Advanced Engineering

Level 2

Maintaining electrical equipment/systems

Unit Code: AUEC2-009

Learner Name: _____

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Unit Overview

This unit of Competence has been developed by employers in the Engineering Sector and is part of an overall development programme designed to meet the requirements of the Sector.

This unit identifies the training and development required in order that the learner can demonstrate that they are competent in being able to prepare for the electrical maintenance activities by obtaining all necessary information, documentation, tools and equipment required, and to plan how they intend to carry out the required maintenance activities and the sequence of operations they intend to use.

They will be required to select the appropriate equipment to use, based on the maintenance operations to be carried out and the type of electrical equipment/systems being maintained. This will include electrical equipment that uses single, three-phase or direct current power supplies, and includes equipment such as control systems, motors and starters, switchgear and distribution panels, electrical plant, pumps, fans, alternators, generators, transformers, wiring enclosures and luminaires, portable appliances and other specific electrical equipment. They will be expected to use a variety of maintenance diagnostic techniques and procedures, such as gathering information from fault reports, using recognised fault finding techniques and diagnostic aids, measuring, inspecting and operating the equipment.
They will be expected to cover a range of maintenance activities, such as isolating and locking off, disconnecting, removing and reconnecting electrical components, wires and cables, attaching cable identification markers, replacing damaged or defective components, cables and wires, setting and adjusting components, and making `off-load' checks before testing the equipment, using appropriate techniques and procedures.

Their responsibilities will require them to comply with health and safety requirements and organisational policy and procedures for the electrical maintenance activities undertaken. They will need to take account of any potential difficulties or problems that may arise with the maintenance activities, and to seek appropriate help and advice in determining and implementing a suitable solution. They will work under a high level of supervision, whilst taking responsibility for their own actions and for the quality and accuracy of the work that they carry out.

Their underpinning knowledge will provide an understanding of their work, and will enable them to apply appropriate electrical maintenance techniques and procedures safely. They will understand the electrical maintenance process, and its application, and will know about the electrical equipment and systems being maintained, the components, tools and consumables used, to the required depth to provide a sound basis for carrying out the activities to the required specification.

They will understand the safety precautions required when carrying out the maintenance activities (especially those for ensuring that the equipment is correctly isolated), and when using maintenance tools and equipment. They will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall company objectives, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity motivation and commitment.

Specific Standard Requirements
In order to prove their ability to combine different electrical maintenance operations, at least one of the electrical maintenance activities carried out must be of a significant nature, and must cover a minimum of **eight** of the activities listed in S5 within the Skills requirements.

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Performance and Skills Requirements

The apprentice must be able to:		**Evidence**	**Reference**
P1	Work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines		
P2	Demonstrate the required behaviours in line with the job role and company objectives		
S1	Carry out **all** of the following during the electrical maintenance activities:		
	1.1 adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) including The Electricity at Work Regulations and other relevant guidelines		
	1.2 ensure the safe isolation of equipment (such as electrical, mechanical, gas, air or fluids), where appropriate		
	1.3 follow job instructions, maintenance drawings and procedures		
	1.4 check that the tools and test instruments are within calibration date and are safe, (such as by PAT testing) and in a usable condition		
	1.5 ensure that the system is kept free from foreign objects, dirt or other contamination		
	1.6 return all tools and equipment to the correct location on completion of the maintenance activities		
P3	Plan the maintenance activities before they start them		
P4	Obtain all the information they need for the safe removal and replacement of the equipment/system components		
P5	Obtain and prepare the appropriate tools and equipment		
P6	Apply appropriate maintenance diagnostic techniques and procedures		

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Performance and Skills Requirements

