

WHS G020 3D Printers - Procurement and Safe Use Guideline

Section 1 - Overview

- (1) 3D printing technology is advancing at a rapid rate, with new designs, feed materials and practices coming on the market weekly.
- (2) This guideline outlines some safety issues to consider prior to the purchase of a 3D printer for your workplace.

Section 2 - Scope

(3) 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.

(4) Some of the common technologies for 3D printing are:

- a. Stereolithography (SLA)
- b. Fused deposition modelling (FDM)
- c. Selective Laser Sintering (SLS)
- d. Selective laser melting (SLM)
- e. Electronic Beam Melting (EBM)
- f. Laminated object manufacturing (LOM)

(5) 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.

(6) 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.

(7) 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.

Section 3 - Guideline

Identified Risks and Controls

Ultrafine Particles

(8) 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.

(9) 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.

(10) 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.

Recommended Controls for Ultrafine Particles

(11) 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 Services or the Work Health and Safety team.

(12) The more sophisticated printers come with built in HEPA filters for which a maintenance program is essential to ensure the filters are changed regularly.

(13) 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.

(14) 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.

(15) 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.

Heat

(16) 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.

(17) 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.

Recommended Controls for Heat

(18) Developing a Standard Operating Procedure (WHS F059 Standard Operating Procedure).

(19) Training the end user in the correct use of the 3D printer can prevent accidents.

(20) 3D printers should have a guarding system which prevents the user from touching the nozzle or the product until it has cooled.

(21) Do not modify the 3D printer unless you are a Competent Person trained to do so.

Entrapment and Entanglement

(22) 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.

(23) 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.

Recommended Controls for Entrapment and Entanglement

(24) Ensure there is an appropriate enclosed system around moving parts of the printer.

(25) Develop a Standard Operating Procedure (SOP) in the use of printers and train the end user in the correct use of the printer.

(26) 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.

(27) Ensure all users are aware of the level of supervision required for the individual printer.

Chemicals

(28) 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.

Recommended Controls for Chemicals

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

Electrical

- (34) 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.

Recommended Controls for Electrical

- (35) Ensure printers are inspected and /or tested and tagged on a regular basis.
- (36) Ensure all maintenance or modifications are performed by a Competent Person.

Competency

- (37) 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.

Recommended Controls for Ensuring Competency

- (38) All users need to be trained by a Competent Person prior to operation. A Competent Person would include the Technical Officer or equivalent.
- (39) 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.
- (40) All printers require a level of supervision. Ensure all users are aware of the level of supervision required for the individual printer.
- (41) All feed materials used require an SDS.
- (42) If a there is a new process or new feed material being developed, ensure it is assessed by a Competent Person before doing so.
- (43) Ensure all maintenance or modification is performed by a Competent Person.
- (44) Seek advice from people within the University who have significant knowledge and skill in the operation of these printers.

Purchasing

- (45) 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.
- (46) Always refer to the relevant manufacturer's manual and consult with qualified and experienced personnel prior to purchase.
- (47) The following should be considered prior to purchase:
 - a. 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 WHS F020 Risk Assessment Form to ensure risk associated with their use is adequately controlled.
 - c. 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.

Authority and Compliance

(48) The Procedure Administrator, pursuant to the University's Work Health and Safety Rule, makes these procedures.

(49) University Representatives and Students must observe these Procedures in relation to University matters.

(50) These Procedures operate as and from the Effective Date.

(51) Previous Procedures relating to 3D Printing are replaced and have no further operation from the Effective Date of this new Procedure.

Section 4 - Definitions

(52) Competent Person means a person who has acquired through training, qualification or experience the knowledge and skills to carry out the task.

(53) Effective Date means - takes effect on the day on which it is published or on such later day as may be specified in the procedure.

(54) University Representative means a University employee (casual, fixed term and permanent) contractor, agent, appointee, UNE Council member, adjunct, visiting academic and any other person engaged by the University to undertake some activity for or on behalf of the University. It includes corporations and other bodies falling into one or more of these categories

(55) Student means an Admitted Student or an Enrolled Student, at the relevant time.

- a. Admitted student means a student who has been admitted to a UNE course of study and who is entitled to enrol in a unit of study or who has completed all of the units in the UNE course of study.
- b. Enrolled student means a student who is enrolled in a unit of study at UNE.

(56) UNE Act means the University of New England Act 1993 No 68 (NSW).