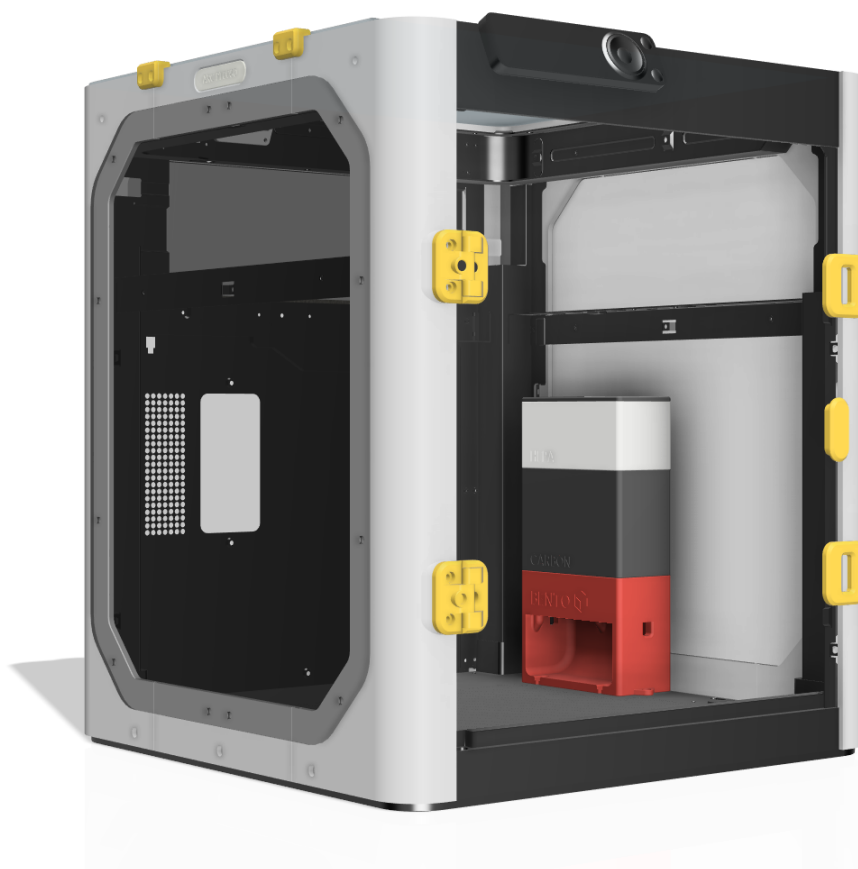


BentoBox V2.0

Installation Guide for BentoBox V2.0 for Bambu Lab Printers

Version 1.1

7 JUL 2023



Design by ThrutheFrame

INTRODUCTION

What is BentoBox?

BentoBox is an activated carbon air scrubber that is installed in an enclosed 3D printer. Its main function is to remove VOCs, small particles and fume within the printer's enclosure. Its secondary function is to circulate the air within the enclosure.

My Design Approach and Why is it called BentoBox

My design approach has always been a minimalist exterior with simple geometry. This makes the part easy to print and pleasant to the eye. The idea of BentoBox was conceptualised while I am eating a bento set at a Japanese restaurant.

