

Producing components by rapid prototyping techniques

Overview

This standard covers a broad range of basic competences that you need to produce components by rapid prototyping techniques. It will prepare you for entry into the engineering or manufacturing sectors, creating a progression between education and employment, or it will provide a basis for the development of additional skills and occupational competences in the working environment. Can also be called additive layer manufacturing or 3D printing.

You will be expected to prepare for the rapid prototyping activities by obtaining all necessary information, documentation, materials, tools and equipment, and to plan how you intend to carry out the required activities and the sequence of operations you intend to use.

You will be expected to prepare the equipment in readiness for the required operations, to start a pre-prepared build and to have an understanding of imported stereo lithography (STL) files required for the build. In producing the components, you will need to set up the machine operating functions, parameters and safety devices, and to produce the components using safe and correct operating procedures.

Your responsibilities will require you to comply with health and safety requirements and organisational policy and procedures for using the rapid prototyping software and for operating the rapid prototyping equipment. You will need to take account of any potential difficulties or problems that may arise with the activities, and to seek appropriate help and advice in determining and implementing a suitable solution. You will work under a high level of supervision, whilst taking responsibility for your own actions and for the quality and accuracy of the work that you carry out.

Your underpinning knowledge will provide an understanding of your work, and will enable you to operate rapid prototyping machines safely. You will understand the rapid prototyping equipment used, and its application, and will know about the equipment, materials and consumables, to the required depth to provide a sound basis for carrying out the activities to the required specification. You will understand the safety precautions required when working with the rapid prototyping equipment. You will be required to demonstrate safe working practices throughout, and will understand the responsibility you owe to yourself and others in the workplace.

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Performance criteria

You must be able to:

1. work safely at all times, complying with health and safety legislation, regulations, directives and other relevant guidelines
2. select the type of rapid prototyping machine to be used
3. identify material specification before you start
4. check material availability
5. load/input the program file to the machine controller, and check the program for errors using the approved procedures
6. check that all safety mechanisms are in place, and that the equipment is set correctly for the required operations
7. produce the required components, using appropriate manufacturing methods and techniques
8. deal promptly and effectively with problems within your control, and seek help and guidance from the relevant people if you have problems that you cannot resolve
9. shut down the equipment to a safe condition on completion of the rapid prototyping activities

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Knowledge and understanding

You need to know and understand:

1. the safe working practices and procedures to be observed when setting and operating rapid prototyping equipment (such as care when working with laser beams; machine guards; ventilation and fume extraction; machine safety devices)
2. how to start and stop the machine in normal and emergency situations, and how to close the machine down on completion of activities
3. the hazards associated with operating rapid prototyping machines (such as dangers from laser beams; live electrical components; materials; fumes/gases), and how they can be minimised
4. the importance of wearing appropriate protective clothing and equipment (PPE), and keeping the work area safe and tidy
5. the importance of ensuring that the machine is isolated from the power supply before working with the equipment
6. the methods and procedures used to minimise the chances of infecting a computer with a virus
7. the implications if the computer you are using does become infected with a virus and who to contact if it does occur
8. the basic principles of rapid prototyping relevant to the machine being used
9. the benefits and limitations of the different types of rapid prototyping equipment
10. the rapid prototyping techniques used, and how to differentiate between the different processes (including the advantages and disadvantages)
11. the finishing techniques that are required, and how they are applied to the different rapid prototyping processes
12. how to use and extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS or ISO standards) in relation to work undertaken
13. how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing
14. how to import appropriate files (STL) from a data system into the rapid prototyping software
15. setting up the rapid prototyping equipment to achieve the component specification (such as electrical and optical conditions; focal distance; forming speed)
16. how to place the machine in the correct operating mode, and how to access the program edit facility, in order to make minor adjustments for production
17. the different materials used to produce components by the rapid prototyping process, and how the various materials used will affect the operating conditions that can be applied relevant to the machine

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- being used
18. the reasons why certain materials are suitable for producing components by the rapid prototyping process
 19. the importance of knowing when components can be unloaded from the machine in relation to the different rapid prototyping processes
 20. the importance of handling and storing materials correctly and linking to the correct documentation
 21. problems and defects that can occur in components produced by rapid prototyping processes, how these can occur, and what preventative actions are needed to overcome them
 22. when to act on your own initiative and when to seek help and advice from others
 23. the importance of leaving the machine in a safe condition on completion of the rapid prototyping activities (such as correctly isolated, operating programs closed or removed, cleaning the machine, and removing and disposing of waste)

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Scope/range related to performance criteria

1. Prepare the system and data for operation by carrying out **all** of the following:
 1. check that all the equipment is in a safe and usable working condition (such as undamaged, safety devices in place and operational)
 2. obtain sufficient quantities of all required materials and checking use by dates
 3. obtain all the necessary data, documentation and specifications for the components to be produced
 4. download the correct build files to produce the components
 5. check that data files are suitable for the application
 6. apply safe working practices and procedures at all times
2. Set up the rapid prototyping equipment, to include carrying out **all** of the following:
 1. powering up the equipment and activating the appropriate software
 2. importing files from system
 3. loading materials
 4. checking/setting equipment operating parameters
3. Produce components using **one** of the following types of rapid prototyping equipment:
 1. stereo lithography apparatus (SLA)
 2. selective laser melting (SLM)
 3. fused deposition modelling (FDM)
 4. 3D printing (thermojet)
 5. selective laser sintering (SLS)
 6. laminated object manufacturing (LOM)
 7. direct metal laser sintering (DMLS)
 8. digital light process (DLP)
 9. other specific prototyping equipment
4. Produce components made from **one** of the following materials:
 1. photo-polymer resin
 2. wax
 3. laminated paper
 4. plastics
 5. metal
 6. polyurethane

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5. Unload the components from the rapid prototyping equipment, to include carrying out **all** of the following:
 1. removing the part from remaining raw material
 2. removing the part from supports (where applicable)
 3. pre-cleaning
 4. infiltrate (when required)
 5. packing to avoid damage
 6. storing
 7. complete all relevant documentation (such as material batch number, CAD file name, date of manufacture, operator's name, quality report)
6. Produce components which comply with **all** the following quality and accuracy requirements:
 1. correctly formed
 2. checked against model specification
 3. free from manufacturing defects
 4. satisfactory visual appearance/finish

Behaviours

Additional Information

You will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall company objectives, such as:

- strong work ethic
- positive attitude
- team player
- dependability
- responsibility
- honesty
- integrity
- motivation
- commitment

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