Unit 42: Manufacturing Primary Forming Processes

Delivery guidance

Approaching the unit

Many products we use on a daily basis rely on primary forming processes. The need to manufacture shapes with minimal waste is a focus for many organisations. The introduction of new materials and demands for quality within manufacturing has refined and specialised primary forming processes, allowing producers to create more accurate and more precisely dimensioned components.

The knowledge and understanding delivered to learners in this unit will allow them to progress to apprenticeships, technician-level roles and higher education. They will investigate moulding processes for metals, ceramics and polymers.
They will also take into account the processes that are potentially hazardous to health and the relevant procedures and protections that must be in place.

You can involve local employers in the delivery of this unit if there are local opportunities to do so.

Delivering the learning aims

In learning aim A, learners should examine how moulding processes involving metals, ceramics and polymers are used in industry. Learners should be given resources for the different types of moulding processes. Through collaborative work they could investigate each type, with a focus on the process, materials, additives, mould features and finishing.

Learners should become familiar with the sustainability of the casting processes. They should compare the use of coal and electric furnaces, water contamination, fumes and particle release. This could be through tutor-led discussions or independent research and report work. It would be beneficial for the learners to experience demonstrations of the different forming processes.

In learning aim B, learners should examine the deformation processes involving metals and polymers. They will investigate the different deformation processes through independent research or a collaborative research project. Learners should experience demonstrations of the processes, eg extrusion, forging, rolling, presswork and metal spinning on ferrous and non-ferrous metal.

Learners should also become familiar with the deformation processes on polymers, and as with metals, experience demonstrations of the processes, eg vacuum forming, extrusion and calendaring. They should investigate the function of additives, mould features and parameters. This could be within the same research project suggested for the metal processes.

In learning aim C, learners will investigate the safe working practices required when manufacturing products using forming processes. They could investigate this through

collaborative work following tutor-led instruction. They should cover the key features of health and safety regulations, focusing on those covered in the specification. Learners should also assess the risk of primary forming work, including investigating guidance from the Health & Safety Executive (HSE) or other appropriate national or international bodies with similar responsibilities and activities to reduce risk.

Learners should also justify the selection of forming processes by reporting on objective criteria used to determine the choice. They could perform this as part of a review process on their own work.

Learning aim	Key content areas	Recommended assessment approach
A Examine how moulding processes involving metals, ceramics and polymers are used in industry	**A1** Metal moulding processes **A2** Ceramic moulding processes **A3** Polymer moulding processes	A portfolio containing written responses and diagrams showing moulding techniques for each material type. This activity could be supported by an electronic presentation.
B Examine how deformation processes involving metals and polymers are used in industry	**B1** Metal deformation processes **B2** Polymer deformation processes	A portfolio containing written responses and diagrams showing deformation processes for metals and polymers. This activity could be supported by an electronic presentation.
C Investigate the suitability of forming processes to manufacture products using safe working practices	**C1** Safe working practices for primary forming processes **C2** Forming process selection	A portfolio containing a written commentary and diagrams justifying the selection of forming processes to manufacture a range of products, and about health and safety and risk reduction approaches that apply to the processes. Evidence could also be in the form of an electronic presentation.

Assessment guidance

The assessment evidence required for this unit is typical engineering documentation. Although much of the evidence will be in the form of reports, there are opportunities for practical observations and videos to be recorded. Annotated photos, planning notes and document portfolios would be more suited to the practical aspects of the unit. The evidence should be clear and concise, containing the information stated in the specification. Learners should provide evidence showing a solid understanding of manufacturing primary forming processes.

Each of the learning aims will be assessed through portfolios containing written reports and diagrams representing the moulding, deformation and forming processes required to manufacture a range of products. You need to ensure that learners have the opportunity to address the health and safety concerns for each process, including completing risk assessments. The evidence will be gathered in a range of ways such as written responses, diagrams, observation records, annotated sketches and photographs, personal accounts, quality checklists, PowerPoint handouts and presentation notes and logbooks.

Getting started

This gives you a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Unit 42: Manufacturing Primary Forming Processes

Introduction

Introduce the unit to the learners, covering the aims and objectives. Produce an overview of the assessment for the unit, and give them an outline of the importance of the primary forming processes within engineering organisations.

Discuss the processes that will be used throughout the unit to manufacture components using metal, ceramics and polymers.

Discuss the evidence types that will be required for the assessment in the unit. Learners will be required to produce a portfolio for each learning aim, consisting of all the notes, sketches, observation records, photographs, annotations, written responses, reports, risk assessments and other documents they have produced during the course of the unit.