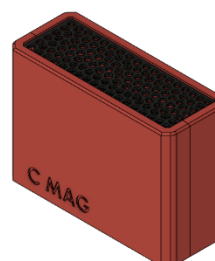
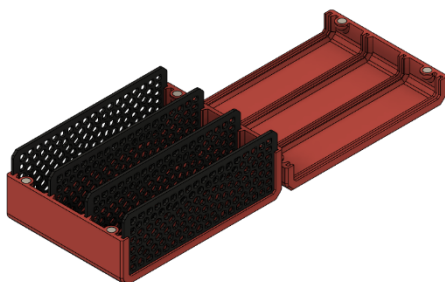
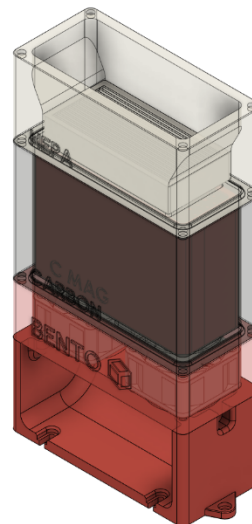
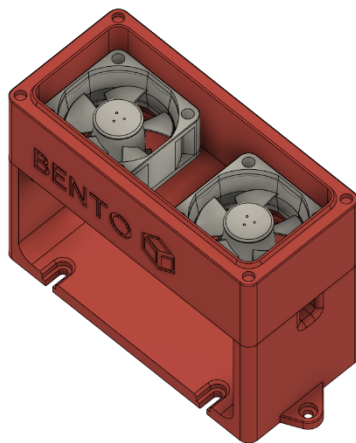
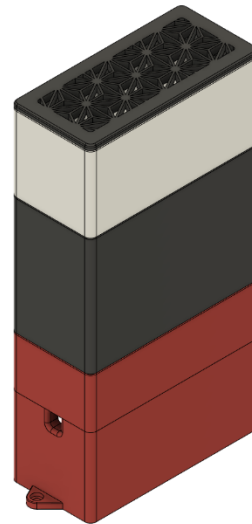
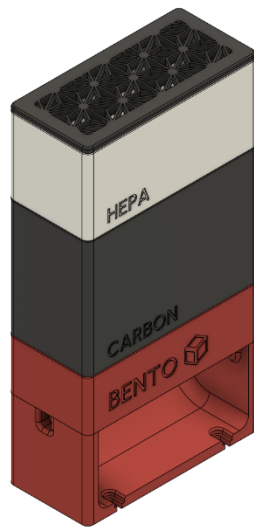
BentoBox pulls the air from the top grill cover through the HEPA and activated carbon filter and pushes it out to the bottom. This process also circulates the hot air from the top to the bottom, keeping the entire chamber temperature constant.

The activated carbon pellets are stored in the carbon magazine, C-MAG for short. A thin layer of pellets is placed inside each section of the C-MAG. This improves airflow through the pellets and VOCs absorption. I got this idea from the food dehydrator.

Bill of Material (BOM)

Item	Qty	Description
4020 or 4028 axial fans	2pcs	As to what voltage to get, it depends on how will be wiring it up. Do not use a Noctua fan. It does not have enough static pressure to pull the air through the carbon pellets.
Brass inserts (M3xOD5mmxL3mm) or (M3xOD5mmxL4mm)	4pcs	
Screws M3 BSCS	4pcs	For 4020 fan - M3x25mm For 4028 fan - M3x32mm
Magnets (Ø4mmL2mm)	32pcs	Optional if you want the parts to magnetically snap together. Always get more magnets than needed. The strength of the magnet range between N35-N42 is sufficient.
HEPA filter 40mmx80mmx15mm (LxBXH)		Amazon Aliexpress
Activated Carbon		Use only acid-free activated carbon pellets. More information is on the project page.

