



Unit 41: Manufacturing Secondary Machining Processes

Delivery guidance

Approaching the unit

This is a practical unit, which allows your learners to investigate the role that a range of traditional machining processes (such as drilling) and specialist machining processes (such as honing and lapping) play in producing machined components. The focus should be on the learners developing practical skills and understanding to be able to set up and operate traditional secondary machining processes in order to manufacture a component. Learners will also need to be able to review and reflect on the skills and processes used and pay due regard to aspects of health and safety when completing or observing practical processes.

You will need to hold skills development sessions for traditional secondary machining processes and your learners should be able to research these processes and apply the knowledge gained. In this way, they will learn what works and will be able to use this knowledge when they come to set up and carry out their own practical work.

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

Delivering the learning aims

For learning aim, A it would be worthwhile starting with a class discussion that introduces the range of traditional and specialist secondary machining processes to your learners. You could then ask an individual in each group to research a different process. You should ensure that all the processes listed under key content areas A1 and A2 of the specification are covered. Learners' research should cover machine types, features of components produced by each process and the accuracy obtainable. Due to the common need to consider tolerances and understand batch sizes in all machining processes, it would be appropriate for you to formally go through these with the whole class before they carry out the individual research activity. Once learners have collected their research information, you could ask each learner to give a PowerPoint presentation to the rest of the group, along with an accompanying set of handouts, which could be used to supplement class notes.

If possible, to support the delivery of this learning aim, it would be beneficial if you could arrange visits to local industries where these processes are taking place. In addition, or as an alternative, you could ask a representative from a local industry to attend the learner presentations.

Having covered key content areas A1 and A2 in this manner, you should then explore the sustainability of these secondary machining processes. Your learners could be asked to reflect on the usefulness of these activities – this would help you prepare them for learning aim D (reflection and review).



Learning aim B builds upon some of the areas covered in learning aim A by looking in more depth at the practical aspects of traditional secondary machining processes. You do not need to develop any skills to set up, or in fact use, any specialist secondary machining processes with your learners. Instead, you could present a number of secondary machining workplace scenarios to your learners and ask them to carry out a risk assessment on each one. Support this practical approach with formal sessions outlining the key features of health and safety regulations or other relevant international equivalent and involve your learners with the use of the health and safety executive website.

The skills development required for learning aim B goes hand in hand with that for learning aim C, which is about using traditional secondary machining processes to manufacture a component safely. To meet the assessment requirements of learning aims B and C, learners need to develop skills in the setting and use of at least two processes and use those skills on a least six features of a component that they will need to manufacture. According to the staffing levels in your workshops and the machines available, you will need to develop a strategy that allows your learners to achieve this. To ensure that you maintain a safe environment while skills development is taking place, you could split the group and give some of the learners desk type activities while the rest are engaged in the practical tasks. The activities could involve finding out and reporting back to the whole group about different tooling requirements for drilling, turning, milling and grinding, along with different work holding devices across the same processes. You should allow time to cover the theory required to work out speeds and feeds for these processes. Again, to help with the workshop management, you should allow some learners (those who are not carrying out machining skills development) to work in a safer part of the workshop in order to develop skills in the use of equipment to check dimensional accuracy and surface texture. During these practical skills development sessions, you need to ensure that learners work in a safe manner, so you need to consider carefully your staffing levels and learner to staff ratio, taking into account the tooling and equipment you have available.

Learning aim D allows your learners to reflect in a detailed way on how they have applied themselves during the rest of the delivery of this unit. There are two aspects to this reflection: the lessons learnt, which should include skills involved regarding health and safety, traditional machining and the more general engineering skills; and relevant behaviours, including initiative and responsibility, communications and problem solving skills. You could ask your learners to prepare a self-evaluative report and allow them to present this to either the rest of the group or invited representatives from industry. To give an opportunity for peer assessment, you could allow other learners in the group to make a judgement about the accuracy of the self-evaluation to help differentiate between fact and opinion.



Learning Aim	Key content areas	Recommended assessment approach
<p>A Examine the technology and characteristics of secondary machining processes that are widely used in industry</p>	<p>A1 Traditional secondary machining processes</p> <p>A2 Specialist secondary machining processes</p> <p>A3 Sustainability characteristics of secondary machining processes</p>	<p>A report focusing on three different traditional processes and an analysis of research case studies on three different specialist processes.</p>
<p>B Set up traditional secondary processing machines to manufacture a component safely</p>	<p>B1 Health and safety requirements when setting up secondary process machines</p> <p>B2 Risk assessment</p> <p>B3 Setting up secondary process machines</p>	<p>A practical activity involving a risk assessment and the setting up of at least two traditional machining processes and the machining of a component.</p> <p>Evidence will include: a developmental logbook, risk assessment, observation records/witness statements, the finished component, annotated photographs and drawings, set up planning notes, and complete quality control documents.</p>
<p>C Carry out traditional secondary machining processes to manufacture a component safely</p>	<p>C1 Features of traditional secondary machining processes</p> <p>C2 Parameters of traditional secondary machining processes</p> <p>C3 Quality control methods</p>	<p>Evidence will include: a developmental logbook, risk assessment, observation records/witness statements, the finished component, annotated photographs and drawings, set up planning notes, and complete quality control documents.</p>
<p>D Review the processes used to machine a component and reflect on personal performance</p>	<p>D1 Lessons learned from machining a component</p> <p>D2 Personal performance while machining a component</p>	<p>The evidence will focus on what went well and what did not go so well when machining a component, and a conclusion of improvements that could be made.</p> <p>The portfolio of evidence will be generated while machining a component, reviewing the processes and reflecting on own performance.</p>



