3D PRINTER SAFETY

3D PRINTING AT THE UW

3D printing, also known as additive manufacturing, occurs on UW campuses in maker spaces, research labs and classrooms. Fused deposition modeling (FDM) and stereolithography (SLA) are the most common types of printers at the UW. 3D printing allows for custom prototyping of components to help designers. It also allows makers to create custom objects of their own design.

It is important to implement safety measures when working with 3D printers to prevent exposure to potential health or safety hazards depending on the material and printing processes used. Users should understand the potential risks associated with their specific printers and adhere to the safety practices outlined in this focus sheet.

POTENTIAL HAZARDS

- Inhalation of ultrafine and nano-sized particles
- Inhalation of volatile organic compounds (VOCs)
- Exposure to ultraviolet radiation and lasers
- Flammable solvents and powder
- Sharp edges
- Thermal or chemical burns
- Electrical shock

3D printers

SAFETY MEASURES

BEFORE WORK

- Get **trained** on the standard operating procedures (SOP) for your printer. An SOP should be available for every type of printer; download templates from the EH&S website.
- Review the printer **operations manual** and instructions.
- Conduct an **inspection** (refer to the standard operating procedures). Ensure the printer is clean and in good working condition.
- Use **manufacturer-recommended materials**; choose lower emitting filaments when possible.
- The printer must be enclosed and have an **interlock system** that prevents the machine from running while moving parts are exposed. User-constructed prototypes may lack this safety feature.
- Printers with **lasers or UV lights** are required to be properly shielded to prevent eye exposure. These devices should be reviewed by Radiation Safety prior to purchase.
- If you are working with or producing metal dust, you are required to have a **class D fire extinguisher** on hand, as other types are less effective. Review the Fire Extinguisher Safety Focus Sheet for information on their selection and use.

DURING WORK

- **Limit time** spent observing the printer while it is operational. Consider using video monitoring or observation windows if needed.
- Follow the **standard operating procedures** (SOP), including using required protective equipment.

AFTER WORK

- Turn off, unplug, and cool down the unit prior to cleaning, repairing, or accessing the product.
- Clean up and properly dispose of waste, scraps, and dust. Read the safety data sheet (SDS) and use the correct protective gear when using chemicals to clean printed parts.
- Wear appropriate gloves to handle the product and support materials. Wash hands thoroughly after handling materials.

GENERAL EMISSION CONTROLS

The Chemical Insights Research Institute (CIRI) and the Campus Safety, Health, and Environmental Management Association (CSHEMA) published guidance on the safe use of 3D printing that covers potential hazards associated with the most common types of 3D printing and recommendations for controlling and reducing exposure.

ELIMINATION

Use printers and feedstock that meet 3D printing emission certifications (i.e., ANSI/CAN/UL 2904 standard).

SUBSTITUTION

Use material with lower emissions recommended by the manufacturer, such as polylactic acid (PLA) instead of the more toxic acrylonitrile butadiene styrene (ABS).

ENGINEERING/VENTILATION

Use the printer in a large, open, well-ventilated area (at least four air changes per hour, open window, or exhausted directly outdoors) for up to two FDM or PLA printers. The building coordinator or facility manager can provide basic ventilation information. The size, type, and number of printers will determine if room ventilation alone is sufficient. EH&S assessment is required for additional printers or technologies.

- Dedicated ventilation is the preferred engineering control and requires coordination with UW Facilities and/or building management.
- Another option is using a room air cleaner equipped with HEPA filtration and activated carbon filters. Filters must be maintained per the manufacturer's recommendations.

ADMINISTRATIVE

- Position workstations away from 3D printers to minimize breathing in emitted particles.
- Control access to 3D printing spaces.
- Develop guidelines, required training programs, and established SOP for all 3D printing activities.
- Train personnel on proper use.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

- Depending on the activities identified in the SOP, **required PPE** may include a lab coat, safety glasses/goggles, a face shield, and heat, cut and/or chemical-resistant gloves.
- **Recommended:** Particle filtering respirator (N95) worn voluntarily to reduce exposure to particles.

QUICK FACTS #1

The Chemical Insight Research Institute (CIRI) found more than 200 different VOCs in 3D printer emissions, many of which are known irritants, carcinogens, and odorants.

ADDITIONAL RESOURCES

There are designated makerspaces for students and faculty to use a 3D printer. These areas provide training and safety orientations, tools, and other resources.

For more detailed information about 3D printer safety or designing a space, contact EH&S at ehsdept@uw.edu or check out the following links:

- Approaches to Safety 3D Printing: A Guide for Makerspace Users, Schools, Libraries, and Small Businesses – CDC/NIOSH
- UL 200B: Guidance Document for Safe Use of 3D Printing for Institutions of Higer Education – CIRI and CSHEMA

STANDARD OPERATING PROCEDURES TEMPLATES

- FDM 3D Printer with PLA Filament
- SLA 3D printer with UV Curable Resin

QUICK FACTS #2

3D printers generate ultrafine particles. The concentration of air pollutants near a 3D printer could be more than near a busy highway.

Contact Environmental Health & Safety at 206.543.7262 or ehsdept@uw.edu for assistance.