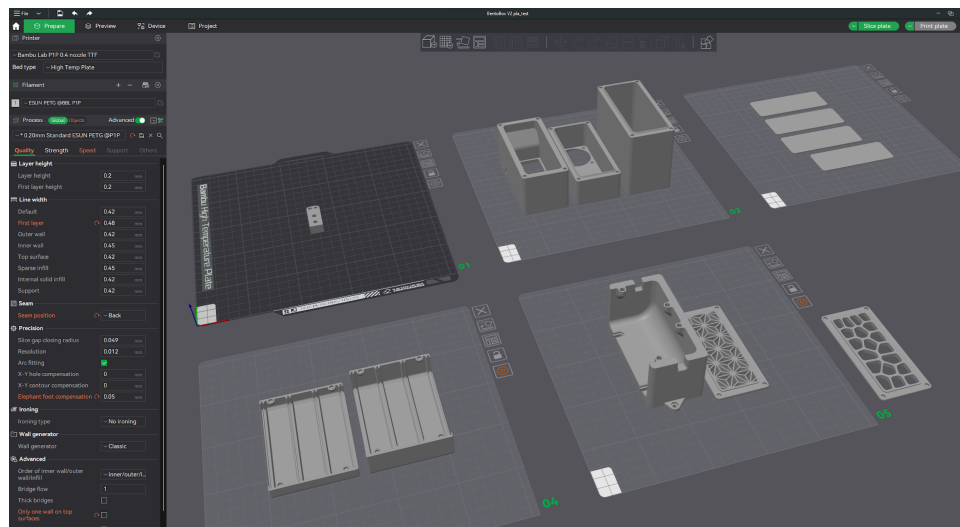
Images of BentoBox V2.0



3MF, SLICING & PRINTING

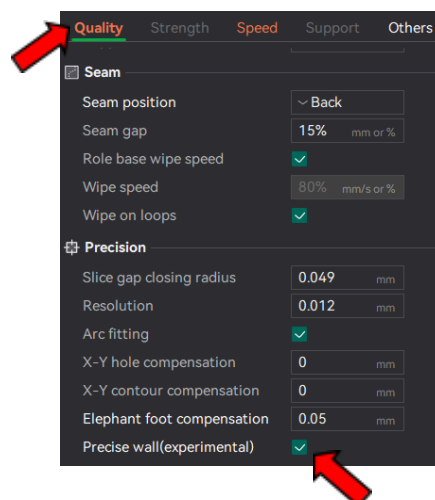
Introduction

There is a total of 5 build plates. While I designed BentoBox in 3 colours, print them in 1 colour to save time and filament. All parts are arranged, seam-orientated and settings are tuned individually. I have my custom code for Bambu Lab P1P printer. Filament settings are tuned for ESUN PETG, it will be slow. If you are using other filaments or printers, please adjust your other setting accordingly. BentoBox is designed with a 0.4mm nozzle and 0.2mm layer height in mind. It is not advisable to increase layer height or use a larger nozzle. Any items placed outside the build plate are considered optional.



Slicing Software

The 3mf file is prepared using Orca Slicer ver1.6.3. I have enabled the “Precise wall” setting to improve the print finish.



Printing

It is known that Bambu Lab printers can print at a very fast speed. But there are limitations when using the high speed and high acceleration capabilities of the printer. Many factors need to consider:

1. Speed vs Quality? What is the finish you are willing to accept?
2. What is the type, brand & specifications of filament used? Is it able to take high-speed printing?
3. Is the pressure advance K value and flow ratio calibrated?

The printing speed and other settings on the 3mf is a guidelines. Users need to adjust accordingly to the environment, filament used and expectation of finish quality. Information and description for each plate in the 3mf file in the next few pages. All the best in the printing journey.

Plate 01

Consist of a test piece to check print accuracy. The top 2 holes are for magnets ($\varnothing 4\text{mm}$ L2mm) - shown by red arrows, and the bottom 2 holes are for brass inserts (M3xOD5mmxL3mm). if you are using ABS or ASA, check the test piece for dimension accuracy 14x36x10mm(LxBxH).

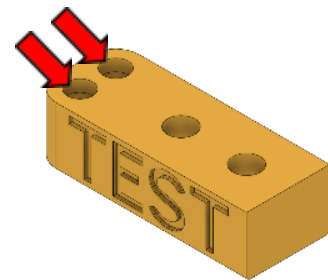


Plate 02

This plate consists of the fan case, HEPA and carbon container. Use a smooth/matte build plate for these parts to improve fitting and air sealing between stacks

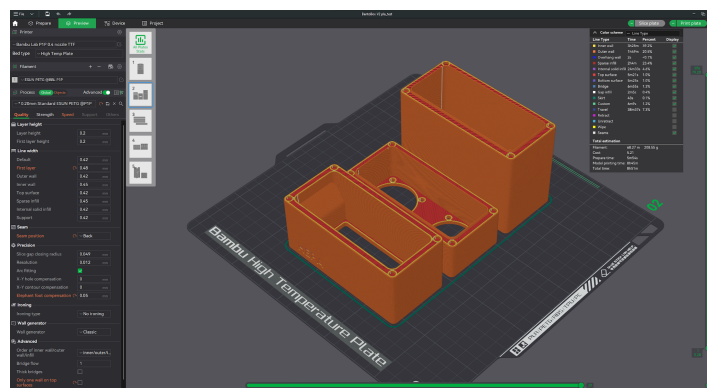


Plate 03

This plate is the hexagonal grid for the container of carbon pellets (C-MAG). You will need to check if these settings are enabled in the objects.

