Unit 30: Setting and Proving Secondary Processing Machines

Unit code: M/600/0282

QCF Level 3: BTEC Nationals

Credit value: 10

Guided learning hours: 60

Aim and purpose

This unit aims to give learners the knowledge and skills needed to set up and use a range of traditional and specialist secondary processing machines to produce components.

Unit introduction

For components to be manufactured to a required standard, the machines that produce them need to be correctly set up by technicians, ready for an operator to use. During this process, trial components are made to check accuracy and ensure a minimum amount of waste during production. Once satisfied that a machine's parameters are correctly set, the technician would then brief the machine operator and the mass production of accurate components can begin.

The aim of this unit is to provide learners with a detailed understanding of the setting of secondary processing machines including traditional machines (for example lathes and drilling machines) and others found in a more specialist workshop (for example spark or wire erosion methods). Learners' ability to set a machine and brief an operator will stem from their knowledge of the machine itself and their ability to select and use the most appropriate work holding devices and tooling.

The unit provides an opportunity for learners to examine a range of secondary processing machines, their set up and the best use of work holding devices and tools. Learners will need to be able to gain an understanding of the features of the component to be made to enable them to effectively set up the machine and hand over to an operator.

Safety is an important issue to be considered when setting and using secondary processing machines. In this unit learners will gain and be able to demonstrate safe working practices when carrying out activities. They will also be able to carry out checks for component accuracy and demonstrate this accuracy after setting a machine and when handing over to an operator.

With the knowledge and understanding gained from this unit there are other opportunities for investigation of a wider range of secondary processing machines, their work holding devices, tools and machine parameters.

Learning outcomes

On completion of this unit a learner should:

1 Know how traditional and specialist secondary processing machines function

2 Understand how work holding devices, tools and machine parameters are set up to produce a range of components

3 Be able to safely set up a secondary processing machine to accurately make a component

4 Know how to produce trial components relevant to the use of a secondary processing machine before handing over to an operator.

Unit content

1 Know how traditional and specialist secondary processing machines function

Secondary processing machines: basic principles of operation; machine's suitability to manufacture given components; relevant safe working practices for each machine; machine terminology eg cross slide, spindle, head stock, generation of shapes, forming of shapes; traditional secondary machining techniques eg turning (centre lathe, capstan, turret, single-spindle automatic, multi-spindle automatic), milling (horizontal, vertical, universal), grinding (surface, cylindrical, centreless, universal, thread grinding, tool and cutter grinding, universal or purpose-built machines), drilling (single spindle, multi-spindle); specialist secondary machining techniques eg boring (horizontal, vertical), electro discharge (spark erosion, wire erosion), honing and lapping (horizontal and vertical honing, rotary disc lapping, reciprocating machines)

2 Understand how work holding devices, tools and machine parameters are set up to produce a range of components

Work holding: devices for traditional secondary machining techniques eg chucks (hard or soft jaws, three or four jaw, collet, power, magnetic), fixtures and other machine specific devices for:

- turning (drive plate and centres, faceplates, magnetic or pneumatic devices, fixed steadies or travelling steadies)
- milling (clamping direct to machine table, pneumatic or magnetic table, machine vice, angle plate, vee block and clamps, indexing head/device, rotary table)
- grinding (centres, face plate, machine vices, clamps, angle plates, vee blocks, works rests, control stops, injector mechanisms, magnetic blocks, pots, arbors)
- drilling (clamping direct to machine table, machine vice, angle bracket, vee block and clamps, drill jigs, indexing device)

Devices for specialist secondary machining techniques eg angle plate, vee block and clamps, other machine specific devices for:

- boring (clamping direct to machine table, machine vice, pneumatic or magnetic table, indexing/rotary device)
- electro discharge machining (clamping direct to machine table, machine vice, pneumatic or magnetic table, ancillary indexing device)
- honing and lapping (pots, magnetic blocks, face plate)

Tools: materials and form eg solid high-speed steel, brazed tungsten carbide, indexible tips, electrode material, abrasive stone, composite wheels; tools for traditional secondary machining techniques eg for:

- turning (turning tools, facing tools, form tools, parting-off tools, thread chaser, single-point threading, boring bars, recessing tools, centre drills, twist/core drills, solid reamers, expanding reamers, taps, dies, knurling tool)
- milling (face mills, slab mills/cylindrical cutters, side and face cutters, slotting cutters, slitting saws, profile cutters, twist drills, boring tools, end mills, slot drills)
- grinding (soft wheel, hard wheel, cup, flaring cup, straight sided wheel, recessed wheel, double recessed wheel, dish, saucer, disc, segmented)
- drilling (drill bit, flat-bottomed drill, counterboring tool, countersinking tool, centre drill, spot facing tool, reamer, tap)

Tools for specialist secondary machining techniques eg for:

- boring (boring tool, facing, turning, recessing, chamfering or radii, forming, twist drill, tap, reamer, milling cutter)
- electro discharge machining (plain electrode, profile electrode, hollow electrode, wire)
- honing and lapping (mandrel, wedge, honing stone, lapping disc/pad)

Machine parameters: position of workpiece; position of tools in relationship to workpiece; cutting fluid/dielectric flow rate; position and operation of machine guards/safety mechanisms; parameters for different traditional secondary processing techniques eg for:

- turning (threading/profile/taper mechanisms, workpiece revolutions per minute, linear feed rate, depth of cut for roughing and finishing)
- milling (linear/table feed rate, milling cutter revolutions per minute, depth of cut for roughing and finishing)
- grinding (linear/table feed rate, depth of cut for roughing and finishing, cross feed, dressing of wheels)
- drilling (tooling revolutions per minute, linear feed rate, swarf clearance)

Parameters for different specialist secondary processing techniques eg for:

- boring (set up and tooling relative to datum, feed rate, cutter/tool revolutions per minute, depth of cut for roughing and finishing)
- electro discharge machining (electrical conditions, wire tension, wire speed, alignment of electrodes and wire, ventilation and fume extraction, filtration)
- honing and lapping (revolutions per minute or reciprocating speed, stroke length, stroke overrun length, stroke speed, stone or disc pressure)

Features of the component: materials eg ferrous, non-ferrous, non-metallic; holes eg drilled, bored (parallel or tapered), reamed, threaded, blind, through, counterbored, flat bottomed; relevant component features produced using traditional secondary processing techniques eg for:

- turning operations (flat faces, parallel diameters, stepped diameters, tapered diameters, profile forms, external threads, eccentric features, parting off, chamfers, knurls or special finishes, grooves, undercuts)
- milling operations (flat faces, square faces, parallel faces, angular faces, steps/shoulders, open ended slots, enclosed slots, recesses, tee slots, profile forms, serrations, indexed or rotated forms, special forms)
- grinding operations (flat faces, vertical faces, parallel faces, faces square to each other, shoulders and faces, slots, parallel diameters, tapered diameters, profiles forms, other thread forms, vee-form threads, right-hand threads, single start threads, multi-start threads, external threads, angular faces)
- drilling operations (countersinking, spot facing, holes)

Relevant component features produced using specialist secondary processing techniques eg for:

- boring operations (internal profiles; external profiles eg external diameters, grooves/recesses, chamfers/radii, flat faces, square faces, parallel faces, angular faces, slots, index or rotated forms)
- electro discharge machining operations (holes; faces – flat, square, parallel, angular; forms – concave, convex, profile, square/rectangular; other features – threads, engraving, cavities, radii/arcs, slots)
- honing and lapping operations (honing holes; lapping faces eg flat, parallel, angular)

3 Be able to safely set up a secondary processing machine to accurately make a component

Set up: machine guards in place; select and set tooling; checking tool/wheel condition; holding components securely without distortion; selection and use of suitable work holding device(s); set machine parameters to manufacture given component

Safe working: safe set up of moving parts eg setting stops, preventing tooling clashes; use of machine guards to protect operator and others; choice and handling of cutting fluids/dielectric flow rate; checks for insecure components; facilities for emergency stop and machine isolation; identification of appropriate protective clothing and equipment; housekeeping arrangements (work area clean and tidy); safe working practices relevant to specific secondary processing technique eg for:

- turning (handling turning tools, airborne particles, tool breakage, swarf disposal)
- milling (handling milling cutters, cutter breakage, swarf disposal, backlash in machine slides)
- boring (handling tools and cutters, airborne particles, tool breakage)
- electro-discharge machining (electrical components, handling dielectrics, fumes, handling and storing electrodes and wires)
- grinding (handling grinding wheels, sparks/airborne particles, bursting wheels)
- drilling (handling drills, taps and reamers, tool breakage, swarf disposal)
- honing and lapping (handling and storing stones, airborne particles)

