

**City & Guilds Tutor Training Guidance Level 3 6014 NVQ Unit 327/027 Understand and carry out electrical work on domestic plumbing and heating systems and components April 2013**

**This document is for tutors only and is not for dissemination to candidates**

City & Guilds is committed to providing support, advice and guidance to centres that deliver our qualifications. One way we support centres is to issue, when appropriate, tutor training guidance to assist in the delivery of our qualifications. The purpose of this document is to provide support and guidance to centres on their delivery of this unit.

**Useful documents for delivery of the unit**

IET on site guide green copy, various manufacturers' documents to assist with the correct terminology of components and terminal fittings.



Learning outcome	Assessment criteria	Delivery guidance and points of reference
01 Know the electrical standards that apply to the mechanical services industry	1.1 State the statutory legislation and guidance information that applies to electrical supply and control of domestic mechanical services systems and their components: <ul style="list-style-type: none"> <li>- general legislation</li> <li>- construction specific legislation</li> <li>- mechanical services specific legislation – professional body guidance</li> <li>- codes of practice</li> <li>- manufacturer installation and service/maintenance instructions</li> <li>- manufacturer user instructions</li> </ul>	Installation guidance documents which relate to electrical installation. Including:- Electricity at work regulations, B.S7671, IET wiring regulations, Part L, PUWER, GS 38, manufacturer’s instructions  The difference between statutory and non-statutory documents
	1.2 Identify the range of information that would be detailed on a minor works certificate for an electrical system or component	Scope and limitations of minor works certificates (IET on site guide green copy p165 G4.5, G4.6)
	1.3 specify the procedure for notifying works carried out to the relevant authority	
02 Know the principles of electricity supply to buildings	2.1 Specify the methods by which electricity is generated <ul style="list-style-type: none"> <li>- basic power station operation</li> <li>- principles of generation</li> <li>- types of supply: single phase, three phase and neutral</li> </ul>	Power supply frequency to the UK (50HZ). Electrical supply to typical domestic dwelling 230v  AC. Types of earth system TT, TN-S, TN-C-S (IET on site guide green copy p15/16 2.1)  Purpose of electrical components meters, consumer unit, main earth
	2.2 Specify the methods by which generated electricity is distributed to non dwellings and commercial properties <ul style="list-style-type: none"> <li>- basic operation of the national grid and local distribution systems: substations, supply transformers, local distribution to three- and single-phase supplies to premises</li> </ul>	
	2.3 State the purpose of electrical components at entry to the property: <ul style="list-style-type: none"> <li>- main fuse (single phase) and cable head connection</li> </ul>	

	<ul style="list-style-type: none"> <li>- meter</li> <li>- consumer unit</li> <li>- main earth terminal.</li> </ul>	terminal
03 Know the layout features of electrical circuits in buildings	3.1 Define the system layout features for electrical circuits in dwellings: <ul style="list-style-type: none"> <li>- ring main circuit</li> <li>- radial circuit</li> <li>- fixed equipment supplies: spurs and fused outlets</li> </ul>	System wiring layouts and maximum floor area of circuits  (IET on site guide green copy section H)
	3.2 Specify the types of cables and conductors used for the installation of electrical equipment in mechanical services systems	Types and limitations of cables including:- SWA, Flat twin & earth, thermosetting , thermoplastic (IET on site guide green copy section H Appendix c)
	3.3 State the applications and limitations of the types of cable and conductors used for the installation of electrical equipment in mechanical services systems	
	3.4 Clarify the difference between Class 1 and Class 2 electrical equipment	Class 1 and Class 2 electrical equipment installation and earthing requirements including symbols
	3.5 Define the function of electrically operated components used in mechanical services systems: <ul style="list-style-type: none"> <li>- flame rectification devices</li> <li>- flame suppression devices</li> <li>- solenoid valves</li> <li>- thermistors</li> <li>- thermocouples</li> <li>- micro switches</li> <li>- relays</li> <li>- printed circuit boards</li> <li>- pressure switches</li> <li>- pumps</li> <li>- fans</li> <li>- leak detection.</li> <li>- control components: thermostats, programmers/timers, electrically operated control valves (actuators), sensors, wiring centres</li> <li>- switches: rocker plate (with/without CPC single and double pole), pull cord, pressure operated, DP lockable isolators.</li> </ul>	Typical function of electrical components including:- Relays, printed circuit boards, wiring centres, solenoid valves, micro switches, thermistors, thermocouples, pressure switches, switches (pull cord, double pole, rocker plate)