- Wall loop: 8
- Top shell layers: 0
- Bottom shell layers: 0
- Sparse infill density: 24%'
- Sparse infill pattern: Honeycomb
- Infill direction: 0 degree
- Only one wall on top surfaces: OFF

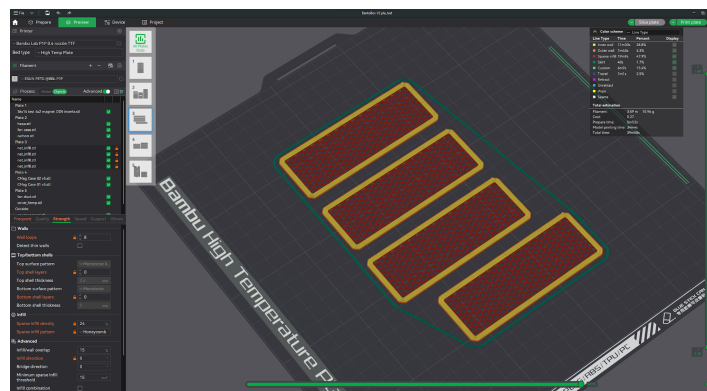
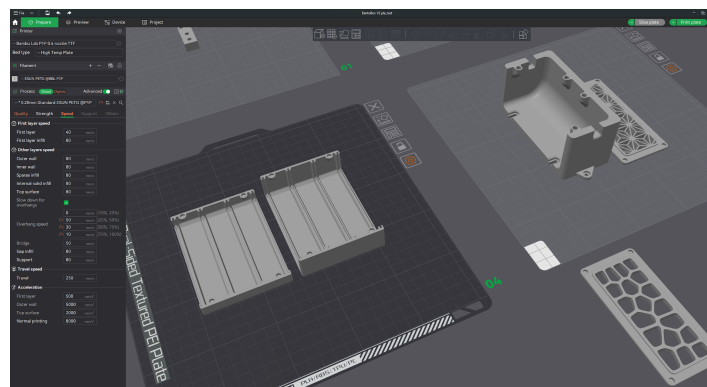


Plate 04 & 05

Textured build plates can be used for 04 and 05, it is for aesthetic purposes and optional, smooth/matte plates can also be used. Plate 04 is the enclosure for C-MAG. Print it slow for better accuracy. There are two top cover patterns on Plate 05; Japanese Hemp and Voronoi. You only need to print one.



