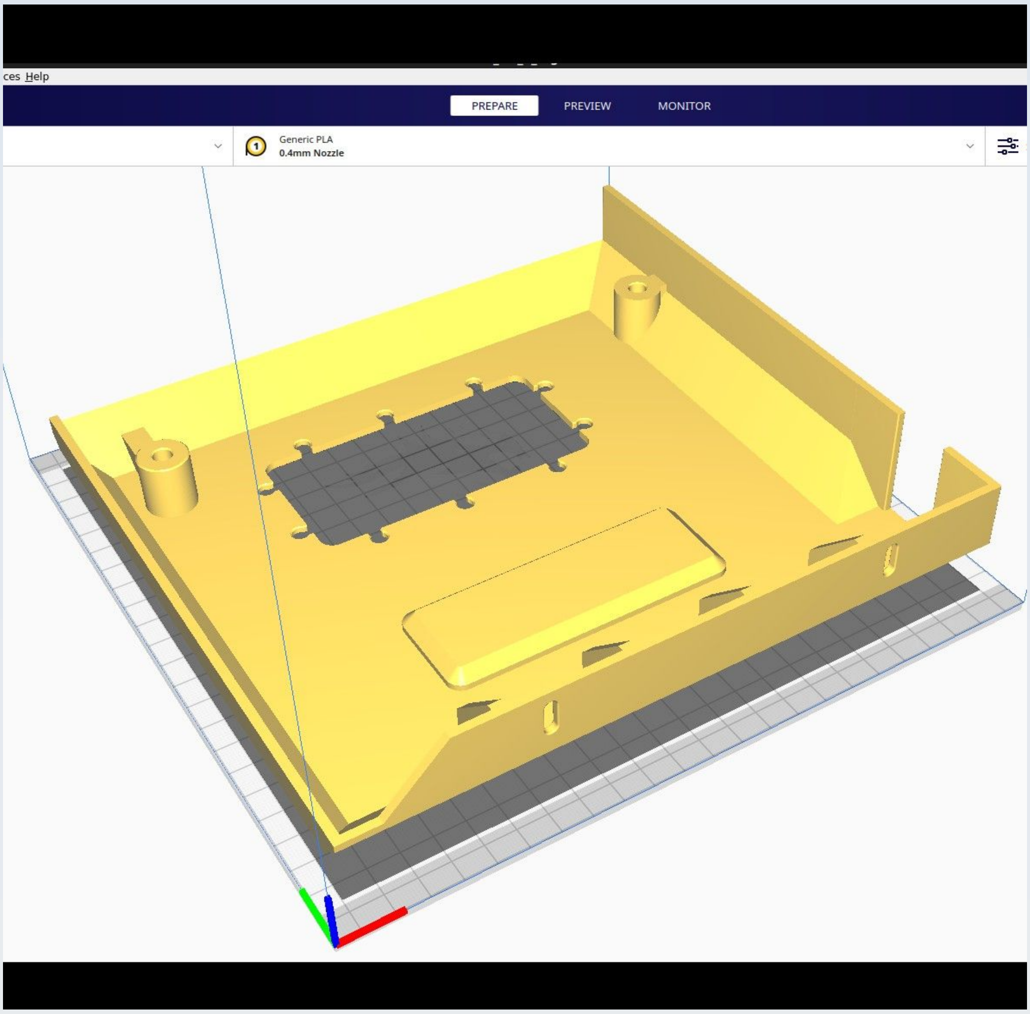
See the section on ‘CN_SD_Forward_L’.