Checks for accuracy: components to be free from burrs and sharp edges; use of appropriate tools and instruments; checks for dimensional accuracy and surface texture; checks relevant to specific secondary machining technique eg for:

- turning (components to be free from false tool cuts, dimensional tolerance equivalent to BS4500 or BS1916 Grade 7, surface finish 63 μin or 1.6μm, reamed or bored holes within H8, screw threads BS medium fit, angles within +/- 0.5 degree)
- milling (components to be free from false tool cuts, dimensional tolerance equivalent to BS4500 or BS1916 Grade 7, surface finish 63 μin or 1.6 μm, flatness and squareness within 0.001 inch per inch or 0.125 mm per 25 mm, angles within +/- 0.5 degree)
- boring (components to be free from false tool cuts, dimensional tolerance equivalent to BS4500 or BS1916 Grade 7, surface finish 63 μin or 1.6 μm, flatness and squareness within 0.005 inch per inch or 0.025 mm per 25 mm, angles within +/- 0.5 degree, bored holes within H8)
- electro-discharge machining (components to be free from false starts; dimensional tolerance to BS4500 or BS1916 Grade 7, surface texture 32 μin or 0.8 μm or 18 VDI; checks eg for parallelism, angle/taper, squareness, profile)
- grinding (tolerance to BS4500 or BS1916 Grade 5, surface texture 8 μin or 0.2 μm, free from false grind cuts)
- drilling (components to be free from false tool cuts, dimensional tolerance equivalent to BS4500 or BS1916 Grade 7, surface texture 63 μin or 1.6 μm, reamed holes within H8, screw threads BS medium fit)
- honing and lapping (components to be free from stone/disc marks; dimensional tolerance equivalent to BS 4500 or BS 1916 Grade 5; surface finish 8 μin or 0.2μm; honed components checked for parallelism and ovality/lobbing; lapped components checked for parallelism and flatness)

4 Know how to produce trial components relevant to the use of a secondary processing machine before handing over to an operator

Trial components: to meet the features and accuracy required by the specification

Use of machine: correct use of work holding devices; tools; machine parameters and safety

Handing over: correct set up; supplies of components and consumables; machine functions correctly; quality requirements; consideration of safe working

Handover procedures: demonstrating operation; explaining the key stages; highlighting critical areas eg safety, specific tolerances, finishes; observing operator and correcting any errors; ensuring operator is working safely and competently before leaving; periodic checks of machine and operator performance

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 describe how four different secondary processing machines function when machining a given component for each	**M1** explain the effects of using an inappropriate work holding device when setting up a secondary processing machine	**D1** justify the choice of a work holding device for a given component when setting up a secondary processing machine
P2 explain how work holding devices and tools are used on four different secondary processing machines to manufacture a different given component for each machine	**M2** explain the importance of setting machine parameters correctly to produce accurate features on a component produced by a secondary processing machine	**D2** evaluate the impact that aspects of working safely have on the effectiveness and accuracy of setting up a secondary processing machine.
P3 explain how a range of machine parameters are set up to produce required features on components machined on four different secondary processing machines	**M3** explain the impact of producing trial components and correct hand over procedures on the operator being able to continuously produce accurate components.	
P4 set up a secondary processing machine to safely produce a given component [IE1, SM3, SM4]		
P5 carry out checks for accuracy of a given component during the set up of a secondary processing machine [IE1]		
P6 explain how to produce trial components on a secondary processing machine		
P7 explain how to hand over a secondary processing machine to an operator including a description of the hand over procedures used.		

PLTS: This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills applicable in the pass criteria. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

The four learning outcomes of this unit are strongly linked and the delivery strategy should ensure that these links are emphasised. Learners needs to gain a coherent view of how to set up and hand over a secondary processing machine to an operator having proved the process by producing correct trial components.

Because of the nature of the unit content, a mainly practical approach to delivery should be used. Work-based learners are likely to be involved with setting a defined secondary processing machine or range of machines during their work and these machines should be used in delivery. While only one learning outcome is mostly associated with the setting of a secondary processing machine, assessment throughout the unit relies on evidence generated by this activity and it is a significant part of the unit.