INSTALLATION GUIDE

Introduction

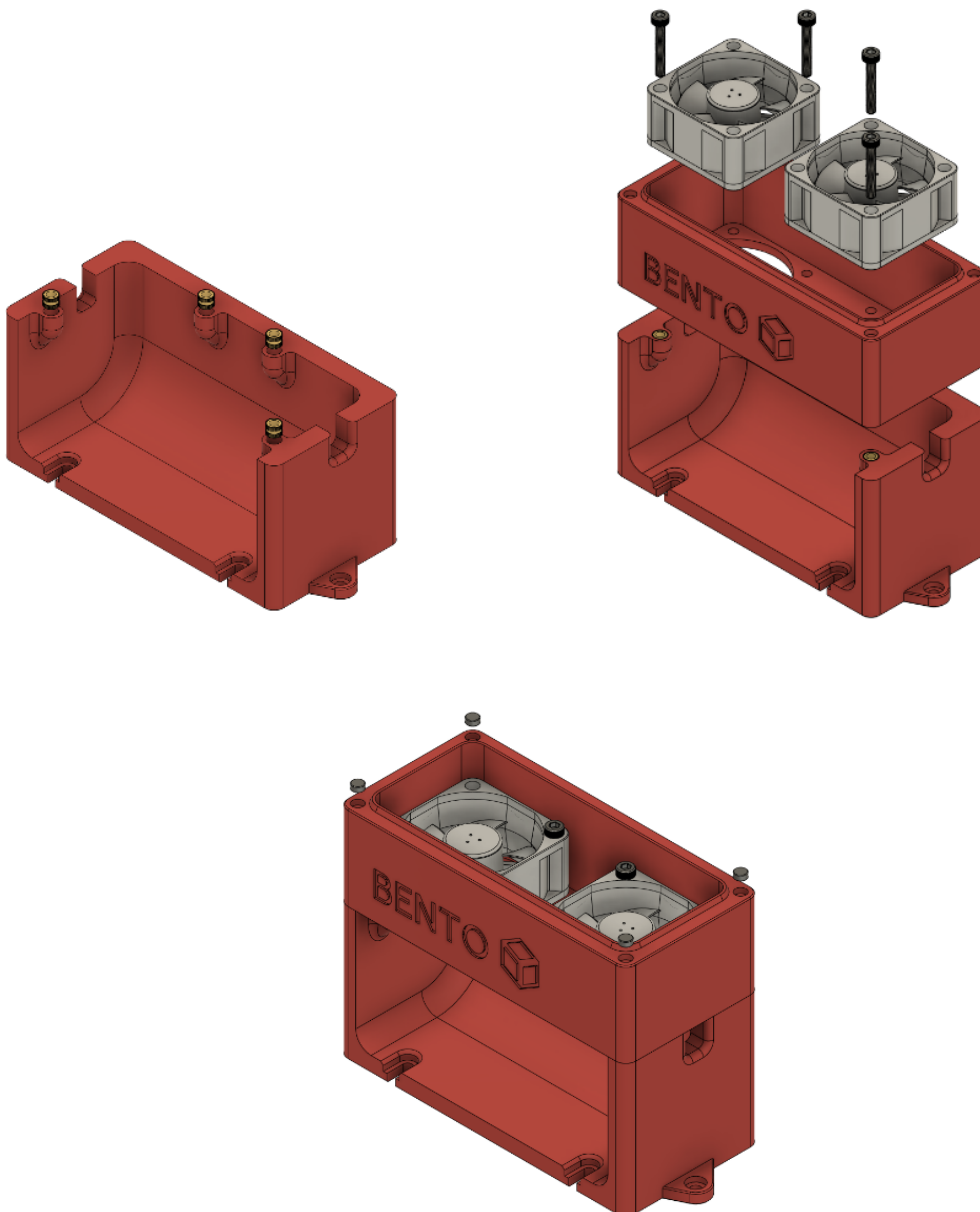
Putting the parts of BentoBox together is pretty straightforward. The main issue to consider is powering the fans. It will also determine what voltage of fan you will need to get. There are several ways.

- Internal power 01 – Using 4020/4028 24V fans and wire directly to the PSU of the printer.
- Internal power 02 – This is for P1P/P1S users. Using 4020/4028 5V fans. There is a 5V 1.5A USB power available at the front of the printer.
- External power – Using a power brick. Choose the fan voltage according to your power brick.
This is the method I use.



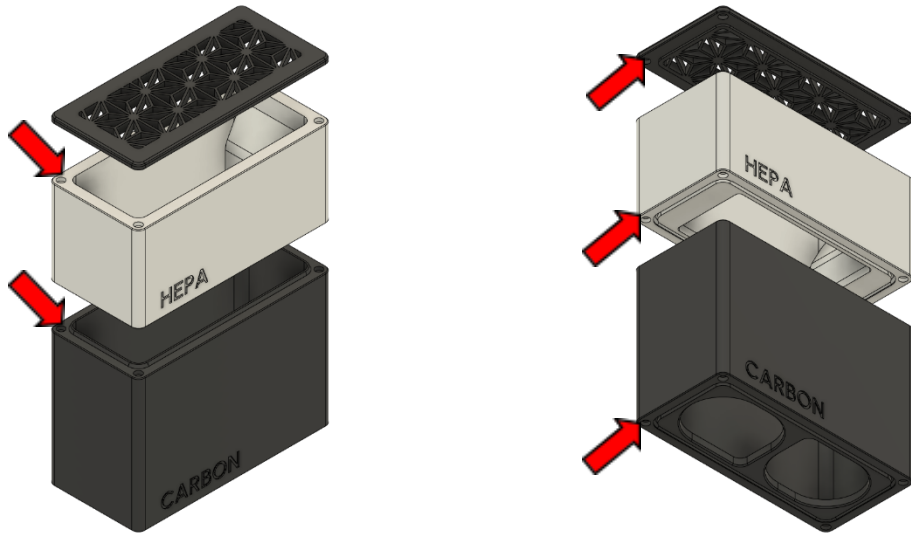
Fan case and duct

- Install the brass inserts onto the fan duct, and ensure it is flush against the surfaces.
- Place the fan blowing downwards. **(Important) BentoBox system pulls air from the carbon case, not push air into the carbon case.**
- Install the fan using the 4 pcs of M3 BHCS to secure the fan case to the fan duct.
- Press fit the magnets into the hole. Take note of the magnets' polarity. You want to get them right at the start. Use a marker to mark the polarity.