CN_SD_Lateral_Left



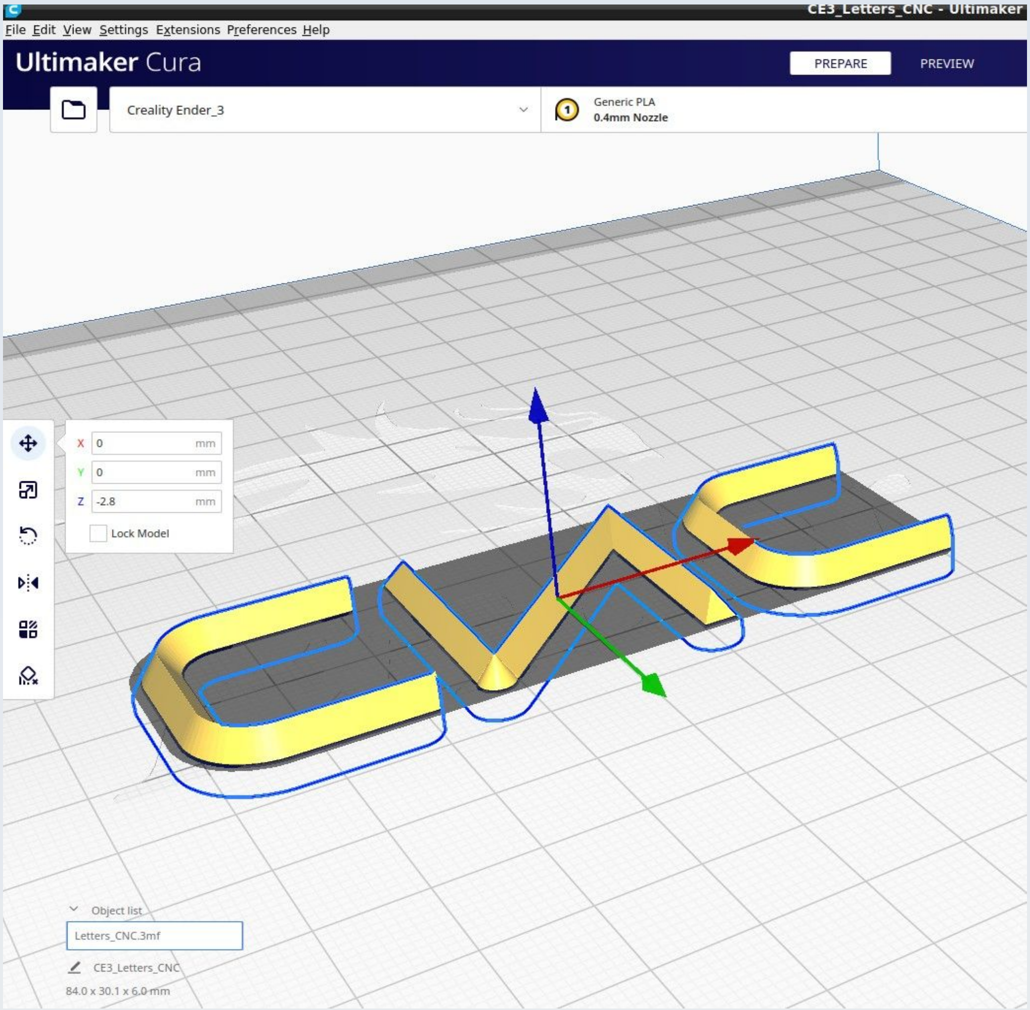
Use ‘Normal’ supports ‘touching buildplate only’ with a 67 degree overhang.

CN_SD_Lateral_Right



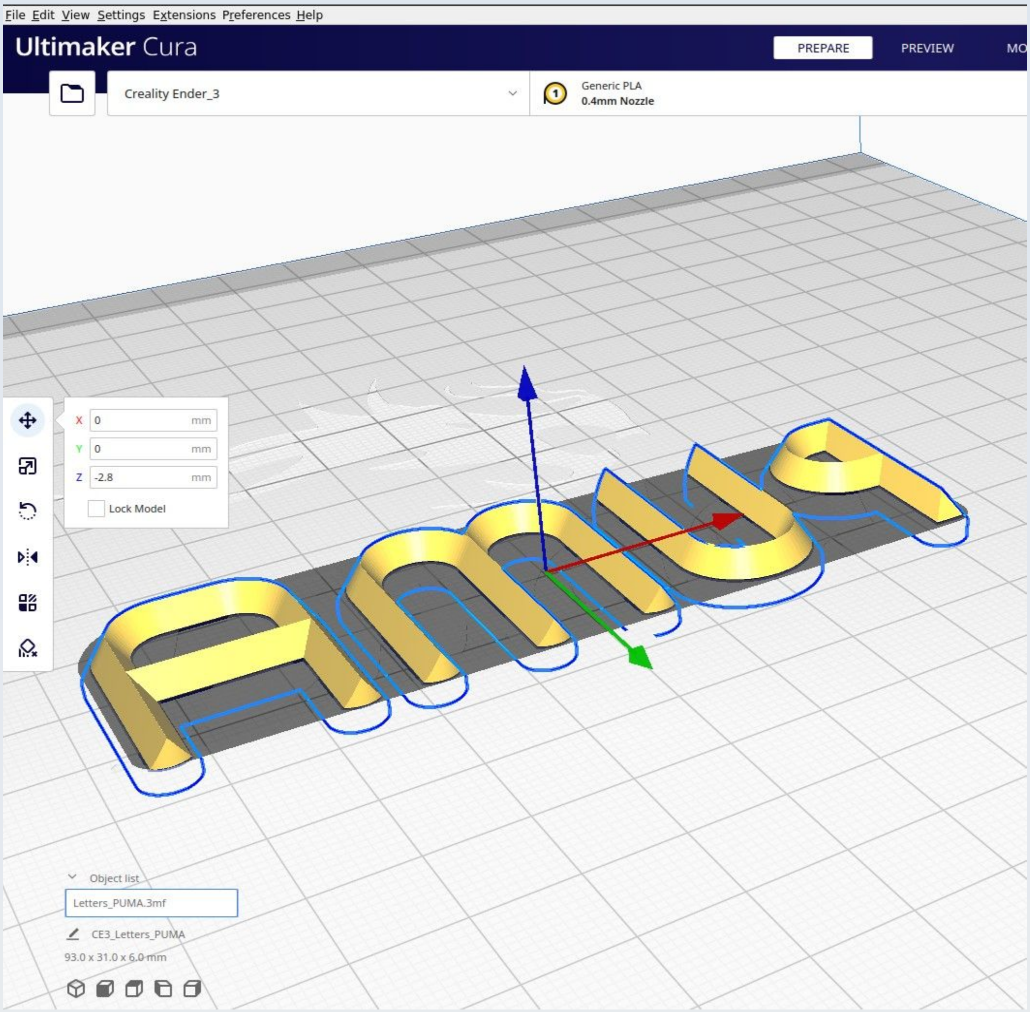
Use ‘Normal’ supports ‘touching buildplate only’ with a 67 degree overhang.

