CSUDH

CALIFORNIA STATE UNIVERSITY, DOMINGUEZ HILLS

3-D Printer Program

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1.0 Background

Three-dimensional, *(3-D) printing*, is a growing technology which involves creating three-dimensional objects by laying down successive layers of materials, which may differ in composition. They are being used in laboratories, offices, shops, and in residential locations (dorm rooms and apartments). Initially, a virtual design is created and stored by computer-aided design (CAD) with 3D modeling software, and/or by using a 3-D scanner/device.

Once a design model (file) is created, a 3-D printer/printing application will print the image by laying down definitive, discreet layers, to create the object, layer-by-layer. Images may be simple, with one type of material, or highly complex with different integrated materials. 3-D scanners employ one of several technologies, with more common technologies including: "time-of-flight", "structured/ modulated light", and volumetric scanning.

2.0 Purpose

The purpose of the 3-D Printer Program (3-D PP) is to identify, evaluate, manage, and reduce potential health risks associated with the use of a 3-D printer(s). In some 3-D printing processes, thermoplastics are heated, nozzle extruded and then deposited onto a surface to build the object. Since most 3-D printers do not have exhaust ventilation or filtration accessories, placement of the printer and selection of printing materials must both be carefully considered. There are both chemical and physical hazards associated with 3-D printers, which are determined by the type of printer, chemicals used for print materials, and parts finishing process:

These hazards include:

- The generation of ultrafine/nano-sized particles
- Chemical vapors (E.g., styrene, acrylonitrile, or formaldehyde, etc.) depending on the media being used.
- Generation of heat and contact hot surfaces
- Mechanical hazards from moving parts
- High Voltage
- Ultraviolet light
- Use of tools to remove and finish parts

3.0 Responsibilities

Principal Investigators and Supervisors are responsible for:

- Meeting with EHS for a risk assessment
- Submitting SDSs and Manuals to EHS
- Creating a Standard Operating Procedure(s)
- Ensuring that all personnel involved with the use of a 3-D printer are adequately trained.

4.0 Printer Materials

There are a variety of printing materials available for use with 3-D printers, each with its own inherent hazards. The two most commonly used materials are Polylactic Acid (PLA) and Acrylonitrile Butadiene Styrene (ABS). In general, PLA is much safer to use than ABS.

Each 3-D printer has been designed to use certain types of materials. These materials have inherent hazards and may become more hazardous when they are subjected to the 3D printing process or are inadvertently ignited.

Thermoplastics

Thermoplastics can be flammable, cause irritation and skin sensitivity. Some may contain small amounts of toxic components. Photopolymers utilize exposure to UV light to harden during the printing process. These often contain hazardous monomers, such as acrylates. Additionally, UV light used for the curing process is a radiation hazard, which can cause damage to vision and skin.

Support Materials

The 3D printing process often utilizes a support material to allow for creation of the empty spaces in the fabrication design. Support materials often contain harmful chemicals, such as phenyl phosphates, that are incorporated into the thermoplastic acrylic polymer, and thus are hazardous during use and disposal.

Metal Materials

Reactive and highly combustible powder metals are used in the fabrication of 3-D printed metal alloy tools and parts. Finely divided metal powders, such as titanium and aluminum, can spontaneously combust causing fires (pyrophoric). This process uses very high heat which may expose users to thermal injury, as well as potential inhalation of the powders.

Standard Operating Procedures (SOPs) are required for operation of this type of 3-D Printer.

5.0 3-D Printer Safety Guidelines

The following is a list of safety precautions that need to be considered when using a 3-D printer:

1. All 3-D printers must be placed in a will ventilated area and/or directly ventilate the printer.
2. Whenever possible, purchase 3D printer models that are enclosed. (Full enclosure appears more effective at controlling UFP emissions than a cover)

3. Any 3-D printer that is larger than a desk top model please contact EHS to conduct a risk assessment.
4. Always use the manufacturer's supplied controls and follow manufacturer's instructions for set up and operation.
5. When 3-D printers are running, users should not congregate around the printing operation to minimize the inhalation of particulates being created.

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6. Maintain a distance from the printer to minimize breathing in emitted particles and choose a low-emitting printer and filament when possible
7. **Whenever possible, 3-D printers that utilize resins and/or corrosives should be placed in areas designed as labs**
8. If the printer nozzle jams, turn off the printer and allow it to ventilate before removing the cover
9. Wash hands thoroughly after working with 3-D printers.
10. There shall be no eating, drinking, applying cosmetics, chewing gum, or handling contact lenses in rooms that contain 3-D printing operations

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11. All work surfaces must be cleaned by a wet method
    a. Sweeping and other dry methods can create airborne particles
12. All 3-D metal printing operations must be assessed on a case-by-case basis by Environmental Health & Safety.
13. If you use a material other than PLA or ABS or using experimental materials while printing, please contact EHS to conduct a risk assessment.
14. **TRAINING**: Anyone that works with a 3-D printer may need to take some type of training, depending on where the printer will be used.

6.0 Use of Corrosive Baths for finishing parts made on 3-D Printers

1. Corrosive baths shall only be used in a designated lab space only.
2. Wear Personal Protective Equipment (PPE), including lab coat or apron, chemical resistant gloves, and safety goggles when handling the chemical, placing an item in, or removing it from the bath.
3. **Ensure** there is an eyewash in the vicinity of the bath, in case of a splash.
4. Use tongs when placing an item in, or removing it from, the bath.
5. **Ensure** tank is properly labeled with the chemical name and associated hazards.
6. **Ensure** there is proper ventilation in the area where the bath is located.
7. **DO NOT** pour any chemical down the drain.
   - All used chemicals must be disposed of as hazardous waste.
8. Anyone that works with the corrosive bath must take General Lab Safety Training.
9. Caustic Soda is corrosive and can cause chemical burns, scarring, and blindness.
10. Mixing it with water generates heat that could ignite other materials.
11. Sodium hydroxide should always be added to water and not vice versa.