Each learner should study in detail at least one of the secondary processing machines listed. Their study should allow safe set up procedures to be used and ensure safe handover to an operator in the workshop. They will, however, need to demonstrate an understanding of a further three machines and their functional procedures. Traditional and specialist techniques are included in the unit content and learners are required to work with four different secondary processing machines (see P1, P2 and P3). It is expected that at least one traditional and one specialist secondary machining technique and processing machine will be studied, leaving a choice for the other two. In the case of work-based learners, their chosen skill route may well determine the choice of machines.

Tutors should ensure that learners are aware of the design of a total of four secondary processing machines and how shapes can be produced using secondary machining techniques including at least one traditional and one specialist technique.

Care needs to be taken to ensure all learners work in a safe manner. Workshop briefings and formative assessment could be used to ensure this. Learners should also be taught how to monitor machine performance during the set up procedure and how to make adjustments to enable trial components to be produced successfully. Tutors should ensure that learners are familiar with appropriate measurement tools and instruments, such as micrometers, texture gauges etc so that they are able to check the accuracy of machined components.

Although it may not be appropriate to expect learners to actually handover to an operator a machine that has been set up correctly, this is something that could be simulated so that they know how to do this before assessment.

Although it is the learners' responsibility to ensure that they and the intended operator have the correct protective clothing and that machines are correctly guarded before operation, the tutor should always verify this before any machine is operated.

Note that the use of 'eg' in the content is to give an indication and illustration of the breadth and depth of the area or topic. As such, not all content that follows an 'eg' needs to be taught or assessed.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way in planning the delivery and assessment of this unit.

Topic and suggested assignments/activities and/assessment
Whole-class teaching/workshop demonstration: • introduction to unit and relevant health and safety procedures • explain terminology and principles of operation of secondary processing machines • introduce and demonstrate a range of traditional and specialist secondary processing techniques. *Group activity:* • investigate and report on the function of two traditional and two specialist secondary processing machines
Whole-class teaching/workshop demonstration: • explain and demonstrate the use of different workholding devices for a range of traditional secondary processing techniques. • explain and demonstrate the use of different workholding devices for a range of specialist secondary processing techniques. • explain and demonstrate the use of a range of tools for a variety of traditional and specialist processing techniques. • explain and demonstrate relationship between position of workpiece and tools. • explain and demonstrate operation of cutting fluids and guards. • explain parameters for a range of different traditional and specialist secondary processing techniques. • explain and demonstrate materials and features of a range of components produced using traditional and specialist secondary processing techniques. *Individual learner research:* • investigate workholding devices, tools and parameters for two traditional and two specialist processing techniques.
Whole-class teaching/workshop demonstration: • explain safe working practices to be followed when setting up and using a range of secondary processing machines. • explain and demonstrate how to set up different secondary processing machines and use them to produce components. • explain and demonstrate how to check components for accuracy. *Learner practical activity:* • practise use of workholding devices and tools. Practise setting up and using traditional and specialist secondary processing machines to produce components • using appropriate tools and instruments to carry out checks for accuracy on components.
Preparing for and carrying out **Assignment 1: Producing Components Using Secondary Processing Techniques** (P4, P5)

Topic and suggested assignments/activities and/assessment
Whole-class teaching: • explain how trial components are produced to meet specification • explain and demonstrate handover procedures. *Group activity:* • in small groups or pairs simulate handover of secondary processing machine.
Preparing for and carrying out **Assignment 2: Investigating Secondary Processing Machines** (P1, P2, P3, M1, M2 and D1)
Preparing for and carrying out **Assignment 3: Producing Trial Components and Handing Over Secondary Processing Machines** (P6, P7, M3, D2)
Unit evaluation, feedback and close.

Assessment

Assessment evidence for this unit is likely to be gained from a mixture of written tasks and practical process evidence (witness statements/observation records).

To achieve a pass grade, learners must demonstrate knowledge of a range of different secondary processing machines and their techniques when carrying out set up procedures. Both traditional and specialist techniques need to be covered. This means that learners need to know set up procedures for at least one technique from each range and an overall total of four.

Assessment of the procedure of actually setting up a machine, the knowledge required to prove the process by making trial components and handing over to an operator is restricted to one secondary processing machine, which can be either traditional or specialist. Centres and learners should pick the one most suitable for individual needs, considering any work-based learning expectations.