	<p>3.6 Define the operating principles of electrical circuit protection devices:</p> <ul style="list-style-type: none"> <li>- miniature circuit breakers</li> <li>- residual current devices including RCBOs</li> <li>- fuses: re-wireable, cartridge, high breaking capacity.</li> </ul>	Operating principles of electrical circuit protection devices including:- miniature circuit breakers, fuses rewireable and cartridge, high breaking capacity system (IET on site guide green copy section 7)
	<p>3.7 Clarify the need for, and requirements of, earthing systems:</p> <ul style="list-style-type: none"> <li>- main earthing systems: TT system, TN-S system, TN-C-S system</li> <li>- protective equipotential bonding</li> <li>- high risk rooms (zones) in dwellings</li> <li>- supplementary earthing (bonding)</li> <li>- temporary continuity bonding</li> </ul>	<p>Requirements for earthing systems including TT, TN-S, TN-C-S (IET on site guide green copy p15/16 2.1)</p> <p>Protective equipotential bonding systems, main protective bonding conductor, supplementary and temporary Protective bonding conductor</p>
	<p>3.8 Identify the warning notices to be applied.</p>	Warning notices for systems and colours (IET on site guide green copy section 6)
04	<p>4.1 Identify the test equipment required to prove that circuits to be worked on are dead:</p> <ul style="list-style-type: none"> <li>- approved voltage indicating device</li> <li>- proving unit</li> </ul>	Test equipment requirements, GS 38 lead requirements, calibration requirements.
	<p>4.2 Specify the electrical industry agreed procedure for safe isolation of electrical circuits:</p> <ul style="list-style-type: none"> <li>- select the approved voltage indicating device and test on a known supply</li> <li>- locate and identify the isolation point for the equipment to be worked on</li> <li>- isolate the supply and prevent re-energisation</li> </ul>	<p>Safe isolation procedures and appropriate equipment.</p> <p>Operation and effects of capacitors</p>

	<ul style="list-style-type: none"> <li>- verify that the equipment is dead</li> <li>- fit warning labels</li> <li>- re-check the approved voltage indicating on a known supply for correct function</li> </ul>	within systems which may affect safe isolation
	<p>4.3 Clarify the methods of ensuring that circuits cannot be re-activated while work is taking place on them:</p> <ul style="list-style-type: none"> <li>- use of locking devices</li> <li>- device retention (fuel removal)</li> </ul>	
06	<p>6.1 Identify the required sources of information when carrying out work on electrical systems:</p> <ul style="list-style-type: none"> <li>- statutory regulations</li> <li>- industry standards</li> <li>- manufacturer technical instructions</li> </ul>	Sources of information when installing appliances and carrying out work including reference to manufacturer's instructions
	<p>6.2 Identify the preparatory work required to be carried out to the building fabric in order to install, commission, decommission or maintain electrical systems or components</p>	Preparatory work prior to installation. Making customer aware of existing damage, protecting customers property
	<p>6.3 State the types of pre-existing damage to the existing building fabric or customer property that may be encountered before commencing work on electrical systems and components:</p> <ul style="list-style-type: none"> <li>- building wall/floor surfaces</li> <li>- existing electrical system components</li> <li>- building décor and carpets</li> </ul>	
	<p>6.4 Identify the protection measure to be applied to the building fabric or customer property, during, and on completion of, work on electrical systems and components:</p> <ul style="list-style-type: none"> <li>- building wall/floor surfaces</li> <li>- existing electrical system components</li> <li>- building décor and carpets</li> </ul>	
	<p>6.5 Identify the cable, materials and fittings required to complete work on electrical systems</p>	

	6.6 Identify the hand and power tools required to complete work on electrical systems	<p>Identification of hand tools used for preparing wire.</p> <p>Use of power tools and associated risks with regards to voltage.</p> <p>Colour identification with regards to voltage</p>
08	8.1 Define the method used to identify that existing electrical supplies and circuits are suitable for the proposed installation of electrical equipment used in domestic mechanical services systems	<p>Maximum demand requirements when connecting to existing installations</p> <p>Documentation used to record suitability including maximum demand (IET on site guide appendix A)</p>
	8.2 State the procedure for sizing electrical materials and components: <ul style="list-style-type: none"> <li>- basic cable sizing procedure type cables and conductors</li> <li>- basic circuit protection device sizing procedure – circuit types</li> </ul>	<p>Basic cable sizing and selection including related terminology (IET on site guide appendix F)</p>
	8.3 Specify the method used to select suitable cables and cords for components and circuits: <ul style="list-style-type: none"> <li>- selection of appropriate multi-core cables</li> <li>- selection of appropriate multi-core cords</li> <li>- selection of PVC single conductors</li> </ul>	
	8.4 Specify the requirements for protecting cables installed in the building fabric and terminating in enclosures: <ul style="list-style-type: none"> <li>• protection methods in wall and floor surfaces: <ul style="list-style-type: none"> <li>- embedded (sheathing) – depth of cover, application of RCD protection</li> <li>- exposed (mini-trunking)</li> <li>- within ducting and pattresses</li> <li>- within timber stud partitions</li> <li>- within timber floor structures</li> </ul> </li> <li>• junction boxes</li> </ul>	<p>Requirements for protecting cables in walls etc and application of RCD protection (IET on site guide section 7)</p> <p>Location of cables to other components including gas meters and pipework etc (IET on site guide</p>

