

Unit 067

General electrical and electronic engineering applications

Level: 2

Credit value: 12

NDAQ number: 500/9514/6

Unit aim

This unit covers the skills and knowledge needed to prove the competences required to cover a broad range of basic electrical and electronic engineering activities. It will prepare the learner for entry into the engineering or manufacturing sectors, creating a progression between education and employment, or it will provide a basis for the development of additional skills and occupational competences in the working environment.

The electrical and electronic engineering activities will include the wiring and termination of a range of wire/cables, electrical components, circuit boards and electronic components. This will involve using a range of tools and equipment, along with soldering techniques and anti-static protection techniques.

The learner will be required to select the appropriate tools, materials and equipment to use, based on the operations to be performed and the components/circuits to be connected. The learner will be expected to use appropriate tools and techniques for the assembly and wiring of the various electrical and electronic components and connectors that make up the circuit. The wiring and testing activities will include making all necessary checks and adjustments to the circuit (such as continuity, polarity, insulation resistance, current, voltage and waveform values), and ensuring that the circuit functions to the specification.

The learner's responsibilities will require them to comply with health and safety requirements and organisational policy and procedures for the electrical and electronic wiring and testing activities undertaken. The learner will need to take account of any potential difficulties or problems that may arise with the wiring and testing activities, or with the tools and equipment used, and to seek appropriate help and advice in determining and implementing a suitable solution. The learner 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.

The learner's knowledge will provide an understanding of their work, and will enable them to apply appropriate electrical and electronic wiring and testing procedures and techniques safely. The learner will understand the wiring and testing methods and procedures used, and their application, and will know about the various cables and components used to produce the circuits, to the required depth to provide a sound basis for carrying out the activities to the required specification.

The learner will understand the safety precautions required when carrying out the wiring and testing activities, especially those for ensuring the safe isolation of the equipment and circuits produced. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Carry out general electrical and electronic engineering applications
2. Know how to carry out general electrical and electronic engineering applications

Guided learning hours

It is recommended that **55** hours should be allocated for this unit, although patterns of delivery are likely to vary.

Details of the relationship between the unit and relevant national standards

This unit has been derived from national occupational standard Performing Engineering Operations Unit No. 67: General electrical and electronic engineering applications (Suite 2).

Support of the unit by a sector or other appropriate body

This unit is endorsed by Semta.

Assessment

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Performing Engineering Operations Level 2 unit assessment strategy which can be downloaded from Semta's website:

http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx

Unit 067

General electrical and electronic engineering applications

Outcome 1

Carry out general electrical and electronic engineering applications

Assessment criteria

Practical skills

The learner will be able to:

1. work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines
2. carry out all of the following during the wiring and testing activities:
 - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations
 - ensure the safe isolation of services during the wiring and testing activities
 - follow job instructions, circuit and assembly drawings and test procedures at all times
 - check that tools and test instruments to be used are within calibration date and are in a safe and usable condition
 - ensure that the components used are free from damage, dirt or other contamination
 - prepare the electrical and electronic components for the assembly and wiring operations (such as pre-forming pins)
 - where appropriate, apply procedures and precautions to eliminate electrostatic discharge (ESD) hazards (such as the use of grounded wrist straps)
 - return all tools and equipment to the correct location on completion of the wiring and testing activities
3. plan the electrical and electronic wiring and testing activities before they start them
4. use appropriate sources to obtain the required specifications, circuit diagrams and test information
5. obtain the correct tools and equipment for the wiring and testing operations, and check that they are in a safe and usable condition
6. use **two** of the following test instruments during the wiring and testing activities:
 - low reading ohmmeter
 - insulation resistance tester
 - clamp meter
 - voltage indicator

Plus **three** more of the following:

- multimeter
- oscilloscope
- logic probe/clip
- logic analyser
- pulse sequencing analyser
- counter-timers
- signature analysers
- protocol analyser
- signal generator

- signal tracer
 - stabilised power supplies
 - measuring bridges
 - software diagnostic programs
 - data communications test set
 - bus exerciser
7. mount and secure the electrical and electronic components safely and correctly, to meet specification requirements
 8. use **three** of the following types of cable when producing the electrical and electronic circuits:
 - single core
 - multi core
 - PVC twin and earth
 - armoured
 - coaxial
 - ribbon cables
 - fibre optics
 - screened
 - wiring loom/harness
 - data/communication
 - flexible (such as cotton or rubber covered)
 - mineral insulated (such as FP 200)
 9. install and terminate the cables to the appropriate connections on the components
 10. wire up **three** of the following electrical circuits/systems:
 - domestic lighting circuits
 - domestic power circuits
 - motor control circuits
 - instrumentation and control circuits
 - vehicle heating or ventilating
 - vehicle lighting
 - vehicle starting and ignition
 - emergency lighting systems
 - air conditioning control circuits
 - refrigeration control circuits
 - heating/boiler control circuits
 - aircraft lighting circuits
 - alarm systems (such as fire, intruder, process control)
 - electro-pneumatic or electro-hydraulic control circuits
 - other control circuits (such as pumps, fans, blowers, extractors)
 - power generation and control circuits
 - avionic circuits and systems
 - communication systems
 - computer systems
 - other specific electrical circuits
 11. apply wiring methods and techniques, to include all of the following:
 - positioning and securing of equipment and components
 - determining size and lengths of cables required

- stripping outer coating without damage to conductor insulation
- stripping cable conductor insulation/protection
- adding cable end fittings (such as plugs, sockets multi-way connectors)
- making mechanical/screwed/clamped connections
- crimping (such as spade end, loops, tags and pins)
- soldering and de-soldering
- attaching suitable cable identification
- leaving sufficient slack for termination and movement
- secure wires and cables (such as clips, plastic strapping, lacing, harnessing)

