2016 Suite

OCR
Oxford Cambridge and RSA

Cambridge **TECHNICALS LEVEL 2**

ENGINEERING

Cambridge TECHNICALS 2016

Unit 3

Mechanical engineering – machine operations

F/615/2132

Guided learning hours: 90

Version 1 September 2016

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LEVEL 2

UNIT 3: MECHANICAL ENGINEERING – MACHINE OPERATIONS F/615/2132

Guided learning hours: 90

Essential resources required for this unit: working drawings for engineering components and assemblies, appropriate machines and equipment for drilling and, turning or milling and suitable measuring tools and equipment

This unit is internally assessed and externally moderated by OCR.

Unit aim

The aim of this unit is for you to gain awareness of appropriate Health and Safety legislation and procedures. You will then consider how materials and equipment should be handled safely and the most appropriate personal protective equipment (PPE) to use when undertaking particular engineering activities.

The unit will also focus on the application of engineering processes used to create and form shapes through different machining techniques. You will learn how to select, set up, monitor and use machining techniques that involve shaping or forming with loss of volume. You will also use work-holding devices and a range of tools so that you can carry out a variety of engineering machining processes. You will learn how to inspect the items you produce for compliance, tolerance and accuracy.

TEACHING CONTENT

The unit content describes what has to be taught to ensure that learners are able to access the highest grade.

Anything which follows an i.e. details what must be taught as part of that area of content.

Anything which follows an e.g. is illustrative, it should be noted that where e.g. is used, learners must know and be able to apply relevant examples to their work though these do not need to be the same ones specified in the unit content.

Learning Outcome The Learner will:		Teaching Content The Learner must be taught:
1. Know the Health and Safety practices and procedures required in an engineering workplace	1.1	Health and Safety regulations relevant to employee and employer rights and responsibilities in an engineering workplace from the following i.e. • The Health and Safety at Work Act • Personal Protective Equipment (PPE) • Control of Substances Hazardous to Health (COSHH) • Reporting of Injuries Diseases and Dangerous Occurrences Regulations (RIDDOR)
	1.2	the importance of following accident and emergency procedures in an engineering workplace, including i.e. • Identification of appropriately qualified persons (e.g. qualified first aider, health and safety representative) • actions in the event of an accident or emergency (e.g. emergency exit, fire exit, first aid station, first aid, emergency eye wash, emergency telephone, assembly point • reporting routines
	1.3	know how to work safely while operating machinery in an engineering workplace i.e. • purpose and use of PPE (e.g. safety glasses when machining) • purpose and use of machinery safety features (e.g. ensuring machine guards are in place, switch off instructions, emergency stop) • identify risks, associated hazards and their control (e.g. remove burrs or sharp edges, alertness to moving parts, keep a clean and tidy work area, observe warning signs) • safe working practices relevant to drilling, turning and milling techniques (e.g. handling of tools, tool breakage procedure, swarf handling, disposal, cutting fluids)

Learning Outcome The Learner will:		Teaching Content The Learner must be taught:
2. Be able to work safely when performing engineering activities	2.1	preparation of the working environment i.e. • ensure that work area is free from hazards • select correct and appropriate personal protective equipment (PPE) • carry out safety checks on relevant tools. considerations for safe working including i.e. • following working instructions and safety procedures • using tools and equipment safely, and only for the purpose intended • maintaining a tidy workplace • taking measures to protect others from harm • correct disposal of unusable tools, equipment, components and waste materials
3. Be able to interpret engineering drawings to produce engineered component(s)	3.1	types of engineering drawings i.e. • 2D multiview orthographic projection (first and third angle) • 3D isometric, oblique • other engineering drawings e.g. o wiring/circuit diagrams o flow charts
	3.2	techniques used in engineering drawings i.e. • sections • auxiliary views • exploded diagrams • pattern (developments) • technical illustration (e.g. cutaways)
	3.3	conventions used in engineering drawings i.e. • drawing standards: British Standards (e.g. BS8888) • layouts (e.g. drawing number, title, issue number, projection symbols first angle, third angle, scale, units, tolerances, name of person responsible for producing drawing, lettering (e.g. titles, notes) • line types (e.g. centre, construction, outline, hidden, leader, dimension) • component features (e.g. dimensions, tolerances, surface finish, manufacturing detail, assembly instructions, parts list, circuit operation) • representation of common features (e.g. screw threads, springs, splines, repeated items • section views
	3.4	symbols and abbreviations used in engineering drawings i.e. • electronic/electrical components • mechanical components (nuts, bolts, screws, springs, pins, clips, keys, drive mechanisms), • weld symbols (square butt, single v butt, single bevel butt, backing run, fillet, plug and spot)