	<ul style="list-style-type: none"> <li>• switch/socket boxes: <ul style="list-style-type: none"> <li>- surface mounted</li> </ul> </li> <li>• wiring centres</li> </ul>	section 2).
	<p>8.5 Define the types of cable termination methods approved for use in dwellings:</p> <ul style="list-style-type: none"> <li>• screw terminals</li> <li>• pillar terminals</li> <li>• claw and washer terminals</li> <li>• crimping</li> <li>• strip connectors</li> </ul>	Cable termination methods including:- screw, pillar, claw and washer, crimping, strip
	<p>8.6 Specify the method of installation and wiring termination for fixed electrical equipment:</p> <ul style="list-style-type: none"> <li>• distribution boards: <ul style="list-style-type: none"> <li>- air handling units/VRF systems/system control panels/building energy management systems/heat pumps/pressure boosting sets/gas supply safety controls</li> </ul> </li> <li>• control panels: <ul style="list-style-type: none"> <li>- heating system wiring centres/pumps/heat pumps/fan motors/solar collection systems/pressurisation units/boilers/motorised valve actuators/solenoid valves/thermostatic control devices and sensors/fire protection controls</li> </ul> </li> <li>• existing appliance supply point: <ul style="list-style-type: none"> <li>- heating system wiring centres/pumps/heat pumps/fan motors/solar collection systems/pressurisation units/boilers/motorised valve actuators/solenoid valves/thermostatic control devices and sensors/fire protection controls.</li> </ul> </li> </ul>	<p>Method of termination to components including the use of wiring centres and connections to controls</p> <p>Uses of thermosetting rubber cable for heating appliances.</p> <p>Limits of electrical water heating appliances and connections to circuits</p>
10	<p>10.1 Specify the requirements of a visual inspection of completed electrical installation work for mechanical services systems prior to electrical inspection and testing</p>	Basic visual inspection requirements
	<p>10.2 Define the equipment used for electrical testing of mechanical services components and its calibration requirements</p>	Instruments for which are used for the testing and calibration of systems
	<p>10.3 Identify the importance of carrying out tests on dead circuits wherever possible</p>	Importance of dead testing where



	10.4 State the purpose of the electrical testing procedures for new and existing circuits: <ul style="list-style-type: none"> <li>• polarity</li> <li>• earth continuity</li> <li>• insulation resistance</li> <li>• earth fault loop impedance</li> <li>• residual current device</li> </ul>	possible  Test requirements for new and existing systems, resistance polarity, fault loop impedance, continuity, , RCD components  (IET on site guide section 11)
	10.5 Clarify the requirements for carrying out functional testing of electrical components	functional test requirements
	10.6 Clarify the procedure for final handover of electrical circuits that supply electrically operated domestic mechanical services components: <ul style="list-style-type: none"> <li>• installation completion of certification</li> <li>• demonstration to the user.</li> </ul>	Handover requirements and documents passed on to the customer  Completion and handover of certification material
12 Know the procedures for safely diagnosing and rectifying faults in electrically operated mechanical services components	12.1 State the methods of obtaining details of system faults from end users	Discussing system faults with the customer for fault diagnosis purposes,
	12.2 Identify and use manufacturer instructions and industry standards to establish the diagnostic requirements of electrical system components	Use of manufacturer's instructions for fault diagnosis, flow diagrams and procedures etc
	12.3 Identify the electrical test equipment used to undertake fault diagnostics	Use of electrical test equipment when finding faults ,low resistance ohmmeter, insulation resistance tester
	12.4 Identify the situations in which dead testing of components can be carried out	Requirements for dead testing (IET on site guide section 9 and 10)
	12.5 Identify the situations in which live testing of components may be necessary	

	and the safety precautions required	Use of live testing equipment ammeters on pumps.  Voltage meters on controls
12.6	<p>Define how to perform a range of routine checks and diagnostics on electrical system components as part of a fault finding process. checking for correct operation of:</p> <ul style="list-style-type: none"> <li>• appliance components: <ul style="list-style-type: none"> <li>- flame rectification devices</li> <li>- flame suppression devices</li> <li>- solenoid valves</li> <li>- thermistors</li> <li>- thermocouples</li> <li>- micro switches</li> <li>- relays</li> <li>- pressure switches</li> <li>- printed circuit boards</li> <li>- pumps</li> <li>- fans</li> <li>- leak detection</li> </ul> </li> <li>• control components: <ul style="list-style-type: none"> <li>- thermostats</li> <li>- programmers/timers</li> <li>- electrically operated control valves</li> <li>- wiring centres</li> </ul> </li> <li>• switches: <ul style="list-style-type: none"> <li>- rocker plate (with/without CPC) - single and double pole pull cord</li> <li>- pressure operated</li> <li>- DP lockable isolators</li> </ul> </li> </ul>	Define how to perform routine checks and diagnostic tests for operation on thermocouples, cylinder and room, thermostats, thermistors, pumps and capacitors.
12.7	State the methods of correcting deficiencies in electrical components:	Methods of correcting deficiencies

	<ul style="list-style-type: none"><li>• inadequate earthing provision</li><li>• defective cable positioning (aged cables/proximity to other services)</li><li>• failed electrical components</li><li>• incorrect polarity</li><li>• provision of inadequate circuit protection devices.</li></ul>	within systems incorrect bonding requirements and insufficient wiring sizes.
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