



Cambridge TECHNICALS 2016

Cambridge **TECHNICALS LEVEL 3**

ENGINEERING

Unit 8

Electrical operations

K/506/7274 Guided learning hours: 60 VERSION 4 - June 2017 black line indicates updated content

LEVEL 3

UNIT 8: ELECTRICAL OPERATIONS

K/506/7274

Guided learning hours: 60

Essential resources required for this unit: electrical and electronic components and devices to construct circuits, interconnecting cables and connectors, hand tools (see assessment guidance), suitable PPE, test equipment (see assessment guidance)

This unit is internally assessed and externally moderated by OCR.

UNIT AIM

Manufacturing of electrical components and devices is a skilled role upon which many industries depend for their own products.

The aim of this unit is for learners to develop the knowledge, understanding and skills to be able to produce electrical components safely.

Learners will develop underpinning knowledge about the performance characteristics of electrical and electronic components and devices. They will go on to learn how to work safely with electricity, develop the ability to construct a circuit, and to test and fault find electrical and electronic equipment as part of the quality assurance process.

TEACHING CONTENT

The teaching content in every unit states what has to be taught to ensure that learners are able to access the highest grades.

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 in their work, though these do not need to be the same ones specified in the unit content.

For internally assessed units you need to ensure that any assignments you create, or any modifications you make to an assignment, do not expect the learner to do more than they have been taught, but they must enable them to access the full range of grades as described in the grading criteria.

Please note – if learners are completing this unit as part of the Extended Diploma qualification they will be required to complete the synoptic unit 25: Promoting continuous improvement. Before your learners complete the assessment of this unit, you must refer to the specification and model assignment requirements for unit 25, so if applicable you can ensure learners gather the appropriate feedback on their own performance and performance of the system, process or artefact that they may have produced in this unit.

Learning outcomes	Teaching content	
The Learner will:	Learners must be taught:	
 Understand operating and performance characteristics of electronic components and devices 	 1.1 the operating and performance characteristics and applications from technical and manufacturers data for the following electrical and electronic components and devices i.e. cables and cable types i.e. solid core multi-core ribbon co-axial resistors i.e. fixed (preferred values E12 series) variable resistors i.e. potentiometers - rotary panel and PCB types, trimmers devices with resistive change i.e. Negative Temperature Coefficient (NTC) thermistor Light Dependant Resistors (LDR) capacitors and capacitor types i.e. polarised (e.g. electrolytic, tantalum bead) non-polarised (e.g. mica, ceramic disc) values/rating/tolerance switches and switch types, i.e. push to break (PTB), push to make (PTM) momentary action, latching action contact arrangements i.e. Single Pole Double Throw (SPST) Double Pole Double Throw (DPST) Double Pole Double Throw DPDT) reed micro toggle dual-in-line package (DIP) rotary binary coded decimal (BCD) 	

Learning outcomes	Teaching content	
The Learner will:	Learners must be taught:	
	 electronic components i.e. input devices (e.g. photodiode, phototransistor, LDR, thermistor, switch, microphone) process devices (e.g. diode, transistor, integrated circuit, microprocessor, microcontroller) output devices (e.g. piezo-electric buzzer, lamp, light emitting diode, liquid crystal display, dot matrix display, relay, solenoid) 1.2 physical identification and application, function and benefits of circuit protection, i.e. fuses (e.g. cartridge, slow-blow, quick-blow, high rupturing capacity (HRC)) circuit breakers (e.g. current-operated type, earth leakage type) diode 1.3 how to determine resistor values by: measurement calculation colour code (including rating/tolerance) 1.4 how to calculate cable sizes and types for voltage and current 1.5 how to select appropriate cable and fuse size and types 	
2. Be able to work safely with electricity	 2.1 the key aspects of current regulations, standards and codes of practice relevant to performing electrical operations (e.g. IET wiring regulations (BS7671), Health & Safety at Work Act) 2.2 how to produce and use safe work method statements for performing electrical operations 2.3 how to carry out risk assessments for electrical operations 2.4 the appropriate use and storage of Personal Protective Equipment (PPE) 2.5 the risks associated with working on live equipment 2.6 how to identify and reduce the risk of electrical hazards, i.e. visual inspection of equipment Portable Appliance Testing (PAT) compliance use of Residual Current Device (RCD) 	

Learning outcomes	Teaching content		
The Learner will:	Learners must be taught:		
3. Be able to construct electrical and electronic circuits	 3.1 safe use of hand tools, i.e. soldering iron wire cutters wire strippers pliers screwdrivers allen keys spanners de-soldering tools manual/PCB drills crimping tools appropriate Personal Protective Equipment (PPE) 3.2 interpretation of circuit diagrams 3.3 circuit construction following circuit diagram(s) 3.4 circuit construction following appropriate methods (e.g. component assembly, soldering techniques, use of hand tools, heat sinks for delicate components) 3.5 construction techniques for joining components, i.e. soldering connecting between components connecting between plugs and sockets i.e. making cable assemblies connecting plugs and sockets, sleeves, insulation, heat shrink, screw terminals) 		
4. Be able to fault find in electrical and electronic equipment	 4.1 fault-finding procedures, i.e. visual inspection the half-split method of fault location six-point fault-finding technique testing, i.e. use of manuals, data sheets and fault-finding data truth tables expected values 4.2 use of appropriate test equipment, i.e. power supply unit multimeter for voltage, current, resistance and continuity signal generator oscilloscope 4.3 production of fault-finding plans for an electrical/electronic operation (e.g. model-based approach) 4.4 development of systematic troubleshooting plans and strategies for electrical/electronic operations 		