Learning Outcome The Learner will:		Teaching Content The Learner must be taught:
4. Be able to prepare and mark out materials to produce engineered component(s)	4.1	mark out and prepare materials to produce engineered component(s) i.e. preparing i.e. • setting out (e.g. radial line, triangulation, projection, true lengths) • calculations (e.g. bend allowance , intersection points, overlap) • detailed drawing (e.g. dimensions, tolerances, scales) • accuracy (e.g. of calculations, setting out, interpretation of drawing) marking out i.e. • equipment (e.g. rule, protractor, tee square, set square, tape measure, compass, dividers, trammel, templates, marker pen, scriber, chalk line, laser level) • reference points (e.g. datum line, centre line datum) • accuracy (e.g. use of equipment, reference points)
5. Be able to select and use tools, and work-holding devices to create machined component(s)	5.1	tools for drilling and, turning or milling techniques i.e. • drilling (e.g. centre drill, drill bit, flat bottomed drill, counter boring tool, countersinking tool, reamer, tap) • turning (e.g. turning tools, facing tools, form tools, parting off tools, single point threading, boring bar, recessing tool, centre drill, twist drill, reamer, tap, die, knurling tool) • milling (e.g. face mills, end mills, slot drills, slotting cutters, slitting saws, profile cutters, twist drills, reamer, boring tools) • tooling materials (e.g. high-speed steel, cobalt steel, tungsten carbide)
	5.2	work-holding devices for drilling and, turning or milling i.e. • drilling (e.g. machine vice, machine table clamping , angle plate, vee block and clamps) • turning (e.g. three jaw chuck with hard jaws, four jaw chuck with hard jaws, centres (live or dead), faceplate, fixed steady or travelling steady) • milling (e.g. machine vice, machine table clamping, angle plate, vee block and clamps, indexing head/device, rotary table.)
6. Be able to perform machine operations to create machined component(s)	6.1	establish and set correct machining parameters prior to and during drilling and, turning or milling i.e. • positional parameters (e.g. position of work piece and position of tool in relationship to work piece) • speed parameters (e.g. correct tool speeds) • feed rate Parameters (e.g. Correct feed rates, linear feed rate) • depth parameters (e.g. cut for roughing and finishing) • debris Parameters (e.g. swarf clearance)

Learning Outcome The Learner will:		Teaching Content The Learner must be taught:
	6.2	drilling and, turning or milling machine operations i.e. • drilling (e.g. through holes, blind holes, flat-bottomed holes, counter bored holes, counter sinking, reaming, tapping) • turning (e.g. facing off flat faces, parallel diameters(turning down), drilled holes (centre drilled), stepped diameters, tapered diameters, bored holes, reamed holes, profile forms, internal threads, external threads, parting off, chamfers, knurls, grooves, undercuts) • milling (e.g. flat faces (skimmed surface), square faces, parallel faces, angular faces, steps/shoulders, open-ended slots, enclosed slots, recesses, tee slots, drilled holes(twist drill), bored holes (milling cutter), profile forms, serrations, indexed or rotated forms)
	6.3	establish and apply accuracy, tolerance and compliance checks for drilling and, turning or milling i.e. • quality checks (e.g. visual checks to ensure engineered component is free from erroneous tool cuts. Free from burrs and sharp edges) • specification checks of dimensional tolerance

GRADING CRITERIA

Learning Outcome	Pass	Merit	Distinction
The learner will:	The assessment criteria which are the pass requirements for this unit.	To achieve a merit the evidence must show that, in addition to the pass criteria, the candidate is able to:	To achieve a distinction the evidence must show that, in addition to the pass and merit criteria, the candidate is able to:
1. Know the Health and Safety practices and procedures required in an engineering workplace	P1* Describe how health and safety legislation and work place policies and procedures impact on employees and employers	M1* Explain why PPE is used and safety procedures are followed when operating an engineering machine	
	P2* State the personal protective equipment (PPE) needed and safety procedures required when performing specific engineering operations and operating specific engineering machines		
2. Be able to work safely when performing engineering activities	P3* Prepare working environment prior to performing engineering activities		
	P4* Follow safe working procedures when performing engineering activities to include: • following instructions • using tools • disposal procedures		