The apprentice must be able to:		**EvidenceReference**
S2	Carry out maintenance/repair activities on **four** of the following types of electrical equipment:	
	2.1 electrical plant	
	2.1 motors and starters	
	2.3 transformers	
	2.4 wiring enclosures	
	2.5 heaters	
	2.6 pumps	
	2.7 portable appliances	
	2.8 luminaires	
	2.9 fans/blowers	
	2.10 generators	
	2.11 switchgear	
	2.12 distribution panels	
	2.13 other specific electrical equipment	
S3	Carry out maintenance/repair activities on **three** of the following electrical systems:	
	3.1 lighting circuits	
	3.2 air conditioning control circuits	
	3.3 power circuits	
	3.4 refrigeration control circuits	
	3.5 motor start and control circuits	
	3.6 heating/boiler control circuits	
	3.7 power generation and control circuits	
	3.8 instrumentation and control circuits	
	3.9 emergency lighting systems	

Performance and Skills Requirements

The apprentice must be able to:		**EvidenceReference**
	3.10 alarm systems (such as fire, intruder, process control)	
	3.11 communication systems	
	3.12 electro-pneumatic or electro-hydraulic control circuits	
	3.13 computer systems	
	3.14 other control circuits (such as pumps, fans, blowers, extractors)	
	3.15 other specific electrical circuits	
S4	Use **both** of the following maintenance diagnostic techniques:	
	4.1 fault finding techniques (such as six point, half-split, input/ output, unit substitution)	
	4.2 test instrumentation measurement (such as voltage, resistance, current)	
	Plus **three** from the following:	
	4.3 diagnostic aids (such as manuals, flow charts, trouble-shooting guides, maintenance records)	
	4.4 information gathered from fault reports	
	4.5 visual checks (such as signs of damage, overheating, missing parts, wear/deterioration)	
	4.6 movement checks (such as loose fittings and connections)	
	4.7 monitoring equipment or gauges	
S5	Carry out **all** of the following maintenance activities:	
	5.1 removing excessive dirt and grime	
	5.2 making mechanical/screwed/clamped connections	
	5.3 dismantling/disconnecting equipment to the required level	
	5.4 soldering and de-soldering	
	5.5 crimping (such as tags and pins)	
	5.6 disconnecting and reconnecting wires and cables	
	5.7 replacing damaged/defective components	

Performance and Skills Requirements

The apprentice must be able to:		Evidence Reference	
	5.8 stripping cable insulation/protection		
	5.9 removing and replacing damaged wires and cables		
	5.10 attaching suitable cable identification markers		
	5.11 setting and adjusting replaced components		
	5.12 removing electrical units/components		
	5.13 making de-energised checks before reconnecting power supply		
	5.14 removing/replacing cable end fittings		
	5.15 checking components for serviceability		
P7	Use the appropriate methods and techniques to remove and replace the required components		
S6	Replace/refit a range of electrical components, to include six of the following:		
	6.1 cables and connectors		
	6.2 capacitors		
	6.3 batteries		
	6.4 locking and retaining devices		
	6.5 circuit boards		
	6.6 transformers		
	6.7 overload protection devices		
	6.8 luminaires		
	6.9 solenoids		
	6.10 inverter and servo controllers		
	6.11 switches or sensors		
	6.12 thermistors or thermocouples		
	6.13 relay components		
	6.14 contactors		

Performance and Skills Requirements

The apprentice must be able to:		**EvidenceReference**	
	6.15 encoders or resolvers		
	6.16 rectifiers		
	6.17 other specific components		
P8	Carry out tests on the maintained equipment, in accordance with the test schedule/defined test procedures		
S7	Carry out **all** of the following checks and tests on the maintained equipment, to include:		
	7.1 making visual checks (such as completeness, signs of damage, incorrect termination)		
	7.2 movement checks (such as loose fittings and connections)		
	7.3 testing that the equipment operates to the circuit specification		
	7.4 check/test load current		
	Plus **five** from the following:		
	7.5 carrying out fault finding techniques (such as half-split, input/output, unit substitution)		
	7.6 protective conductor impedance		
	7.7 power rating		
	7.8 insulation resistance values		
	7.9 polarity		
	7.10 frequency values		
	7.11 continuity		
	7.12 resistance		
	7.13 inductance		
	7.14 voltage levels		
	7.15 capacitance		
	7.16 RCD disconnection time		
	7.17 specialised tests (such as speed, sound, light, temperature)		

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Performance and Skills Requirements