Assessment guidance

This unit is internally assessed by means of a maximum of three assignments. The first assignment should cover learning aim A, the second learning aims B and C and the third should cover learning aim D. Each assessment should cover a whole learning aim; it is recommended that the learning aims for this unit must not be split over assignments.

Learning aim A will be assessed through a written report which will need to include analysis of research of case studies on three different traditional and three different specialist processes. While preparing learners for this assessment, you will also need to facilitate the requirements of learning aim D as, for the third assessment, your learners will need to produce a portfolio of evidence which will be gathered together during all the activities associated with learning aims A, B and C. Learners will need to review the practical elements and reflect on their own performance in the activities, after the processes have been completed. The assessment requirements for learning aims B and C are practical in nature and you will need to select appropriate components that allow at least two different processes to be set up and used and that have at least six different features that need to be machined. You should also pay due regard to the accuracy requirements of the features/component. You will need to ensure that learners deal appropriately with the health and safety requirements including completing a risk assessment. The evidence will be gathered in a variety of ways, for example, written responses for the risk assessment, logbooks, witness statements/observation records, annotated photographs, personal accounts, the finished components or accuracy checklists.



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 41: Manufacturing Secondary Machining Processes

Introduction

Many of the products and components we use daily rely on secondary machining processes. The use of traditional processes is usually easy to spot in manufactured components or products, but sometime more specialised processes are used.

The ultimate aim of this unit is for your learners to explore and safely carry out secondary machining processes to manufacture shapes by the removal of material.

Learning aim A – Examine the technology and characteristics of secondary machining processes that are widely used in industry

- This first learning aim is about raising awareness of the range of secondary machining processes used in industry and sets the scene for the other practical learning aims in this unit.
- You could begin by having a group discussion on the different processes used when manufacturing simple engineering products such as parts for a bicycle or parts of a car. Your learners will require initial input from you so that they have an awareness of the different traditional secondary machining processes covered by this unit.
- You could use a range of videos to show the dynamic operation of drilling, turning, milling and grinding.
- Once your learners are familiar with the capabilities of these processes, you could deliver formal sessions about tolerances and batch sizes that need to be considered in all machining processes.
- You could then split the learning by giving responsibility to different learners for different parts of the content. All learners will need to know about all the traditional secondary machining processes. A good way to do this would be to ask different learners to research different processes and report back to the whole group through the use of handouts and PowerPoint presentations. If any of your learners are struggling with this activity, you could ask them to work in pairs. You should ensure that the relevant technology and characteristics found under topic A1 in each case are covered.
- Next, your learners will require your input so they have an awareness of the different specialist secondary machining processes covered by this unit.
- You could use a range of videos to show the dynamic operation of presswork, electro discharge, broaching, honing and lapping machines and processes.
- You could again split the learning by giving responsibility to different learners for different parts of the content covering the specialist processes. All learners will need to know about all the specialist secondary machining processes. A good way to do this could be to ask different learners to research different processes and report back to the whole group through the use of handouts and PowerPoint presentations. Again, if any of your learners are struggling with this activity, you could ask them to work in pairs. You should ensure that the relevant technology and characteristics found under topic A2 in each case are covered.



- To provide an alternative and more engaging approach, you could ask a representative from a local industry to attend the learner presentations.
- Once your learners are familiar with the capabilities of the processes, you could deliver formal sessions about the sustainability of the range of secondary machining processes.
- Your learners could be given a reflective activity, which would help you prepare them for learning aim D (reflection and review).
- Throughout the delivery of this learning aim, your learners would benefit from regular visits to the workshops to see the process under discussion. Alternatively, a visit to a local engineering company would be beneficial.
- Approaching the delivery of this learning aim in the suggested manner will give your learners an opportunity to practise skills involved in researching case studies, which form part of the assessment criteria for this learning aim.

Learning aim B – Set up traditional secondary processing machines to manufacture a component safely

- This learning aim builds upon some of the areas covered in learning aim A by looking in a practical sense at the setting up of traditional secondary machining processes. You should note that there is no need to develop any skills to set up, or in fact use, any specialist secondary machining processes.
- Furthermore, this practical work should be seen as associated with, and could be delivered concurrently with, learning aim C. However, before any attempt is made to set up and use traditional secondary machining processes, your learners will need to have a good awareness of the requirements of health and safety when using these processes. This should include the need to carry out and abide by risk assessments.
- You should make your learners aware of the relevance and range of regulations associated with the setting up and use of secondary machining processes. Please refer to the specification content for the appropriate regulations.
- Each group could identify the relevant parts of the regulations that apply to each of the traditional secondary processes and report back to the whole group.
- Likewise, your learners will need to know how to carry out and use a risk assessment. It is important that your learners understand the difference between hazards, risks and measures.
- It may be appropriate that the delivery of the rest of this learning aim is combined with that for learning aim C.