To achieve a merit grade, learners will need to demonstrate that they can explain some of the effects of using an inappropriate work holding device when setting up a secondary processing machine. This could be achieved through the selection of appropriate work holding devices for P2 together with learners demonstrating an appreciation of the possible effects of an inappropriate device. In addition, learners are required to explain the importance to producing accurate features on components produced by a secondary processing machine of setting machine parameters correctly. For example, if the depth of cut and/or feed rate in a turning operation is not set correctly, then the component is likely to have an out of tolerance surface finish and not be free from false tool cuts.

Finally, learners need to explain the impact of producing trial components and correct handover procedures on the operator being able to continuously produce accurate components. For example, if trial components are meeting the correct accuracy checks then the 'setter' will be confident when demonstrating to the operator the procedures to follow and the correct tolerance and finish requirements explained more easily to the operator. The required evidence for these criteria is likely to be in the form of a written response to tasks set for the learner.

To achieve a distinction grade, learners will need to justify their choice of a work holding device for a given component when setting up a secondary processing machine. This machine is likely to be one from their chosen skill route. Judgement needs to be made as to whether the device used would succeed and whether it is likely to meet the needs and features of the component, alignment and use of the tooling and tool-component interface.

They also need to be able to evaluate the impact of working safely on the effectiveness and accuracy of setting up a secondary processing machine. They need to consider whether the use of the safety equipment hampers the set up process. Again, the required evidence for these criteria is likely to be in the form of a written response to tasks set for the learner.

Wherever possible it is important to maximise the opportunities for assessment through practical tasks. A possible scenario would be to use a total of three assignments. It may be best to set a practical assignment as the first of these. This could be to set up a secondary processing machine (P4) and carry out checks for accuracy (P5). Evidence for these criteria could be in the form of annotated photographs, observation record/witness statement(s), notes and sketches produced by learners that capture the processes carried out. Learners will also need to maintain a record of all measurements taken and the action taken to correct any errors in the set up to complete the requirements of P5.

Following the practical, learners could then prepare a written report on how this secondary machining process functions and is set up. This could then be used to cover one of the four different machines required for P1, P2 and P3. It may also be the best opportunity to work towards the merit and distinction criteria M1, M2 and D1.

The second assignment could follow on from the practical activities, and involve learners preparing a report on the machining process used in assignment 1. They would also need to research and report on three more machines to generate the evidence required for P1, P2 and P3. The tasks undertaken should make it clear what secondary processing machines are to be covered (this could be set by the tutor or could be decided through learner choice).

To meet the requirements of the unit content for outcomes 1 and 2, both traditional and specialist techniques need to be covered. However, as long as at least one of each type is covered then the other two can be either traditional or specialist machines. When choosing from the examples listed in the unit content, eg turning (centre lathe, capstan, turret, single-spindle automatic, multi-spindle automatic), it would be sufficient to select from any one of the machines listed eg for a turning machine – use of a single-spindle automatic. This applies equally to the other aspects of unit content where examples are given.

The choice from these lists will be solely determined by the component being machined. For example, work holding devices for turning lists drive plate and centres, faceplates, magnetic or pneumatic devices, fixed steadies or travelling steadies. If the component only requires mounting on a faceplate then this would be sufficient. However, when choosing components centres need to take care to ensure the use of a reasonable range of techniques. For example, if all the components, for all four machines selected could be simply held in a three-jaw chuck to complete all operations, then this would be considered insufficient.

The last assignment could ask learners to explain how trial components are produced (P6) and how to handover a secondary processing machine to an operator (P7). The assignment could also provide an opportunity to explain the impact of producing trial components and the impact of correct handover procedures on the operator being able to continuously produce accurate components (M3). It could also evaluate the impact of working safely on the effectiveness and accuracy of setting up a secondary processing machine (D2). See earlier examples of what is expected for criteria M3 and D2; remember that the explanation and evaluation are likely to be a consideration of the experience of the practical work carried out in the first assignment.

Although simulated or practical activities would be the preferred means of capturing evidence for P6 and P7, it is accepted that this might not always be possible or realistic for a number of reasons. If a simulation is possible then for P7 it may be best if the tutor takes the role of the operator. For both P6 and P7 process evidence (records of observation and oral questioning) could be used. This process evidence could then be supplemented/supported by the product evidence that will be available from the activities eg the trial components, the learners' own preparation notes before handover and their own records of the actual handover process.