Learning aim A – Examine how moulding processes involving metals, ceramics and polymers are used in industry

- Introduce learners to metallic, ceramic and polymer moulding processes, and how they are used to manufacture products. Give learners the resources to research and investigate these processes.
- You could begin with a tutor-led presentation or discussion on different processes and how they are used in manufacturing.
- You could then present the learners with case studies on known organisations and products that use those processes.
- For maximum impact on learning, give demonstrations of each or select processes, prompting learners to make notes of the processes.

Learning Aim B – Examine how deformation processes involving metals and polymers are used in industry

- Introduce learners to the different deformation processes involving metals and polymers.
- You could begin by introducing the learners to different deformation processes with practical demonstrations. Ensure learners are aware of the risks involved in each process, asking them to make note of the steps you perform and enforce the risk measures you are following.
- You could then ask learners to repeat the steps you followed and identify further risks that could be included in the risk assessment for that process.
- Your learners should have comprehensive notes on the processes, which could be supported with formal presentations and discussions in a classroom setting on the processes and the health and safety implications.
- It is important that learners understand the processes fully and can identify risks associated with each before moving on to the next learning aim.

Learning aim C – Investigate the suitability of forming processes to manufacture products using safe working practices

- Ask learners to reflect on the safe working practices they observed through the demonstrations given for learning aims A and B. Learners should create a portfolio containing written commentary and diagrams justifying the selection of forming processes to manufacture a range of products. They should include evidence of investigation into the management of risk and adherence to health and safety regulations required to protect the operator, others and the organisation.
- You could begin with examples of poor practice in forming processes. These could be written case statements for learners to analyse and suggest process improvements for or resources from the internet.
- You could ask the learners to set up and form a product, using safe working practices.
- You could assess this through photographs and observation records. The learner would have a checklist and risk assessment in place before carrying out the activity.
- Learners should then reflect on the forming of their product and how they effectively carried out the steps, following their risk assessments. They could also adjust their risk assessment to include any risks they thought could occur during the process. They should reflect on the contributing factors outlined below.
- You could then ask learners to evaluate the sustainability of the process they undertook and suggest areas that could be improved to reduce waste.
- You could ask learners to produce a self-evaluation report on their actions and present it to the rest of the group. To give an opportunity for peer assessment, you could ask other learners to observe the process being carried out and offer their judgement and assessment of it.

Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

Pearson BTEC International Level 3 Qualifications in Engineering:

- *Unit 2: Delivery of Engineering Processes Safely as a Team*
- *Unit 3: Product Design and Manufacture in Engineering*
- *Unit 25: Mechanical Behaviour of Metallic Materials*
- *Unit 26: Mechanical Behaviour of Non-metallic Materials*
- *Unit 45: Additive Manufacturing Processes*
- *Unit 46: Manufacturing Joining, Finishing and Assembly Processes*
- *Unit 49: Aircraft Workshop Methods and Practice*

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC International Qualifications in Engineering. Check the Pearson website (http://qualifications.pearson.com/en/support/published-resources.html) for more information as titles achieve endorsement.

The special resources needed for this unit are:

- access to metallic, ceramic and polymer processes
- access to a range of health and safety regulations, as required by the unit content.

Textbooks

- Meyers AR and Slattery TJ – *Basic Machining Reference Handbook, 2nd Edition* (Industrial Press Inc, 2001) ISBN 9780831102012.
  Basic Machining Reference Handbook is intended to serve as a memory jog for the experienced, as well as a reference for programmers and others who will not do the machining but do need to know exactly what is involved in performing a given machining step, a series of steps, or a complete job. This is a good resource for the tutor rather than the learner.
- Walker JR – *Machining Fundamentals: From Basic to Advanced Techniques, 8th Edition* (Goodheart-Willcox Co Inc, 2004) ISBN 9781590702499.
  This book has a range of illustrations and detailed instructions on how to set up many basic machining operations. Also, each section has the particular safety issues highlighted. There are several references regarding cutting feeds and speeds – this is a good resource for the tutor.
- Black BJ – *Workshop Processes, Practices and Materials, 5th Edition* (Routledge, 2015) ISBN 9781138784727.
  A very good introduction for entry level engineers and workshop technicians, as learners with little or no practical experience. It contains detailed illustrations throughout and is written in a simple, clear language – good for learners.
- Davidi G – Plastic forming processes of composite materials (Scholar's Press, 2013) ISBN 978-3639700848.
  A good resource for tutors.

Websites

- www.hse.gov.uk/simple-health-safety/risk/index.htm
  The Health and Safety Executive website gives information and templates about risk assessment.
- www.hse.gov.uk/work-equipment-machinery/standard.htm
  The Health and Safety Executive website gives information about Machinery Standards.

Pearson is not responsible for the content of any external internet sites. It is essential for tutors to preview each website before using it in class so as to ensure that the URL is still accurate, relevant and appropriate. We suggest that tutors bookmark useful websites and consider enabling learners to access them through the school/college intranet.