Learning Outcome	Pass	Merit	Distinction
3. Be able to interpret engineering drawings to produce engineered component(s)	P5* Interpret key features of an engineering drawing that complies with standards such as BS8888.	M2* Explain different types of engineering drawings and how they are used in the production of an engineering component(s)	
4. Be able to prepare and mark out materials to produce engineered component(s)	P6* Prepare and mark out an engineered component(s) from information given in an engineering drawing	M3* Explain why tolerances and accuracy are important when preparing and marking out materials to produce an engineered component(s)	D1* Evaluate the accuracy of your preparation and marking out of an engineered component(s), with respect to dimensions, tolerances and scales.
5. Be able to select and use tools, and work-holding devices to create machined component(s)	P7* Select and use appropriate tools for accurate drilling and turning or drilling and milling P8* Select and use work-holding devices for accurate drilling and turning or drilling and milling.	M4* Explain the use of each tool and work-holding device used for a drilling and turning or drilling and milling task, stating why each was suitable for the task.	
6. Be able to perform machine operations to create machined component(s)	P9* Set correct parameters prior to machine operations and during machining for: • drilling and turning or • drilling and milling.		

Learning Outcome	Pass	Merit	Distinction
	P10* Produce machined component(s) that demonstrate drilling and turning or drilling and milling machine operations.	M5* Explain why it is important to establish and apply checks on tolerance, compliance and accuracy of machined component(s)	D2* Evaluate your own accuracy and quality of your machined component(s), identifying strengths and areas for improvement.
	P11* Perform appropriate checks for tolerance, compliance and accuracy for drilling and turning or drilling and milling machine operations.		

ASSESSMENT GUIDANCE

Feedback to learners: you can discuss work-in-progress towards summative assessment with learners to make sure it's being done in a planned and timely manner. It also provides an opportunity for you to check the authenticity of the work. You must intervene if you feel there's a health and safety risk.

Learners should use their own words when producing evidence of their knowledge and understanding. When learners use their own words it reduces the possibility of learners' work being identified as plagiarised. If a learner does use someone else's words and ideas in their work, they must acknowledge it, and this is done through referencing. Just quoting and referencing someone else's work will not show that the learner knows or understands it. It has to be clear in the work how the learner is using the material they have referenced to inform their thoughts, ideas or conclusions.

For more information about internal assessment, including feedback, authentication and plagiarism, see the centre handbook. Information about how to reference is in the OCR Guide to Referencing available on our website: http://www.ocr.org.uk/i-want-to/skills-guides/.

P1

Learners could produce a report or presentation (including detailed speaker notes) to describe the relevant aspects of health and safety legislation and work place policies and procedures (such as accident and emergency procedures) impacting on employees and employers.

P2/ M1
Learners should produce evidence (such as annotated photographs, procedures log, risk analysis and/or report) on the relevant PPE and safety procedures that they will/have followed when operating specific engineering machines and carrying out specific engineering operations. Tutors should ensure that learners have the opportunity to review different engineering machines and operations to ensure they cover the range of safety considerations in this unit. For M1 this should include an explanation, justifying why PPE is used and safety procedures are followed when operating an engineering machine.

P3
Learners must demonstrate how they have carried out appropriate safety checks on relevant tools, equipment and work areas prior to their use. Evidence should be in the form of documented safety checks, supporting witness statements and annotated photographic evidence.

P4
Learners must demonstrate that they can follow working instructions safely, use tools and follow appropriate procedures for the safe disposal of waste products when performing engineering activities. Evidence could be in the form of photographs or video footage with accompanying annotations, which should be supported by witness statements.

P5
Tutors must provide learners with an engineering drawing from which learners will extract information on conventions such as: component features, dimensions, tolerances, layouts, line types, projection types, common features. Tutors should ensure that the supplied drawing(s) covers the range of techniques and conventions in engineering drawings given in the content of this unit.

The engineering drawing must not contain any annotations as it is a requirement that learners independently interpret key features and conventions of the engineering drawing.

Evidence should be in the form of annotated engineering drawing(s) which show how they intend to prepare and mark out the engineering component(s).

M2
From the given engineering drawing learners should be able to explain how the drawing would be used in an engineering environment to aid manufacture and by whom. The explanation should include types, techniques, conventions and symbols. Learners should focus on why a specific type of engineering drawing is used for a specific purpose.

P6
Using a given engineering drawing learners should be able to extract dimensions and tolerances necessary to prepare and mark out engineering components. Evidence should be in the form of annotated engineering drawings, which could be part of the evidence provided for P5 as well as annotated photographs of prepared and marked out components supported by witness statement.

M3
Learners must produce evidence that explains why tolerances and accuracy are important when preparing and marking out materials. Evidence could be in the form of a written report or a presentation including detailed speaker notes.
D1
Learners should reflect back on their preparation and marking out of their engineered component and show how accurate they have been with dimensions, tolerances and scales compared to those in the given engineered drawing. Evidence could be in the form of a written evaluative report which details levels of accuracy.