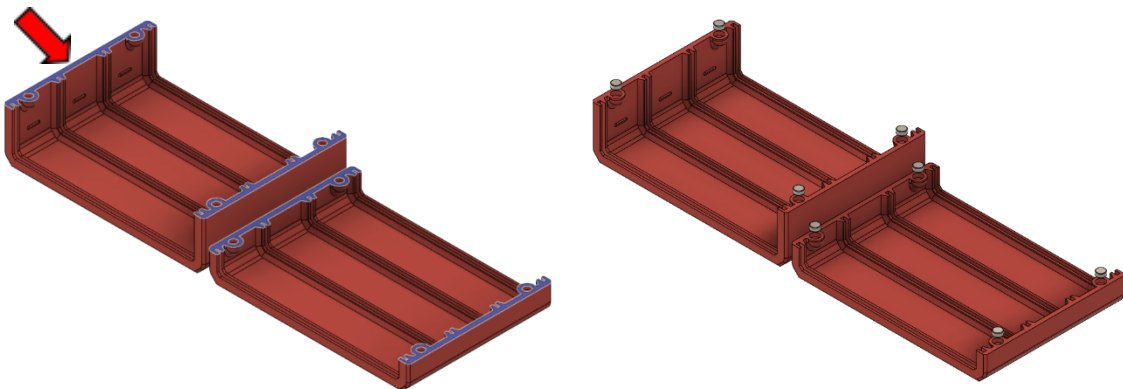
Carbon, HEPA and Cover

- Install the magnets according to polarity. The holes are tight-fitting. Take your time to check before press-fitting the magnets in.
- A total of 20 magnets are needed.

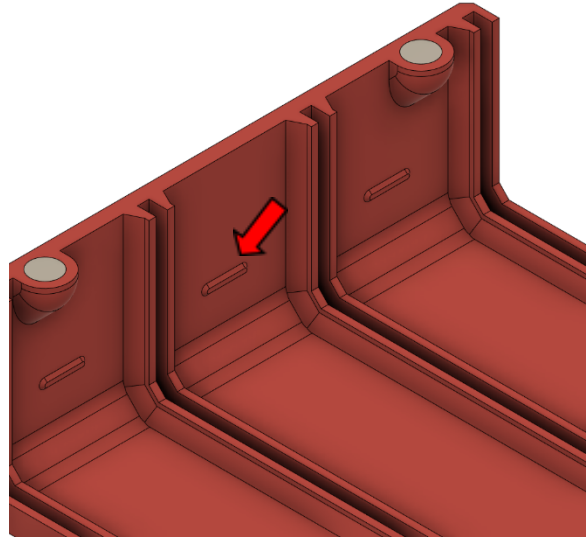
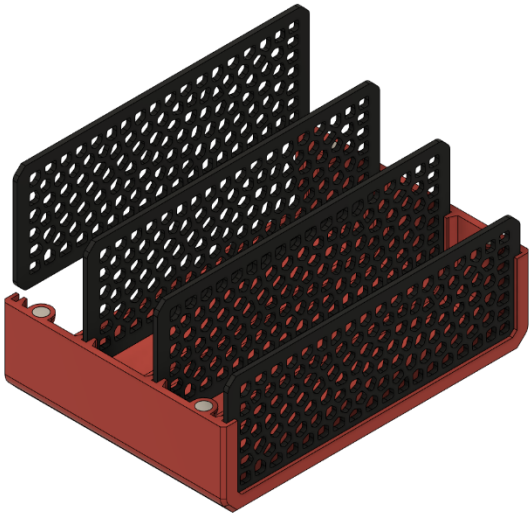


C-MAG

- Sand the edges with fine grid sandpaper (indicated in blue)
- Insert the magnets as shown in the right image. Make sure the polarity is correct.



