

3D Printing Safety



3D printing is the additive manufacturing technology of making three dimensional objects by depositing successive layers of material under computer control. 3D printers are becoming more popular and can be used in scientific laboratories, workshops and offices. This fact sheet establishes the health and safety practices for using 3D printers at Clemson University campuses.

3D Printer Types

There are different types of 3D printers depending on the printing process and media material used. The two most popular printer types are Fused Deposition Modeling (FDM) and Stereolithography (SLA).

FDM



FDM is the most widely-used 3D printing technology. The thermoplastic filament materials is melted to build up the layers on a platform to create a 3D object.



PLA (Polylactic Acid) and **ABS** (Acrylonitrile Butadiene Styrene) are the most popular materials used in FDM 3D printer.

SLA



SLA is a prototyping process technology. The liquid form of photopolymer resin is solidified by applying the ultraviolet (UV) light to create a 3D object layer-by-layer.

The object usually follows by a chemical bath and a post-cure in an ultra violet oven processes.

Hazards Associated with 3D Printing

Chemical Hazards

3D printers use a variety of materials, such as thermoplastic filament, resin, powdered metal, butanol, and other. There are chemical hazards associated with these materials.

1. **Chemical Exposure:** Sodium hydroxide, paints, resins.
2. **Chemical Vapor:** Printing materials, PLA and ABS, release toxic chemical vapors into the air during the heating process.
3. **Nano/Ultrafine size particles:** Ultrafine Particles (UFP) and other microscopic particles are emitted from desktop 3D printers during operation.

Physical Hazards

3D printers are relatively complex instruments. Usually hand sanding or other processes are needed for finishing the printed product. Operator exposures to the following physical hazards when handling the equipment.

1. **Mechanical Hazards:** Moving parts.
2. **Hot Surfaces:** Fire or burn hazard.
3. **Electricity Hazards:** High voltage power supplies, shock or fire.
4. **Sharp Objects:** Scalpels, screwdrivers, hand tools.
5. **UV light Laser:** Eye and skin burns.

Safety Guidelines

1. A 3D printer that is larger than a desktop model, uses uncommon media (e.g., powdered metal) or special operations must be reviewed and assessed by Research Safety on a case by case basis.
2. 3D Printers should be placed in well ventilated areas.
3. Supervisors are responsible for providing required personal protective equipment (PPE). Operators must be protected from physical hazards, such as hot surface, UV light, and chemical hazards associated with the printers.
4. Operators must receive training by their supervisor in the correct and safe operation of the 3D printer before working with the equipment.
5. Operators need to complete HAZCOM, and hazardous waste training.
6. Safety Data Sheets must be readily accessible in the workplace. An emergency eyewash/shower and a chemical spill kit may be required to be in the immediate vicinity of work where chemicals, including resins and corrosives, are being used.
7. All used chemicals and sharps should be collected and disposed as hazardous waste by following the university's disposal regulations.

For more information on the safety of 3D printers go to <https://www.clemson.edu/research/safety/ihsafety/threedprintsafety.html>