Unit Title:	**An introduction to Rapid Prototyping and Additive Manufacturing**
OCR unit number	9
Level:	2
Credit value:	5
Guided learning hours:	40
Unit reference number	K/503/5862

Unit purpose and aim

This unit will introduce learners to the field of Rapid Prototyping and Additive Manufacturing. Learners will develop their knowledge of the technology, how it works and the different types of machines and technologies used. Learners will consider the advantages and limitations of Rapid Prototyping (RP) and Additive Manufacturing (AM) along with the key developments that have shaped the technology.

Learners will use the technology, to analyse an STL file and produce a component using a rapid prototyping or additive manufacturing machine.

Learning Outcomes	Assessment Criteria	Teaching Content
The Learner will:	**The Learner can:**	
1 Understand Rapid Prototyping and Additive Manufacturing	1.1 Identify the key features of Rapid Prototyping and Additive Manufacturing processes 1.2 Describe the different types of Rapid Prototyping and Additive Manufacturing systems 1.3 Identify the technological developments of Rapid Prototyping and Additive Manufacturing	• Key features: o layering technology o produced directly from 3D CAD data o utilise STL format o range of materials o unconstrained geometry creation • Different types of systems include: o FDM o SLA o SLS o LOM • Key developments: o developments in speed o advances in materials

Learning Outcomes	Assessment Criteria	Teaching Content
		o the move from rapid prototyping to additive manufacturing o strength and functionality of components
2 Understand the applications of Rapid Prototyping and Additive Manufacturing systems	2.1 Identify applications where Rapid Prototyping and Additive Manufacturing could be used 2.2 Identify the advantages of Rapid Prototyping and Additive Manufacturing systems 2.3 Explain how the use of materials has developed applications for Rapid Prototyping and Additive Manufacturing systems 2.4 Identify possible future applications of Rapid Prototyping and Additive Manufacturing systems	• Applications for Rapid Prototyping and Additive Manufacturing have increased with developments in materials • Production parts • Short production or one-offs. Applications in motorsport and aerospace • Soluble cores • High temperature materials – PPSF, polycarbonate, metal laser sintering • Jigs and fixtures • Advantages of Rapid Prototyping and Additive Manufacturing systems in relation to conventional production techniques: o removal of geometric constraints associated with conventional techniques o accurate production direct from CAD data o speed of production for short batch production, one-offs or prototypes o cost when compared to conventional techniques for production of one-offs or short batch production

Learning Outcomes	Assessment Criteria	Teaching Content
		• Range of application: o concept models o functional prototypes o end-use parts o manufacturing tools – jogs, fixtures, tooling masters, mould tools • Possible future applications: o machines in the home o transportable machines for vehicle/onsite repair o customisable products o mass production of complex geometry
3 Be able to produce a component on a Rapid Prototyping / Additive Manufacturing system	3.1 Use proprietary software to analyse an STL file 3.2 Use proprietary software to assess an STL file to ensure a successful operation 3.3 Prepare a prototyping/additive manufacturing machine for building a component 3.4 Assess the finishing requirements of a built component	• Analyse an STL file: o orient a model o slice a part o run tool paths • Assessment should include: o wall thickness o orientation o successful tool path creation o check each layer for successful build • Machine is ready to build a component: o build platten is secure o machine is appropriately calibrated o material levels checked o temperatures checked

Learning Outcomes	Assessment Criteria	Teaching Content
		• Learners will be able to assess the finishing requirements of a completed component o support removal o soluble support removal o component finishing – sanding, painting o final application assessment – chemical coatings or impregnation

Assessment

This unit is centre assessed and externally verified. In order to achieve the unit you must produce a portfolio of evidence which, on request, will need to be made available to the OCR external verifier. Portfolios of work must be produced independently and centres must confirm to OCR that the evidence is authentic.

Evidence requirements

Learners will produce a written report/poster/display board/verbal presentation discussing the different types of rapid prototyping and additive manufacturing systems. It should cover the key features of such systems and the technological advancements that have taken place since its inception. It will discuss advantages, applications and the future developments of rapid prototyping and additive manufacturing systems. The presentation will be supported by practical evidence of a rapid prototyped part produced on a machine by the learner.

Guidance on assessment and evidence requirements

Tutors should ensure that the delivery of this unit is as practical as possible. Learners should be given exposure to rapid prototyping equipment and allowed time to use the machine. If centres do not have access to a machine then partnerships with local companies, universities or colleges could be formed. Tutors should ensure that learners are taught about the range of different technologies available regardless of the 'in-house' system. Learners should also understand and be able to assess a variety of models to decide the appropriate orientation and effectiveness of the build.

National Occupational Standards (NOS) mapping/signposting

NOS can be viewed on the relevant Sector Skills Council's website or the Occupational standards directory at www.ukstandards.co.uk.

Occupational standards	Unit number	Title
Engineering Technical Support Suite 2 2007	TS2-15	Assisting in Producing or Modifying Operating Programs for Computer Controlled Machines
Design	DES7	Contribute to the production of prototypes, models, mock-ups, artwork, samples or test pieces
Design	DES10	Create visual designs
Design and Draughting	O15NDD03ECRS1.19	Complete chosen engineering designs

Functional skills signposting

This section indicates where learners may have an opportunity to develop their functional skills.

Functional Skills Standards					
English		**Mathematics**		**ICT**	
Speaking and Listening		Representing		Use ICT systems	✓
Reading	✓	Analysing		Find and select information	✓
Writing		Interpreting		Develop, present and communicate information	✓

Resources

Equipment

For effective delivery of this unit centres should have access to the following resources and equipment.

- Computer system with Internet access, word processing, spread sheet, business presentation and 3D CAD software.
- 3D CAD software e.g. Solidworks, Solid Edge, Inventor, Pro/Engineer.
- Access to **or** an on-site rapid prototyping / additive manufacturing system e.g. FDM, SLA, SLS machine.
- Proprietary STL file analysis software.

- Finishing equipment e.g. soluble support removal tanks.

- Hand tools for part finishing e.g. sand paper, files, filler, and aerosol paint.

Additional information

For further information regarding administration for this qualification, please refer to the OCR document '*Admin Guide: Vocational Qualifications' (A850)* on the OCR website www.ocr.org.uk .