GRADING CRITERIA

LC)	Pass	Merit	Distinction
		The assessment criteria 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.	Understand operating and performance characteristics of electrical and electronic components and devices	P1: Use technical data to identify different resistor types and their applications.	M1: Determine a wide range of resistor values by measurement, calculation and colour code.	D1: Evaluate methods and benefits of circuit protection.
		P2: Use technical data to identify different cable types and their applications. M2: Analyse the operation and performance characteristics of a diverse range of electrical and	M2: Analyse the operation and performance characteristics of a diverse range of electrical and	
		P3: Use technical data to identify different capacitor types and their applications.	electronic devices using appropriate data.	
		P4: Use technical data to identify different switches and their applications.		
		P5: Use technical and manufacturers' data to identify a different input, output and process electronic devices and their applications.		
		P6: Calculate cable size and select appropriate cables for a range of voltage and current applications. * synoptic link to Unit 2 Science for Engineering		

LO		Pass	Merit	Distinction
		 P7: Calculate and select appropriate fuse types and ratings for a range of applications. * synoptic link to Unit 2 Science for Engineering and Unit 4 Principles of Electrical and Electronic Engineering 		
2.	Be able to work safely with electricity	 P8: Know the purpose and key features of relevant health and safety regulations, standards and codes of practice. P9: Identify hazards and risks associated with working on electrical systems. P10: Identify risks associated with working on live equipment. 	M3: Compare techniques to identify potential electrical hazards including reasons for their use.	D2: Produce a detailed safe working method statement and risk assessment (including identification of appropriate PPE).
3.	Be able to construct electrical and electronic circuits	P11: Use hand tools safely to construct a circuit. P12: Interpret a circuit diagram in order to construct a circuit.	M4: Construct circuits and electrical/electronic assemblies using appropriate joining techniques from circuit diagrams.	
4.	Be able to fault find in electrical and electronic equipment	P13: Use test equipment on electronic equipment in order to undertake electrical fault finding. * synoptic link to Unit 4 Principles of Electrical and Electronic Engineering		D3: Use a variety of fault-finding procedures and test equipment to establish faults in electrical equipment.

LO	Pass	Merit	Distinction
	P14 Interpret manuals, data sheets and expected values in order to undertake electrical fault finding.		
	P15: Carry out visual inspection to locate an electrical fault.	M5: Produce a fault-finding plan and systematic troubleshooting plan for an electrical or electronic system.	

***SYNOPTIC ASSESSMENT AND LINKS BETWEEN UNITS**

When learners are taking an assessment task, or series of tasks, for this unit they will have opportunities to draw on relevant, appropriate knowledge, understanding and skills that they will have developed through other units. We've identified those opportunities in the grading criteria. Learners should be encouraged to consider for themselves which skills/knowledge/understanding are most relevant to apply where we have placed an asterisk.

ASSESSMENT GUIDANCE

LO1: Understand operating and performance characteristics of electrical and electronic components and devices

Learners should be able to use appropriate data in order to identify the features and applications for the range of electrical/electronic devices specified. For P6 they should perform calculations in order to select appropriate cable types and sizes. For P7 they should perform calculations in order to select appropriate fuse types and ratings for given applications. At M2 learners should consider the operation and performance of a diverse range of electronic devices (e.g. input, output and process devices).

LO2: Be able to work safely with electricity

Learners should demonstrate knowledge of health and safety regulations, standards and codes of practice. They should be able to identify hazards and risks, and ways in which they might be mitigated. For D2 they should also be able to produce a detailed safe working method statement and risk assessment. Teachers might wish to adopt standard templates such as those available from the Health and Safety Executive (HSE) website.

LO3: Be able to construct electrical and electronic circuits

Learners should be able to use appropriate tools and techniques to safely construct electrical/electronic circuits including cable assemblies. Teachers should select a range of circuits in order that learners can demonstrate a range of construction techniques. Evidence of circuit construction might be in the form of a documentary record (e.g. log book) which could include circuit diagrams, procedures and photographs of construction taking place.

LO4: Be able to fault find in electrical and electronic equipment

Learners should safely use test equipment and appropriate test and fault finding techniques to undertake electrical/electronic fault finding. Teachers might provide learners with suitable activities on which to perform fault finding. Evidence might be in the form of a documentary record (e.g. log book) of a range of fault finding activities.

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: <u>http://www.ocr.org.uk/i-want-to/skills-guides/</u>.

MEANINGFUL EMPLOYER INVOLVEMENT - a requirement for the Foundation Diploma, Diploma and Extended Diploma (tech level) qualifications

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

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 engagement		Suggestion/ideas for centres when delivering this unit
1. L v t	Learners undertake structured work-experience or work-placements that develop skills and knowledge relevant to the qualification.	Placements with electrical/electronic engineering firms; working with the electrical maintenance department or electrical/electronic manufacturing department, researching component manufacture and/or maintenance or assembly standards for electrical/electronic devices.
2. L 8 F	Learners undertake project(s), exercises(s) and/or assessments/examination(s) set with input from industry practitioner(s).	Project set on measurement and inspection of components using industry standard equipment, to determine if the production method proposed by learners is realistic and that components are of the correct quality.
3. L a r	Learners 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.	Talks from practicing electrical/electronic engineers involved in product inspection, development and testing. Input could include examples of methodology, calculations and working documentation used within professional commercial electrical/electronic engineering practice.
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 and review from practicing electrical/ electronic engineers relating to the correct identification of manufacture and or testing principles outlined in learners' project work and documentation.

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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