3D Printer Safety

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Research Safety
Office of Research
UNIVERSITY OF GEORGIA

I. Purpose & Scope

This document is meant to provide an overview of the University's requirements and recommendations for the safe placement and use of 3D printers in offices, workspaces, and laboratories around campus. In recent years, 3D printer technology has become ubiquitous around college campuses but the health and safety concerns inherent with this equipment have often been given little regard. Under normal conditions of use, 3D printers can emit coarse, fine, and ultra-fine particles as well as volatile organic compounds (VOCs), some of which are known to be hazardous.

II. Feedstock Types

The list below is not intended to be all-inclusive, but to give a general overview of some of the more commonly used feedstock (filament) types available for 3D printers. There are other types not shown on this list.

A current Safety Data Sheet (SDS) for each feedstock in use should be kept in the lab or at least in a location that is readily available to all users of the printer. It is important to understand the hazards posed by the filament you're using prior to use. When not in use, feedstock should be stored in accordance with manufacturer's instructions.

- Polyactic Acid (PLA) – Recognized to be generally safe and non-toxic in its natural form. Made from corn starch and sugar cane and is thus biodegradable.
- Acrylonitrile butadiene styrene (ABS) – Made from petroleum based products and one of the most commonly used feedstocks. Recognized as toxic due to the harmful microparticles it emits during the printing process. The feedstock also generates a strong smell but the material generates images that can withstand higher temperatures.
- Polyvinyl Alcohol (PVA) – Generally non-toxic and water soluble.
- Nylon Polyamide – Strong yet flexible material that is extremely sensitive to moisture and will emit toxic fumes when heated.
- Polycarbonate – Very strong filament resistant to impact but can emit toxic fumes when exposed to extremely high temperatures.

III. Safety Concerns

A. Toxic Emissions

Studies have shown that different filament types can emit ultrafine particles (UFP)

and VOCs during the printing process, some of which present a toxicity hazards to users and those in the immediate vicinity. Emitted substances include styrene and methymethacrylate, both of which are toxic by inhalation and can lead to bronchitis, eye irritation, and aggravate asthma symptoms for susceptible populations. Long term exposure can have detrimental effects on the brain and nervous system as well.

Therefore, all 3D printers should be set up in a well-ventilated space and if possible have local exhaust control available such as a snorkel hood (local exhaust ventilation would be a requirement if the printer needed to be set up in an area with poor general ventilation). Generally, offices, classrooms, and libraries do not provide the necessary ventilation for the safe operation of 3D printers. Large workrooms, shops, makerspaces, and laboratories usually have the appropriate ventilation and air turnover rates for appropriate use of 3D printers.

It is recommended that users contact the Office of Research Safety or the Environmental Safety Division prior to purchasing a 3D printer if they have questions about the ventilation in their space(s).

B. Heat

The extrusion temperatures for many of the feedstocks listed above is typically in the range of 190-260°C. Additionally, some 3D printers also have heated beds to keep the plastic at an elevated temperature during printing to prevent plastic warping. The bed temperatures are usually much lower than the extrusion temperatures but can still reach upwards of 120°C.

These temperatures can cause extreme burns; consequently, manipulation of the filament and/or printer during operation should be strictly prohibited. Any sort of adjustment to the printer that would necessitate handling of the bed or extrusion instrument should only be performed after powering down the printer and allowing for a cool down period.

Additionally, 3D printers should not be left on and unattended for an extended period of time as some heat beds have been known to catch fire under such circumstances.

Some 3D printers are kept within a complete enclosure, which mitigates the potential burn hazards. However, for printers that are not enclosed, extreme heat and burns should be a concern that is considered when setting up and operating the instrument.

C. Mechanical Risks/Moving Parts

3D printers contain several moving parts that while unlikely to cause serious injury can still entrap a user's finger, hair, or loose clothing, particularly if the printer is not housed in an enclosure. For this reason, loose hair, clothing, scarves, and jewelry should be secured prior to working with a 3D printer.

IV. Other General Safety Considerations

Users should not alter or modify 3D printers in any way. All printers should be used as specified by the manufacturer. By removing instrument covers to make alterations or modify a printer, users can be exposed to dangerous electrical voltages.

Follow all personal protective equipment (PPE) recommendations on the SDS for the filament being utilized.

Uncured printing material is hazardous and should only be handled while wearing nitrile gloves. If any uncured material requires disposal, it should be disposed of as hazardous waste.

During post-processing, it is often necessary to use flammable solvents such as acetone or tetrahydrofuran, or corrosive baths made with sodium hydroxide. The use of these substances should only be done within a fume hood and with appropriate PPE including gloves, lab coats, and safety glasses.

V. Contacts

Environmental Safety Division: 706-542-5801
Office of Research Safety: 706-542-5288

VI. References

3D Printer Safety, Concordia University, Environmental Health & Safety Office, 2017.

ANSI/UL 2904: Standard Method for Testing and Assessing Particle and Chemical Emissions From 3D Printers, 2019.