

3D Printing with Filaments: Health and Safety Questions to Ask

Review the questions on the left and explore different control options and other information to reduce your exposure on the right.

1 Characterization of Potential Hazards



What potential hazards are associated with 3D printing? Are there known health effects from the filaments (for example, see safety data sheets)? What is the work environment like (for example, open or isolated area)?

Potential hazards may include:

- Breathing and skin contact with volatile organic chemicals (VOCs) and particulates (printing) and other chemicals (post-printing)
- Hot surfaces and moving parts

Printing considerations:

- Printing material (e.g., use polylactic acid [PLA] filament rather than acrylonitrile butadiene styrene [ABS] when possible)
- Filaments with additives (e.g., metals, nanomaterials, carbon fibers)
- Frequency and duration of printing
- Manufacturer's recommendations for bed and nozzle temperatures

Work environment best practices:

- Print in a negatively pressured area with a dedicated ventilation system, in an area away from other work
- Reduce time spent near printing process (e.g., monitor remotely or leave area)

2 Work Activities



Could the work activity cause exposures? What is the likelihood of exposure? Can you change the way you do the activity to reduce the likelihood of exposure (high potential to low)?

Pre-printing

Higher potential for exposures:

- Cleaning printer heads/nozzles
- Heating nozzles

Lower potential for exposures:

- Loading filament into printer
- Changing printer heads/nozzles
- Prepping build plate

Printing

Higher potential for exposures:

- Using printer in general office work area
- Working near printer
- Going to printer quickly after print failures and during start up

Lower potential for exposures:

- Using video monitoring

Post-printing

Higher potential for exposures:

- Removing support structures with solvents or other chemicals
- Post-processing activities with filaments containing nanomaterials

Lower potential for exposures:

- Removing part and changing filaments
- Scraping build plate with tools

Maintenance and cleaning

Higher potential for exposures:

- Cleaning printer head/build plate with solvents

Lower potential for exposures:

- Changing filament
- Collecting waste
- Housekeeping

3 Engineering Controls



Based on the work activity, what engineering controls will reduce the likelihood of exposure? What are the key design and operational requirements for the control?

- High efficiency particulate air (HEPA)-filtered local exhaust ventilation placed near printing
- If concerned about VOCs, add gas and vapor filters to local exhaust ventilation
- Ventilated enclosure or containment (for example, fume hood)

Applies to All Printing Stages

- Local exhaust ventilation or ventilated enclosure for post-processing activities involving chemicals (for example, cleaning or spray painting parts)
- Ventilated enclosure or downdraft table for cutting and grinding parts during postprocessing

4 Administrative Controls



Have you considered your workplace practices and policies? Have you set up a plan for waste management? Have you considered what to do in case of a chemical spill?

- Incorporate 3D printing into workplace safety plans
- Develop standard operating procedures and train workers
- Do not consume food or drinks in work areas

Applies to All Printing Stages

- Select the lowest printing temperature that achieves the desired product
- When possible, choose a filament with lower known emission rates
- Use signs to alert workers of hazards and appropriate actions to protect themselves

- Restrict access to essential personnel or use remote monitoring
- Handle and dispose of all waste materials (including cleaning materials/gloves) in compliance with all applicable federal, state, and local regulations

5 Personal Protective Equipment (PPE)



If the measures above do not effectively control the hazard, what PPE can be used? Have you considered PPE for other safety hazards (for example, thermal gloves to prevent burns from hot printer heads)?

- Nitrile or chemical resistant gloves
- Lab coat or coveralls

- Safety glasses, goggles, or face shields
- Respiratory protection when indicated and when engineering controls cannot control exposures, and in accordance with federal regulations (29 CFR 1910.134)

- NIOSH guidance on respirators can be found at www.cdc.gov/niosh/topics/respirators/

Wear PPE that is appropriate for the activities around you (for example, a coworker cleaning a printer next to your work station may require you to wear the same level of PPE). Follow proper PPE replacement practices. Do not wear PPE outside of work areas. Examples of possible PPE are:

