

Unit Title:	An introduction to manufacturing techniques for product production
OCR unit number	11
Level:	2
Credit value:	6
Guided learning hours:	50
Unit reference number	T/503/5864

Unit purpose and aim

This unit will develop learners' knowledge and understanding of manufacturing techniques that can be used for the production of a range of products. Learners will gain an understanding of casting processes including sand, die and investment casting. They will also explore plastic moulding including, injection, blow, extrusion and vacuum forming. Learners will gain an overview of fabrication and sheet metal work along with CNC technology.

Throughout the unit learners will develop knowledge of the key considerations that need to be applied to components when designing for production. Learners should also be exposed to the technologies through experience or industrial context where possible.

Learning Outcomes	Assessment Criteria	Teaching Content
<p>The Learner will:</p> <p>1 Know the principles of casting processes</p>	<p>The Learner can:</p> <p>1.1 Describe sand and investment casting processes</p> <p>1.2 Describe die-casting processes</p> <p>1.3 Identify applications of casting processes</p> <p>1.4 Identify key considerations when designing for casting</p>	<p>Sand casting:</p> <ul style="list-style-type: none"> ○ mould and core production ○ moulding parts – boxes, boxless ○ moulding sand – oil sand, green sand, chemically bonded ○ cores – horizontal, vertical ○ runners ○ risers <p>Investment casting:</p> <ul style="list-style-type: none"> ○ wax patterns ○ producing shells/moulds ○ curing shells moulds ○ rapid prototyped patterns

Learning Outcomes	Assessment Criteria	Teaching Content
		<ul style="list-style-type: none"> • Die casting processes: <ul style="list-style-type: none"> ○ gravity die casting ○ pressure die casting • Range of applications where casting is used eg: <ul style="list-style-type: none"> ○ transport ○ heavy equipment ○ machine tools ○ aircraft parts ○ hardware ○ pumps and valves • Key considerations when designing components for casting: <ul style="list-style-type: none"> ○ minimum thickness of section ○ tolerance capability of the material ○ calculation of shrinkage ○ defining radii ○ parting lines ○ surface drafts
<p>2 Know the principles of plastic moulding</p>	<p>2.1 Describe the injection moulding process</p> <p>2.2 Describe blow moulding processes</p> <p>2.3 Describe the vacuum forming process</p> <p>2.4 Describe the extrusion process</p> <p>2.5 Identify applications of plastic moulding processes</p> <p>2.6 Identify key considerations when designing for plastic moulding</p>	<ul style="list-style-type: none"> • Injection moulding processes: <ul style="list-style-type: none"> ○ raw plastic material – granular ○ plastic melted ○ mould – moving and fixed platens clamped ○ molten plastic melted from pellet form in the barrel is injected under pressure ○ dwelling – pressure applied to ensure all cavities are filled ○ cooling – plastic parts allowed to solidify ○ opening – mould separates ○ part ejected

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		<ul style="list-style-type: none"> • Blow moulding processes: <ul style="list-style-type: none"> ○ thermoplastic resin heated ○ extruded through die head to form parison ○ parison is inflated ○ plastic solidifies as it is cooled ○ mould opens component is removed • Vacuum forming processes: <ul style="list-style-type: none"> ○ production of mould – drafts, air holes ○ clamp plastic sheet ○ heat until malleable ○ platten raised ○ air sucked from vacuum former ○ sheet is unclamped ○ mould removed ○ excess material trimmed • Extrusion processes: <ul style="list-style-type: none"> ○ plastic pellets fed into hopper ○ material conveyed continuously forward by rotating screw in a heated barrel ○ softened plastic is forced through a die ○ die is a metal plate with a profile removed. This determines the cross section ○ plastic extruded profile is cooled and fed along rollers to pull the extrusion from the die

Learning Outcomes	Assessment Criteria	Teaching Content
		<ul style="list-style-type: none"> • Applications for plastic moulding parts <ul style="list-style-type: none"> ○ bottle production ○ consumer electronics ○ drinking straw ○ piping ○ decorative mouldings ○ conduit ○ automotive interiors and exteriors • Key considerations when designing plastic moulded parts <ul style="list-style-type: none"> ○ draft angles ○ wall thickness ○ ribs ○ radii ○ ribs ○ bosses ○ split lines
<p>3 Know the principles of fabrication and sheet metal techniques</p>	<p>3.1 Describe the equipment requirements for fabricated structures</p> <p>3.2 Identify the types and forms of materials used for fabrication.</p> <p>3.3 Describe the cutting and forming processes associated with sheet metal work</p> <p>3.4 Describe the joining and assembly procedures associated with fabrication</p> <p>3.5 Identify applications of fabrication and sheet metal processes</p> <p>3.6 Identify key considerations when designing for sheet metal and fabricated products</p>	<ul style="list-style-type: none"> • Equipment requirements for fabricated structures. <ul style="list-style-type: none"> ○ PPE and safety equipment ○ hand tools – tin snips, hacksaw, files, measuring tools ○ machine tools – guillotine, band saw, punching and cropping machines, forming tools, laser marking and cutting, CNC • Types and forms of materials used for fabrication <ul style="list-style-type: none"> ○ metallic – mild steel, tinned steel, aluminium, stainless steel, brass, copper ○ non-metallic – plastics and rubbers