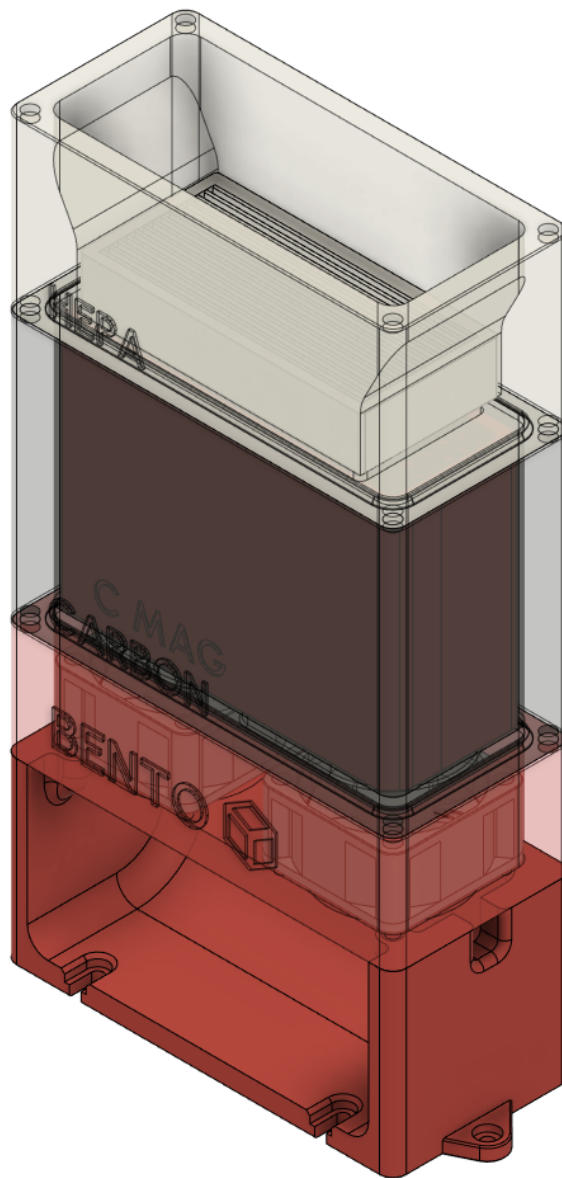
- Insert the grills into the larger cover as seen in the left image. You can use CA glue to bond the grills to this section of the C-MAG.
- Fill the pellets to the indicator line inside the C-MAG as seen in the right image.



- Close the cover and the C-MAG installation is complete.



Putting Everything Together



APPRECIATION

I designed BentoBox because I needed an air scrubber in the X1C. I was going to print ABS, and a single pass filter that the chamber fan uses was not going to cut it. Sharing it online with the community has returned many feedbacks and I felt that it was time to update the design and incorporate ideas that improve the performance of BentoBox. I would like to thank those that had contributed new ideas and kofi to this project.

FAQ

Q: What is the difference between version 2.0 & version 1.0?

A: While the exterior looks identical, the internal is totally revamped. For example, the magnets are now smaller with thinner walls, thus using less filament. Parts from version 1.0 and 2.0 are not compatible.

Q: Why do you not use 5015 blower fans instead of a 4020/4028 axial fan?

A: Using 5015 (push) or 4020 (pull) makes very little difference because both are relatively low-pressure fans. What makes a difference in performance is the unobstructed distance of the fan to the carbon pellets.

I notice remixes of BentoBox where 5015 fans push air through the HEPA filter followed by the carbon pellets. If you imagine the blower fan is waves and the HEPA filter is the wave breaker on the beach. Once waves hit the breaker, a lot of initial force is lost. There will be very little air movement through the carbon pellets. On the other hand, BentoBox pulls air by creating a low-pressure system directly below the carbon pellets. In my opinion, it is a more efficient system.

Q: Is BentoBox an open-source project? If yes, where can I download the STEP files

A: While BentoBox is free for personal use, it is **not** an open-source project. The STEP or Fusion design file will not be shared openly. But I am always open to good ideas /remixes.

Q: How can I contribute to the BentoBox project.

A: Post your build online (Facebook group, Bambu Lab Discord, Reddit, Printables). Spread the word about your experience with BentoBox. Make a contribution to my Kofi or paypal.me. More information can be found at:

<https://www.printables.com/model/272525-bambu-lab-x1c-bentobox-air-filter>