12. assemble electronic components to produce **four** of the following types of circuit:

- audio amplifiers
- signal converters
- signal generators
- counter-timers
- oscillators
- filters
- microprocessor-based applications
- comparators
- power amplifiers
- motor control
- regulated power supplies
- logic function controls
- display circuits
- other specific circuit
- sensor/actuator circuit (such as linear, rotational, temperature, photo-optic, flow, level, pressure)
- digital circuit (such as process control, microprocessor, logic devices, display devices)
- signal processing circuit (such as frequency modulating/demodulating, amplifiers, filters)
- alarms and protection circuits
- ADC and DAC hybrid circuits

13. use appropriate test methods and equipment to check that the completed circuit is safe and meets all aspects of the specification

14. carry out checks and adjustments, appropriate to the equipment and circuits being wired, to include three of the following:

- making visual checks (such as signs of damage, incorrect termination, solder bridges, dry joints, incorrect value components)
- movement checks (such as loose wires, fittings and connections, incorrectly seated devices/packages)
- testing that the equipment operates to the circuit specification
- carrying out fault finding techniques (such as half-split, input/output, unit substitution)

Plus **six** more from the following:

- protective conductor resistance values
- insulation resistance
- continuity
- polarity
- power rating

- resistance
- capacitance
- dc voltage/current levels
- ac voltage/current levels
- logic states
- clock/timer switching
- oscillations
- attenuation
- pulse width/rise time
- open/short circuit
- waveform analysis
- frequency values
- inductance
- RCD disconnection time
- modulation/demodulation
- amplification
- signal noise/interference levels

15. produce electrical and electronic circuits which comply with one or more of the following standards:

- BS 7671/IEE wiring regulations
- other BS and/or ISO standards
- company standards and procedures

16. 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

17. leave the work area in a safe and tidy condition on completion of the wiring and testing activities

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Outcome 2

Know how to carry out general electrical and electronic engineering applications

Assessment criteria

Underpinning knowledge

The learner will be able to:

1. describe the specific safety practices and procedures that they need to observe when wiring and testing electrical and electronic circuits (including any specific legislation, regulations or codes of practice for the activities, equipment or materials)
2. describe the hazards associated with wiring and testing electrical and electronic circuits and equipment, and with the tools and equipment used (such as using sharp instruments for stripping cable insulation), and how they can be minimised
3. describe the importance of wearing appropriate protective clothing and equipment, and keeping the work area safe and tidy
4. describe the interpretation of circuit diagrams, wiring diagrams, and other relevant specifications (including BS and ISO schematics, wiring regulations, symbols and terminology)
5. describe the basic principles of operation of the equipment/circuits being produced, and the purpose of the individual modules/components used
6. describe the different types of cabling and their application (such as multicore cables, single core cables, solid and multi-stranded cables, steel wire armoured (SWA), mineral insulated (MI), screened cables, data/communications cables, fibre-optics)
7. describe the application and use of a range of electrical components (such as plugs, switches, sockets, lighting and fittings, junction boxes, consumer units, relays, solenoids, transformers, sensors and actuators)
8. describe the application and use of circuit protection equipment (such as fuses and other overload protection devices, trips, residual current device (RCD))
9. describe the various types of circuit boards used (such as printed circuit boards, thin film, thick film and flexible film circuitry)
10. explain how to recognise, read the values and identify polarity and any other orientation requirements for all electronic components being used in the assemblies (such as capacitors, resistors, inductors, diodes, transistors, integrated circuit chips, and other discrete through-hole or surface-mounted components)
11. explain how to check that components meet the required specification/operating conditions (such as values, tolerance, current carrying capacity, voltage rating, power rating, working temperature range)
12. describe the methods of mounting and securing electrical equipment/components to various surfaces (such as the use of nuts and bolts, screws and masonry fixing devices)
13. describe the methods of laying in or drawing cables into conduit, trunking and traywork systems, and the need to ensure the cables are not twisted or plaited
14. describe the techniques used to terminate electrical and electronic components and equipment (such as plugs and sockets; soldering; screwed, clamped and crimped connections, glands and sealed connectors)
15. describe the use of BS7671/IEE wiring regulations when selecting wires and cables, and when carrying out tests on circuits
16. describe the methods of attaching markers/labels to components or cables to assist with identification (such as colour coding conductors, using coded tabs)

17. describe the tools and equipment used in the wiring activities (including the use of cable stripping tools, crimping tools, soldering irons and torches, gland connecting tools)
18. explain how to check that tools and equipment are free from damage or defects, and are in a safe and usable condition
19. describe the importance of conducting inspections and checks before connecting to the supply (such as visual examination for loose or exposed conductors, excessive solder or solder spikes which may allow short circuits to occur, strain on terminations, insufficient slack cable at terminations, continuity and polarity checks, insulation checks)
20. describe the care, handling and application of electrical and electronic test and measuring instruments (such as multimeter, insulation resistance tester, loop impedance test instruments, oscilloscopes, signal generators and logic probes)
21. explain how to apply approved test procedures; the safe working practices and procedures required when carrying out the various tests, and the need to use suitably fused test probes and clips
22. explain how to identify suitable test points within the circuit, and how to position the test instruments into the circuit so as to ensure the correct polarity and without damaging the circuit components
23. explain how to set the instrument zero readings; obtaining instrument readings and comparing them with circuit parameters
24. describe the problems that can occur with the wiring and testing operations, and how these can be overcome
25. describe the fault-finding techniques to be used if the equipment fails to operate correctly
26. explain when to act on their own initiative and when to seek help and advice from others
27. describe the importance of leaving the work area and equipment in a safe and clean condition on completion of the wiring and testing activities (such as returning hand tools and test equipment to the designated location, cleaning the work area, and removing and disposing of waste)