For P7 – P11
Tutors, please note that learners can demonstrate all three techniques (drilling, turning and milling) but learners should only submit for assessment drilling and turning or drilling and milling.

P7/ 8
Learners must provide evidence of their selection and use of drilling and turning or drilling and milling machining techniques and relevant work holding devices which should be in the form of annotated photographs or video footage supported by a detailed witness statement to confirm accuracy and/or a log.

M4
Learners should explain why each tool and work holding device they have used for drilling, turning or milling was suitable for each specific use. The explanation should include features such as safety and precision and accuracy.

P9
Learners should set parameters for position, speed, feed, depth and debris. Evidence should be in the form of annotated photographs or video footage supported by a detailed witness statement to confirm accuracy and/or a log.

P10
Learners will need to be provided with an engineering drawing of an engineering assembly that requires learners to demonstrate drilling and turning or drilling and milling techniques. The engineering work piece for P10 can comprise of a single component or an assembly of components that make up an engineered product. Evidence could be in the form of photographs or video footage with accompanying annotations, which should be supported by witness statements.

P11
Evidence could be in the form of a table of recordings/checks/measurements, with annotated photographs confirming that checks took place, both work in progress and on the completed components.

M5
Learners must produce evidence that explains why it is important to establish and apply checks on tolerance, compliance and accuracy of machined component(s). Evidence could be in the form of a written report or a presentation including detailed speaker notes.

D2
Learners should reflect back on the accuracy and quality of their machined components, evaluating their strengths and weaknesses, suggesting areas for improvement. Evidence could be in the form of a written evaluative report.

*SYNOPTIC ASSESSMENT AND LINKS BETWEEN UNITS

Unit 3 is one of the synoptic units within the Certificate and Diploma qualifications. Please see section 6 of the centre handbook for more detail. We have indicated in this unit where these links are with an asterisk and provided more detail in the synoptic assessment grid below.

Synoptic assessment grid

This unit and specific LO	Related unit	Related LO	Assessment requirements
Unit 3 LO1 Know the Health and Safety practices and procedures required in an engineering workplace	Unit 2	LO3 3.1 LO4 4.1, 4.2, 4.3 LO5 5.1, 5.2	• Learners must use their understanding of materials processing techniques, electrical and fluid power systems from Unit 2 when stating the personal protective equipment (PPE) needed and safety procedures required when performing specific engineering operations and operating specific engineering machines. • Learners must also draw on their understanding of Health and Safety legislation, working practises and risk reduction from unit 4 to achieve P1 and P2 • Learners should use their knowledge of Health and Safety when constructing automated control systems from Unit 5 and apply this to Health and Safety practices and procedures required in an engineering workplace. • Learners should know safe working procedures for product assembly and manufacture from Unit 7 and should this to achieve P1 and P2
	Unit 4	LO1 1.1, 1.2, 1.3 LO2 2.5, 2.6 LO3 3.1, 3.2	
	Unit 5	LO2 2.1, 2.2	
	Unit 7	LO2 2.2 LO3 3.1, 3.2, 3.3 LO4 4.2	
	Unit 8	LO3 3.2, 3.3, 3.4	
Unit 3 LO2 Be able to work safely when performing engineering activities	Unit 2	LO3 3.1 LO4 4.1, 4.2, 4.3 LO5 5.1, 5.2	• Learners must use their understanding of materials processing techniques, electrical and fluid power systems from Unit 2 when preparing the work environment and following safe working procedures when performing engineering activities
	Unit 4	LO1 1.1, 1.2, 1.3 LO2 2.5, 2.6 LO3 3.1, 3.2	• Learners must also draw on their understanding of health and safety legislation, working practises and risk reduction from Unit 4 to achieve P3 and P4.