Learning Outcomes	Assessment Criteria	Teaching Content
		<ul style="list-style-type: none"> ○ material forms – sheet, plate, section materials, bar, profiles, pipe and tube ● Cutting and forming processes associated with sheet metal work <ul style="list-style-type: none"> ○ hand and machine tools ○ straight cuts, curved contours, round holes, filing, drilling, punching ○ stakes and formers ○ hand and powered bending ○ rolling machines ○ forming tools ● Joining and assembly procedures associated with fabrication <ul style="list-style-type: none"> Joining: <ul style="list-style-type: none"> ○ tack welding ○ soldering / brazing ○ spot welding ○ riveting ○ threaded inserts ○ structural fasteners ○ adhesives Assembly: <ul style="list-style-type: none"> ○ frames ○ tanks ○ ducting ○ box sections ● Applications of sheet metal and fabrication processes: <ul style="list-style-type: none"> ○ automotive ○ kitchen applications– stainless steel sinks, microwave ovens, cookers ○ aerospace – fuselage, wings

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		<ul style="list-style-type: none"> ○ consumer electronic housings – amplifiers, refrigerators ○ structural frames – industrial equipment ○ civil engineering ● Key considerations when designing for sheet metal and fabricated products <ul style="list-style-type: none"> ○ tolerances ○ bend relief ○ material thickness ○ deformation ○ corner finishing ○ hole tapers
<p>4 Know the principles of CNC machines</p>	<p>4.1 Describe the types of CNC machines</p> <p>4.2 Identify applications for CNC machines</p> <p>4.3 Identify the key areas for consideration when producing a CNC machined component</p> <p>4.4 Identify quality approval processes used to check conformity to specification</p>	<ul style="list-style-type: none"> ● Types of CNC machines <ul style="list-style-type: none"> ○ mills ○ lathes ○ plasma cutters ○ welders ○ laser cutters ○ punch presses ○ robots ○ routers ○ EDM ● Applications for CNC machines <ul style="list-style-type: none"> ○ finishing operations ○ component production ○ precision welding ○ precision fabrication production ○ automotive, aerospace, electronics, marine, civil ● Key areas of consideration when producing a CNC machined component <ul style="list-style-type: none"> ○ clamping of material ○ machinability ○ material

Learning Outcomes	Assessment Criteria	Teaching Content
		<ul style="list-style-type: none"> ○ speeds and feeds ○ cutting tools ○ complex geometry ○ optimisation ○ tolerance ○ surface finish ○ time ● Key quality approval processes to check conformity to specification. <ul style="list-style-type: none"> ○ measurement – micrometres, callipers, digital, CMM ○ flatness ○ surface finish ○ geometrical – profiles, roundness, concentricity ○ tolerances

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 should produce a written report/presentation/display board of their investigations into a range of manufacturing techniques. This will detail their understanding of the process accompanied with photographic evidence of visits or practical work. Where practical exposure or visits are not possible learners should present evidence of their research with explanations of their understanding of the technique.

Guidance on assessment and evidence requirements

Tutors should aim to make this unit as practical possible. Centres may not have access to every process highlighted in this unit so provision should be made for learners to undertake industrial visits or attend partner institutions to ensure they gain real exposure to the techniques discussed. Learners should use as much of the technology as possible within the time allowed and within the resource constraints of the centre.

Where visits or practical exposure are not possible, video and detailed presentations should be used to deliver the fundamentals of the process.

Learners should be encouraged to consider the requirements of these processes and make suggestions of which technology they would use when designing components.

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	TS2-08	Checking Mechanical Components and Assemblies
Engineering Technical Support Suite 2 2007	TS2-15	Assisting in Producing or Modifying Operating Programs for Computer Controlled Machines
Metal Processing and Allied operations	MPA14	Cast metals
Metal Processing and Allied operations	MPA13	Prepare for casting
Metal Processing and Allied operations	MPA24	Finish metal products
Metal Processing and Allied operations	MPA51	Fabricate structural steelwork components using hand tools
Metal Processing and Allied operations	MPA52	Assemble structural steelwork components to meet specifications
Metal Processing and Allied operations	MPA53	Fabricate structural steelwork using thermal joining processes
Performing Manufacturing Operations Suite 1 and 2 2003	PMO1.14	Carrying out moulding operations
Performing Manufacturing Operations Suite 1 and 2 2003	MPF2.60	Operating Plastic Injection Moulding Machines
Performing Manufacturing Operations Suite 1 and 2 2003	MPF3.61	Producing Components using Plastic Injection Moulding Machines

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 photo manipulation software
- Photography equipment for recording evidence
- Document scanner

It is an aim of this unit that learners gain as much practical exposure to the techniques and technology as possible however, it is clear that centres will not have access to all of the areas covered. It is therefore recommended that learners may gain practical access to at least **one** of the techniques discussed and the rest should be supported through demonstration, video or industrial visits.

For practical delivery of each element centres may require the following equipment:

- Casting facility
- Injection or blow moulding machine
- Plastic extrusion machine
- Vacuum forming machine
- Fabrication equipment - drilling, punching, bending equipment, rolling, forming tools
- Welding equipment
- CNC machining centre, CNC turning centre

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 .