The apprentice must be able to:		**EvidenceReference**	
S8	Maintain electrical equipment, in accordance with **two** of the following quality and accuracy standards:		
	8.1 BS 7671/IET wiring regulations		
	8.2 other BS and/or ISO standards		
	8.3 company standards and procedures		
	8.4 equipment manufacturer's requirement		
P9	Deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve		
P10	Leave the work area in a safe and tidy condition on completion of the maintenance activities		

08 Knowledge and Understanding

The apprentice must know and understand:		EvidenceReference
K1	Outline the health and safety requirements, and safe working practices and procedures required for the electrical maintenance activities undertaken	
K2	Describe the isolation and lock-off procedure or permit-to-work procedure that applies to electrical maintenance activities (to include electrical isolation, locking off switchgear, removal of fuses, placing of maintenance warning notices, proving that isolation has been achieved and secured)	
K3	Identify the hazards associated with carrying out electrical maintenance activities (such as dangers of electric shock, capacitor discharge, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures), and how to minimise them	
K4	Explain what constitutes a hazardous voltage and how to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and how to obtain first aid assistance)	
K5	Explain the importance of wearing appropriate protective clothing and equipment (PPE), and keeping the work area safe and tidy	
K6	Outline the procedure for obtaining drawings, job instructions, related specifications, replacement parts, materials and other consumables necessary for the maintenance activities	
K7	Explain the importance of applying the appropriate behaviours in the workplace and the implications for both the learner and the business if these are not adhered to	
K8	Describe how to obtain and interpret information from job instructions and other documentation used in the maintenance activities (such as drawings, specifications, manufacturers' manuals, BS and ISO wiring regulations, symbols and terminology)	
K9	Outline the general principles of how the equipment they have maintained functions, and the working purpose of individual units/components and how they interact	

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Knowledge and Understanding

The apprentice must know and understand:		Evidence Reference
K10	Outline the various maintenance diagnostic techniques and aids that can be used (such as fault reports, visual checks, measuring, movement and alignment checks, testing)	
K11	Outline the various fault location techniques that can be used, and how they are applied (such as half-split, input-to-output, function testing, unit substitution, and equipment self-diagnostics)	
K12	Explain how to use a range of fault diagnostic equipment to investigate the problem	
K13	Describe the care, handling and application of electrical measuring instruments	
K14	Identify the different types of cabling used in the maintenance activities, and their methods of termination	
K15	Outline the techniques used to dismantle/assemble electrical equipment (such as unplugging, desoldering, removal of screwed, clamped and crimped connections)	
K16	Describe the methods of removing and replacing cables and wires in wiring enclosures without causing damage to existing cables	
K17	Explain the use of BS 7671/IET wiring, and other regulations, when selecting wires and cables and when carrying out tests on systems	
K18	Outline the different earthing systems and their applications such as TN-S, TN-C-S, TT and IT	
K19	Explain why electrical bonding/earthing is critical, and why it must be both mechanically and electrically secure	
K20	Outline the methods of attaching identification markers/labels to removed components or cables, to assist with re-assembly	
K21	Identify the tools and equipment used in the maintenance activities (such as the use of cable stripping tools, crimping tools, soldering irons and torches, gland connecting tools)	

Knowledge and Understanding

The apprentice must know and understand:		Evidence Reference
K22	Describe the methods of checking that components are fit for purpose, and the need to replace `lifed' items (such as seals and gaskets overload protection devices)	
K23	Outline how to check that tools and equipment are free from damage or defects, and are in a safe and usable condition	
K24	Explain the importance of completing documentation and/or reports following the maintenance activity	
K25	Explain the importance of making `off-load' checks before proving the equipment with the electrical supply on	
K26	Describe how to use appropriate lifting and handling equipment in the maintenance activity	
K27	Outline the problems that can occur during the electrical maintenance activity, and how they can be overcome	
K28	State when to act on their own initiative and when to seek help and advice from others	
K29	Explain the importance of leaving the work area in a safe and clean condition on completion of the maintenance activities (such as returning hand tools and test equipment to is designated location, cleaning the work area, and removing and disposing of waste)	