CN_SD_Letters_CNC



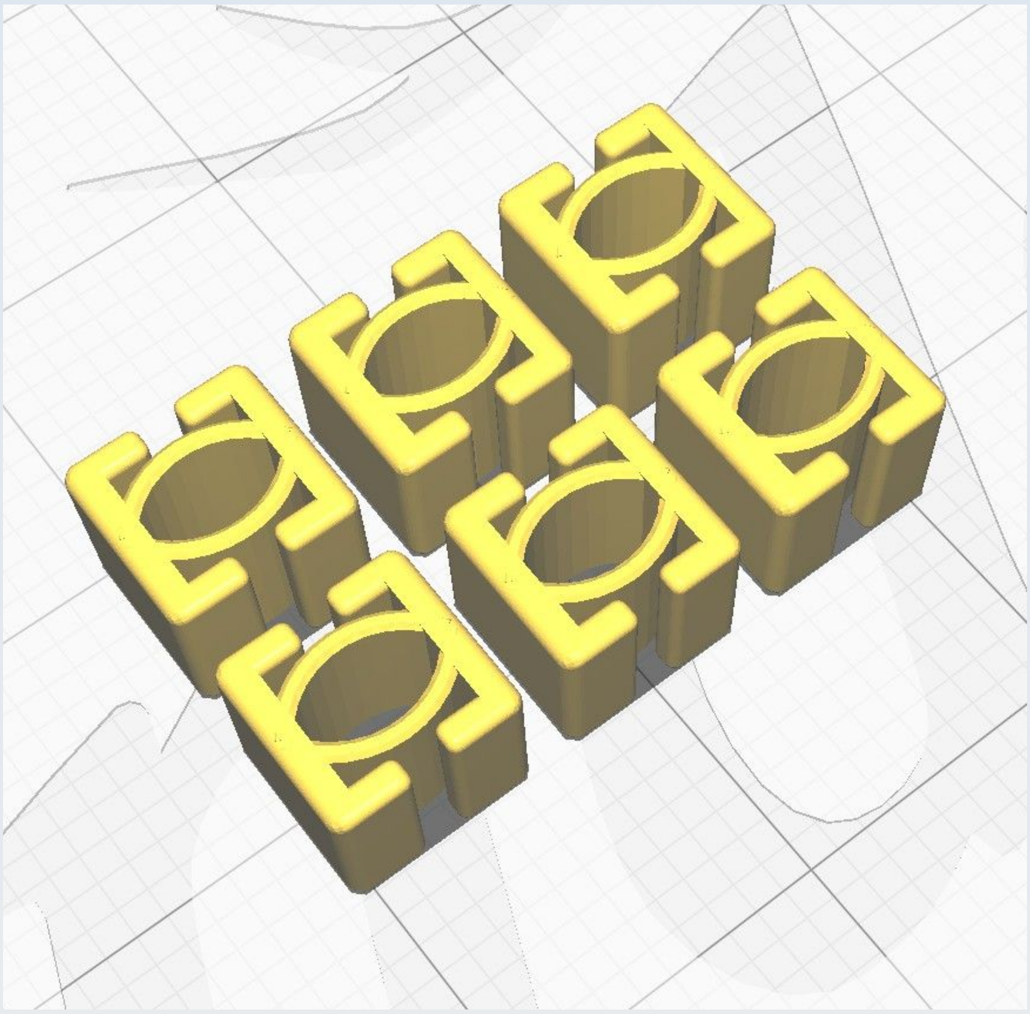
Submerge the model 2.8 mm below the build plate surface before slicing (as shown) and use the ‘Concentric’ value for ‘Top/Bottom pattern’.