Learning aim C – Carry out traditional secondary machining processes to manufacture a component safely

- The theoretical parts of learning aim B should have been dealt with earlier in this unit. The rest of learning aim B and all of learning aim C rely on demonstration, practice and skills development involving the setting up and using a range of traditional secondary machining processes, along with the use of quality control methods to establish 'fit for purpose' manufactured products.
- According to the staffing levels in your workshops and the machines available, you will need to develop a strategy that allows your learners to gather skills to manufacture components.



- Each learner, as an individual, should develop skills in at least two processes and use those skills on at least six features of a component that they will need to manufacture.
- The skills development should not be rushed and the majority of delivery time is likely to be spent on these activities.
- Demonstration will form a large part of the skills development, but learners should be given plenty of opportunities to practise using these skills themselves.
- For learning aim B, your learners will be expected to set up tooling and work pieces. The correct selection of speeds and feeds will be important.
- Before learners attempt to set up the two traditional secondary machining processes, they could annotate the component drawing. The purpose of this is to indicate the range of features that require machining and other important information such as the tooling to be used. They should show positional elements to hold both the work and the tooling relative to the work. This way you will be able to establish whether the learner has the knowledge required to set up the machines properly. A similar approach regarding the safety features of the machine and the personal protective equipment [PPE] needed could be demonstrated.
- It could be appropriate to develop learner skills concurrently to carrying out the machining processes, as each learner will be working at a different rate.
- For learning aim C your learners will be expected to produce [machine] a range of features [at least six] when using the two processes.
- Learners should be given the opportunity to develop the skills necessary to be able to adjust parameters to achieve correct machining actions.
- It is important for learners to develop skills in using quality control equipment, such as external micrometers to check dimensional accuracy and comparators to check surface texture,
- Once each learner has demonstrated a safe set-up procedure and has demonstrated a level of competence in the two machining processes, you could allow them to manufacture an engineering product independently. This activity would act as a trial or mock run before assessment.
- According to your facilities, you may find the strategy of workshop management easier if you can manage a smaller number of learners actually working on machines in the workshop. You could achieve this by having theoretical type activities involving speeds, feeds and quality control available for some learners in a safe environment within the locality of the workshop away from where the machines are located.

Learning aim D – Review the processes used to machine a component and reflect on personal performance

- This learning aim is about reflecting on what has been achieved throughout the unit with reference to two aspects: the lesson learnt from the practical elements of making an engineered component, and the learners' own personal performances.
- Your learners will require your initial input so that they have an understanding of the scope of reflection required to meet the needs of the unit. You could do this as a formal lecture which could include:
 - health and safety, machining skills, and wider engineering skills, such as the mathematics they used when deciding on speeds and feeds



- personal performance, i.e. initiative and responsibility, communication, literacy skills, and problem solving skills.
- Your learners could reflect on their research activities from learning aim A and produce a simple report linking their outcomes to the practical activities they carried out during the machining of their component.
- You could ask your learners to prepare a self-evaluation report and allow them to present this to the rest of the group, invited representatives from industry.
- To give an opportunity for peer assessment, you could allow other learners in the group to make a judgement about the accuracy of the self-evaluation to help differentiate between fact and opinion.



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

Pearson BTEC International Level 3 Qualifications in Engineering:

- *Unit 39: Modern Manufacturing Systems*
- *Unit 40: Computer Aided Manufacturing and Planning*
- *Unit 42: Manufacturing Primary Forming Processes*
- *Unit 43: Manufacturing Computer Numerical Control Machining Processes*

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.

Textbooks

- Meyers A and Slattery J – *Basic Machining Reference Handbook* (International Press Inc., 2001) ISBN 9780831131203.
The Basic Machining Reference Handbook is intended to serve as a memory jogger for the experienced, as well as a reference for programmers and others who do 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 not the learner.
- Walker J R – *Machining Fundamentals: From Basic to Advanced Techniques* (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. 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 B J – *Workshop Processes, Practices and Materials* 5th Edition (Routledge, 2015) ISBN 1138784727.
This is a very good introduction for entry-level engineers and workshop technicians, and for learners with little or no practical experience. It contains detailed illustrations throughout and is presented in a simple, clear language. It is good for learners to use.
- Khire M and Bhandare A – *Electro Discharge Machining Studies* (LAP Lambert Academic Publishing, 2012) ISBN 9783848423828.
This is a good resource for the tutor.

Websites

- www.hse.gov.uk/work-equipment-machinery/standard.htm
The Health and Safety Executive web site providing information about Machinery Standards

Pearson is not responsible for the content of any external internet sites. It is essential for tutors to preview each



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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.