



## 3D PRINTER TECHNOLOGY - PRE-PURCHASE CONSIDERATIONS AND SAFE USE

### 1. PURPOSE AND SCOPE

3D printing technology is advancing at a rapid rate, with new designs, feed materials and practices coming on the market weekly.

This guideline outlines some safety issues to consider prior to the purchase of a 3D printer for your workplace.

There are various types of 3D printing technology and feed material to choose from, with each having their own safety implications. The main control measures include the use of appropriate Personal Protective Equipment or PPE, and the appropriate location for your 3D printer to minimise fume, chemical and noise exposure to yourself and others working in the vicinity.

Some of the common technologies for 3D printing are:

- Stereolithography (SLA)
- Fused deposition modelling (FDM)
- Selective Laser Sintering (SLS)
- Selective laser melting (SLM)
- Electronic Beam Melting (EBM)
- Laminated object manufacturing (LOM)

3D printers range from low price, basic quality 'hobbyist' machines with few built in safety features, through to high quality 'professional' machines that are fully enclosed with interlocks and fumes filters.

Part of the 3D printing process can include chemical baths or high pressure cleaners to remove printed support structures or harden the 3D printed material.

All post processing considerations need to be addressed when setting up your 3D printing area. This may include sanding, use of solvents to smooth a print and painting.

### 2. IDENTIFIED RISKS AND CONTROLS

#### 2.1 ULTRAFINE PARTICLES

Intense heating of the "feed material", particularly in the popular FDM machines, produce fumes containing ultrafine particles. Some studies have indicated that long term exposure to these particles at high concentrations could be harmful to health. Different brands of feed material combined with heat settings can affect the amount of fumes generated.

The type of feed material will determine the chemical composition of the fumes. Ensure that you read the manufacturer's guide and refer to the Safety Data Sheet of the feed material prior to use.

Sanding a 3D part during post processing to smooth the surface also produces particles. Depending on the 3D printing material used, the particles may be hazardous. All reasonable steps should be taken to limit the exposure of the user to fumes and particles generated by 3D printers and during post processing.



### 2.1.2 Recommended Controls

- a. Printers should be located in a room with adequate local ventilation. Ventilation requirements should be considered in line with the number of printers, printer type, feed material and frequency of use. If unsure, consult with Facilities Management or the Safety and Wellbeing team.
- b. The more sophisticated printers come with built in HEPA filters for which a maintenance program is essential to ensure the filters are changed regularly.
- c. 3D printers that are going to be run for extended periods of time should ideally be located in a separate room or in a location with adequate exhaust ventilation.
- d. Situating multiple printers in one room and operating them at the same time increases the amount of fumes generated in the space, in which case you may have to consider local exhaust ventilation.
- e. When sanding or using solvents during post processing, the appropriate dust mask must be worn. The appropriate local extraction ventilation for sanding and solvents may also be required.

## 2.2 HEAT

Some printers use heat in the process, i.e. FDM printers. The end material or 3D printed object can cause burns if touched during or shortly after printing.

A fire caused by a 3D printer is highly unlikely unless a fault develops due to the printer being modified, poorly maintained or of poor design. Heat dissipation is an important consideration if the printer is to run unattended.

### 2.2.1 Recommended Controls

- a. Developing a Standard Operating Procedure (SOP)
- b. Training the end user in the correct use of the 3D printer can prevent accidents.
- c. 3D printers should have a guarding system which prevents the user from touching the nozzle or the product until it has cooled.
- d. Do not modify the 3D printer unless you are a competent person trained to do so.

## 2.3 ENTRAPMENT AND ENTANGLEMENT

3D printers can have fast moving parts which pose the risk of entrapment or entanglement if it is not guarded or if the user accesses the enclosed area while the printer is in operation.

Some “hobbyist” printers may have issues with parts lifting off of the print platform and becoming entangled within moving parts and should be monitored when in use.

### 2.3.1 Recommended Controls

- a. Ensure there is an appropriate enclosed system around moving parts of the printer.
- b. Develop a standard operating procedure in the use of printers and train the end user in the correct use of the printer.



- c. Make users aware of issues that may occur with the individual printer and when to stop a print if required, for example, when parts lift off of a build platform during a print.
- d. Ensure all users are aware of the level of supervision required for the individual printer.

## 2.4 CHEMICALS

Some printers use liquid feed material that is hardened during the 3D printing. Part of the 3D printing process may also include chemical baths used to separate the support material or harden the model material. These are commonly separate to the printer but are still part of the overall system.

### 2.4.1 Recommended Controls

- a. The appropriate gloves should be worn as identified by the Safety Data Sheet (SDS) in relation to any chemicals.
- b. Safety glasses must be worn during all chemical processes.
- c. An appropriate PPE mask should be worn as identified by the SDS.
- d. Ensure there are provisions for all spills to be managed adequately.
- e. Ensure all chemical waste is disposed of appropriately.

## 2.5 ELECTRICAL

An electrical shock is an unlikely risk unless the operator is undertaking maintenance or modification to the printer. These practices should always be performed by a competent person.

### 2.5.1 Recommended Controls

- a. Ensure printers are inspected and /or tested and tagged on a regular basis.
- b. Ensure all maintenance or modifications are performed by a competent person.

## 2.6 COMPETENCY

The general assumption is that a 3D printer is similar to a desktop inkjet printer. Although they are becoming more user friendly, competency is essential to ensure a safe operating procedure is adhered to. Consult with a competent person for advice when in doubt.

### 2.6.1 Recommended Controls

- a. All users need to be trained by a competent person prior to operation. A competent person would include the Technical Officer or equivalent.
- b. All users need to be aware of issues that may occur with the individual printer and when to stop a print if required, i.e. parts lifting off of a build platform during a print.
- c. All printers require a level of supervision. Ensure all users are aware of the level of supervision required for the individual printer.
- d. All feed materials used require an SDS.



- e. If there is a new process or new feed material being developed, ensure it is assessed by a competent person before doing so.
- f. Ensure all maintenance or modification is performed by a competent person.
- g. Seek advice from people within the University who have significant knowledge and skill in the operation of these printers.

### 3. PURCHASING

Ensure the printer is fit for purpose. Cheaper machines come with fewer safety features and print quality can be poor. Purchasing fewer higher quality printers may be more cost effective than purchasing several cheap machines.

Always refer to the relevant manufacturer's manual and consult with qualified and experienced personnel (including advice from your WHS Consultant) prior to purchase.

The following steps should be followed prior to purchase:

- a. Complete WHS79 Plant & Equipment Pre-Purchase Checklist when considering the cost of maintenance, consumables, installation, location, ventilation and technical support in your purchase approval plan. The additional costs and time associated with resolving these issues can be significant over the equipment's lifetime.
- b. Complete WHS41 Plant & Equipment Risk Assessment for 3D Printers to ensure risk associated with their use is adequately controlled.

Check if there is an existing printer within the University that may meet your requirements. In such cases, purchasing an additional 3D printer may not be required. Sharing access between programs and schools will ensure that printers are used to their full potential.

#### Useful Links and Documents:

- [UniSA Safety & Wellbeing website](#)
- [SafeWork SA Resources \(Codes of Practice\)](#)
- [Australian Standards online \(UniSA subscription\)](#)
- [WHS79 Plant & Equipment Pre-Purchase Checklist](#)
- [WHS42 3D Printer Plant & Equipment Risk Assessment](#)