

Procedure for Using Bambu labs H2S VEC-402

1. Bambu H2S is a 3D printer using FDM (Fused Deposition Modeling). The complete package consists of:

- Bambu Labs H2S and accessories.
- Bambu H2S Air Purifier i.e. HEPA Filter, pre grade filter, activated carbon filter type VOC filtration, particulate Matter Filtration
- Picture of installed system



d.

2. Precautions

- The “hotend” nozzle, i.e. extruder can reach **200–300 °C**; The heated bed can reach **100 °C+**. Avoid touching them during and right after printing.
- Although FDM printing can use many different types of materials. PLA will be the main filament type used. PLA is chosen because it is safest but there is still a small risk of emitting ultrafine particles. For this reason, the air purifier which consists of a HEPA filtration unit must be on at any time during the 3d printing process.
- PLA (Polylactic Acid) is widely considered the safest filament for hobby FDM 3D printing. Here is why:
 - Made from renewable resources like **corn starch, sugarcane, or cassava**.
 - Not petroleum-derived, unlike ABS, ASA, PETG, etc.
 - Breaks down more readily in industrial composting compared to most plastics.
 - Prints at **~180–220 °C**, much lower than ABS or Nylon.
 - Lower temps mean reduced risk of thermal degradation and fewer toxic byproducts.
 - Heated bed is often optional or only mildly heated (~50–60 °C).
 - Emits **far fewer ultrafine particles (UFPs)** and volatile organic compounds (VOCs) compared to ABS or ASA.

3. Engineering Controls

- Store filament dry and away from dust; moisture can cause poor prints and nozzle popping.
- Only run the 3d Printer with the front door closed to facilitate air extraction and to improve safety by preventing hands from touching the “hotend” or heated bed
- Operate the Bambu H2S on a stable surface. The system will be installed in VEC-402



4. Administrative Controls

- a. Do not work alone in the lab. Implement the buddy system.
- b. Attend baseline laboratory safety training.
- c. Attend laboratory-specific training on 3D printer work which should include reading the operation manual for the 3D printer, maintenance manuals, and any other training materials. Ask your lab safety officer if you have any questions.
- d. Only those trained to repair equipment should conduct maintenance or repair on the 3D printer.
- e. Review this SOP and applicable safety data sheets as part of your laboratory specific training. All safety sheets for all materials used in a 3D printer process must be reviewed prior to use of the 3D printer.
- f. Keep a hard copy of the safety data sheet (SDS) for the specific filament material used in the 3D printer next to the printing station.
- g. Only authorized personnel should be allowed to operate 3D printers.
- h. 3D printers must be installed, operated, and maintained according to the manufacturer's instructions.
- i. Clean up work areas promptly after use and properly dispose of dust, scraps, and waste. Use wet methods for cleaning up dust.
- j. Turn off, unplug and cool down the unit prior to cleaning or maintenance.
- k. Follow manual maintenance guidelines and procedures

5. Personal Protective Equipment

- a. No gloves, eyeglasses or special protective clothing are needed during normal usage.
- b. After a 3d printed part has been made, eyeglasses are needed if removing supports or attempting other modifications to the 3d printed part.

6. Storage

- a. Store unused filaments dry and away from dust; moisture can cause poor prints.

7. Disposal

- a. 3d printed parts made from PLA may be safely disposed of in the trash.

8. Emergency Procedures

- a. Fire:
 - i. Evacuate the lab, pull the nearest fire alarm pull station and then go to a safe area and call 911 or 562-985-4101 from a cell phone. Follow the fire safety evacuation plan.
- b. Work-related employee injuries/illnesses occurring during normal working hours (Monday-Friday, 7:00 AM to 5:00 PM) shall be immediately reported (verbally) to the PI. Serious injuries MUST be reported to the Worker's Compensation Manager immediately to allow for compliance with the CAL/OSHA 8-hour reporting time frame.

9. References and Additional Resources

- a. ISO/TC 261 Technical Committees. <https://www.iso.org/committee/629086.html>
- b. ASTM International Committee F42. <https://www.astm.org/COMMITTEE/F42.htm>
- c. ASTM International. AM Standards Structure and Primer. https://www.astm.org/COMMIT/F42_AMStandardsStructureAndPrimer.pdf
- d. ANSI/CAN/UL 2904-2019. Standard Method for Testing and Assessing Particle and Chemical Emission from 3D Printers.
- e. NIOSH Slides. Overview of Additive Manufacturing and Potential Occupational Hazards. https://orau.org/ihos/downloads/meetings/support-files/2019/NIOSH/GRoTh-AM_Proc_Haz.pdf
- f. NIOSH Science Blog. Characterizing 3D Printing Emissions and Controls in an Office Environment. <https://blogs.cdc.gov/niosh-science-blog/2018/08/16/3d-printing/>
- g. Steinle, P., 2016. Characterization of emissions from a desktop 3D printer and indoor air measurements in office settings. Journal of occupational and environmental hygiene, 13(2), pp.121-132.
- h. Azimi, P., Zhao, D., Pouzet, C., Crain, N.E. and Stephens, B., 2016. Emissions of ultrafine particles and volatile organic compounds from commercially available desktop three-dimensional printers with multiple filaments. Environmental science & technology, 50(3), pp.1260-1268.
- i. Oskui, S.M., Diamante, G., Liao, C., Shi, W., Gan, J., Schlenk, D. and Grover, W.H., 2015. Assessing and reducing the toxicity of 3D-printed parts. Environmental Science & Technology Letters, 3(1), pp.1-6.
- j. Occupational Safety and Health Administration (OSHA) Annotated TABLE Z-1. <https://www.osha.gov/dsg/annotated-pels/tablez-1.html> 11. ACGIH® 2019 Threshold Limit Values for Chemical Substances in the Work Environment. See <http://www.acgih.org/>.
- k. NIOSH Pocket Guide to Chemical Hazards. <https://www.cdc.gov/niosh/npg/default.html>
- l. NIOSH slides. Additive Manufacturing: Observations, Hazards, and Opportunities. https://www.turi.org/Our_Work/Training/Continuing_Education/Recent_Training_Presentations/Continuing_Education_Conference_Spring_2018/Additive_Manufacturing_Observations_Hazards_and_Opportunities
- m. NIOSH Science Blog. Potential Hazards of Additive Manufacturing. <https://blogs.cdc.gov/nioshscience-blog/2019/04/09/am/>

- n. Baldauf, R. Ultrafine Particle Metrics and Research Considerations: Review of the 2015 UFP Workshop. In Proceedings, EPA Workshop - State of Science on Effect of Ultrafine Particles, RTP, NC, February 04, 2015. MPS Multimedia Print Service, Domodossola, Italy, 1054, (2016).
- o. Emissions of Ultrafine Particles and Volatile Organic Compounds from Commercially Available Desktop Three-Dimensional Printers with Multiple Filaments. Parham Azimi, Dan Zhao, Claire Pouzet, Neil E. Crain, and Brent Stephens. Environmental Science & Technology 2016 50 (3), 1260-1268 DOI: 10.1021/acs.est.5b04983.

PI for the lab is responsible to monitor and change out the HEPA filters after a total printing time of 1,440 hours (or 60 days). A filter change out log will be posted on or nearby the equipment. The PI is required to document training for all students allowed to use this equipment by recording their information and signature below.

I acknowledge that I have read and understand the content of this SOP. Furthermore, should I encounter conditions not covered in this SOP that may endanger my health or safety or the health or safety of others while operating this device, I will stop all work and request assistance from the principal investigator or COE Safety Officer.

[illegible]