Programme of suggested assignments

The table below shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the assessment and grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Edexcel assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P4, P5	Producing Components Using Secondary Processing Techniques	Learners are required to produce a component using a secondary processing machine and check it for accuracy.	A practical assignment evidenced through photographs, tutor observation records and learners' notes.
P1, P2, P3, M1, M2 and D1	Investigating Secondary Processing Machines	Learners need to prepare an information leaflet giving details of four different secondary processing machines.	A written report detailing how each functions, the holding devices, tools and machine parameters associated with each.
P6, P7, M3, D2	Producing Trial Components and Handing Over Secondary Processing Machines	Learners explain to a new member of staff how to produce a trial component and correctly hand over a secondary processing machine.	A written report detailing how to produce trial components and the correct hand over procedures for a secondary processing machine.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC Engineering sector suite. This unit has particular links with the following unit titles in the Engineering suite:

Level 1	Level 2	Level 3
	Selecting and Secondary Machining Techniques to Remove Material	Engineering Secondary/Finishing Processes
		Computer Numerical Control of Machine Tools

The unit also covers some of the knowledge and understanding associated with the SEMTA Level 3 National Occupational Standards in Mechanical Manufacturing Engineering, particularly:

- Unit 4: Setting Centre Lathes for Production
- Unit 6: Setting Turret Lathes for Production
- Unit 8: Setting Milling Machines for Production
- Unit 16: Setting Horizontal Boring Machines for Production
- Unit 18: Setting Vertical Boring Machines for Production
- Unit 20: Setting Electro Discharge Machines for Production
- Unit 22: Setting Grinding Machines for Production
- Unit 24: Setting Honing and Lapping Machines for Production
- Unit 53: Setting Capstan and Turret Lathes for Production Operations
- Unit 54: Setting Single-Spindle Automatic Turning Machines for Production
- Unit 55: Setting Multi-Spindle Automatic Turning Machines for Production
- Unit 56: Setting Single and Multi-Spindle Drilling Machines for Production
- Unit 57: Setting Tool and Cutter Grinding Machines for Production.

Essential resources

To meet the needs of this unit it is essential that the centre has, or has access to some if not all of the range of machines specified in the unit content. This should include at least one specialist secondary processing machine. All auxiliary equipment such as that required for measuring accuracy should also be made available.

Employer engagement and vocational contexts

Much of the work for this unit can be set in the context of learners' work placements supported by case studies of local employers and well known national companies. All four learning outcomes lend themselves well to visits or input from visiting speakers from local employers.

There are a range of organisations that may be able help centres engage and involve local employers in the delivery of this unit, for example:

- Work Experience/Workplace learning frameworks – Centre for Education and Industry (CEI, University of Warwick) – www.warwick.ac.uk/wie/cei
- Learning and Skills Network – www.vocationallearning.org.uk
- Network for Science, Technology, Engineering and Maths Network Ambassadors Scheme – www.stemnet.org.uk
- National Education and Business Partnership Network – www.nebpn.org
- Local, regional Business links – www.businesslink.gov.uk
- Work-based learning guidance – www.aimhighersw.ac.uk/wbl.htm

Indicative reading for learners

Textbooks

Edwards J – *Lathe Operation and Maintenance* (Hanser, 2003) ISBN 1569903409

Timings R L – *Basic Manufacturing* (Newnes, 2004) ISBN 0750659904

Delivery of personal, learning and thinking skills

The table below identifies the opportunities for personal, learning and thinking skills (PLTS) that have been included within the pass assessment criteria of this unit.

Skill	When learners are ...
Independent enquirers	identifying questions to answer and problems to solve when selecting and setting tooling, workholding devices and machine parameters
Self-managers	organising time and resources and prioritising actions when setting up and using a secondary processing machine anticipating, taking and managing risks when safely producing a given component.

Although PLTS are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are ...
Reflective learners	setting goals with success criteria for their development and work reviewing progress and acting on outcomes
Team workers	collaborating with others when investigating and reporting on a range of different secondary processing machines.

Functional Skills – Level 2

Skill	When learners are ...
English	
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	researching a range of different secondary processing machines
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	compiling a report detailing how secondary processing machines function and the holding devices, tools and machine parameters associated with them.