This unit and specific LO	Related unit	Related LO	Assessment requirements
	Unit 5 Unit 7 Unit 8	LO2 2.1, 2.2 LO2 2.2 LO3 3.1, 3.2, 3.3 LO4 4.2 LO3 3.2, 3.3, 3.4	• Learners should use their knowledge of Health and Safety when constructing automated control systems from Unit 5 and apply this to working safely when performing engineering activities. • Learners should know safe working procedures for product assembly and manufacture from Unit 7 and should use this to achieve P3 and P4.
Unit 3 LO3 Be able to interpret engineering drawings to produce engineered component(s)	Unit 1	LO1 1.1, 1.3, 1.4	• Learners must use knowledge of SI units and their derivatives from Unit 1 to develop scales and dimensions for engineering drawings. • Learners should use their experience of interpreting circuit diagrams from Unit 4 when interpreting engineering drawings to produce engineered components. • Learners will recognise schematic diagrams of basic programmable devices in circuit from Unit 5 and must apply this knowledge where appropriate to interpreting engineering drawings. • Learners will have created engineering drawings using 2D and 3D techniques in Unit 6 and should use these skills to interpret engineering drawings to produce engineered components. • Learners will have knowledge of interpreting manufacturer's data and instructions from Unit 8 which should be applied to interpreting engineering drawings.
	Unit 4	LO2 2.1, 2.2, 2.3, 2.4	
	Unit 5	LO1 1.1, 1.2, 1.3 LO2 2.2	
	Unit 6	LO1 1.1 LO3 3.1, 3.2 LO4 4.1 LO5 5.1	
	Unit 8	LO3, 3.1, 3.4	
Unit 3 LO4 Be able to prepare and mark out materials to produce engineered component(s)	Unit 1	LO1 1.1, 1.3, 1.4	• Learners must use knowledge of SI units and measurements from Unit 1 to accurately mark out engineered components. • Learners should use their experience of interpreting circuit diagrams from Unit 4 when preparing and marking out materials.
	Unit 4	LO2 2.1, 2.2, 2.3, 2.4	

This unit and specific LO	Related unit	Related LO	Assessment requirements
Unit 3 LO5 Be able to select and use tools, and work-holding devices to create machined component(s)	Unit 4	LO2 2.5, 2.6 LO3 3.2	• Learners should use their experience of selecting and using tools and equipment safely when constructing electrical circuits in Unit 4 when they are selecting and using tools and work-holding devices • Learners will have used tools and equipment to test the operation of a control system in Unit 5, which could be used to support the selection and use of tools and work holding devices. • Learners could use their understanding of product assembly using mechanical fastening, adhesives and hot joining techniques from unit 7 to achieve P8
	Unit 5	LO4 4.1	
	Unit 7	LO3 3.1, 3.2, 3.3	
	Unit 8		
Unit 3 LO6 Be able to perform machine operations to create machined component(s)	Unit 1	LO1 1.4	• Learners must use their knowledge of measurements to set correct machine parameters. • Learners must use their understanding of materials processing techniques when performing machine operations. • Learners could use their understanding of product assembly using mechanical fastening, adhesives and hot joining techniques from unit 7 to achieve P10
	Unit 2	LO3 3.1	
	Unit 7	LO3 3.1, 3.2, 3.3	
	Unit 8	LO3 3.2, 3.3, 3.4	

MEANINGFUL EMPLOYER INVOLVEMENT - A REQUIREMENT FOR TECHNICAL CERTIFICATE QUALIFICATIONS

These qualifications have been designed to be recognised as Technical certificates in performance tables in England. It is a requirement of these qualifications for centres to secure employer involvement through delivery and/or assessment of these qualifications for every learner.

The minimum amount of employer involvement must relate to at least one or more of the elements of the mandatory content.

Eligible activities and suggestions/ideas that may help you in securing meaningful employer involvement for this unit are given in the table below.

Please refer to the Qualification Handbook for further information including a list of activities that are not considered to meet this requirement.

Meaningful employer involvement – eligible activities	Suggestion/ideas for centres when delivering this unit
1. Students undertake structured work-experience or work-placements that develop skills and knowledge relevant to the qualification.	*Placements with engineering firms, in the engineering manufacturing department, researching common component/product design standards.*
2. Students undertake project(s), exercises(s) and/or assessments/examination(s) set with input from industry practitioner(s).	*Tasks set on engineering product design or re-design of components, using industry standard equipment and standards, written to determine if a design of the product is capable of manufacture within that business. Employers could provide learners with industry standard risk assessments to complete for the engineering activities that they will carry out during this unit.*
3. Students take one or more units delivered or co-delivered by an industry practitioner(s). This could take the form of master classes or guest lectures.	*Lectures from practicing design engineers involved in product design, development and testing. Input to include examples of engineering work.*
4. Industry practitioners operating as 'expert witnesses' that contribute to the assessment of a student's work or practice, operating within a specified assessment framework. This may be a specific project(s), exercise(s) or examination(s), or all assessments for a qualification.	*Input from practicing design engineers assessing the clarity of engineering products and correct identification of engineering principles, during learners' project work and documentation.*

You can find further information on employer involvement in the delivery of qualifications in the following documents:

- Employer involvement in the delivery and assessment of vocational qualifications
- DfE work experience guidance

To find out more
ocr.org.uk/engineering
or call our Customer Contact Centre on **02476 851509**

Alternatively, you can email us on **vocational.qualifications@ocr.org.uk**

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