CN_SD_Letters_PUMA



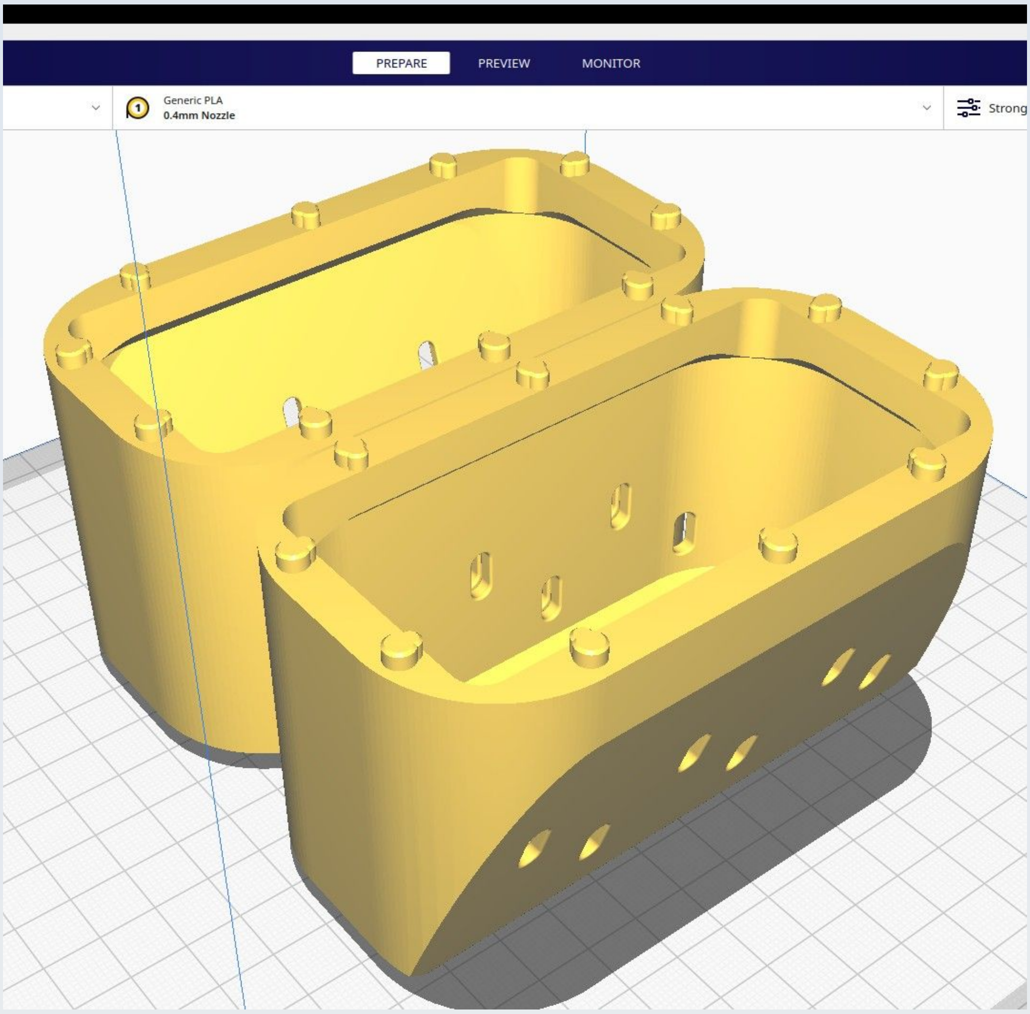
Submerge the model 2.8 mm below the build plate surface before slicing (as shown) and use the ‘Concentric’ value for ‘Top/Bottom pattern’.

CN_SD_T_nut_positioner



These are very small and quick to print and you will need 6 of them so it makes sense to print them all together, as shown.

CN_SD_XMotor_cover_L



The figure shows both the ‘CN_SD_Xmotor_cover_L’ and ‘CN_SD_Xmotor_cover_R’ models positioned on the build plate to be printed togather for convenience.

Note that the two models are not simply the same model rotated but one is a mirror image of the other and some features (notably two of the articulating keys at the top) will be in the wrong position if you try to duplicate one of the models instead of printing left and right models – so don’t do that.

CN_SD_Xmotor_cover_R

See the section on ‘CN_SD_Xmotor_cover_L’, above.