

Overview

This standard covers a range of basic competences that you need to assemble electronic components to produce circuits. It will prepare you 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.

You will be expected to prepare for the assembly of the electronic components by obtaining all the necessary job instructions, components, tools, equipment and any documentation that may be required.

The activities will include the assembly of a range of electronic components, such as resistors (fixed and variable), capacitors (fixed and variable), diodes, transistors and other semiconductor devices, integrated circuits (analogue and digital), miniature transformers, switches, indicators, wire links and a range of connectors, spacers and brackets, to form various types of circuits. This will involve using a range of tools and equipment, along with soldering techniques and anti-static protection techniques. On completion of the electronic component assembly activities, you will be expected to return all tools and equipment to the correct location, and to leave the work area in a safe and tidy condition.

Your responsibilities will require you to comply with health and safety requirements and organisational policy and procedures for the electronic assembly activities. You will need to report any difficulties or problems that may arise with the assembly activities, and to carry out any agreed actions. You will work under a high level of supervision, whilst taking responsibility for your own actions and for the quality and accuracy of the work that you carry out.

Your underpinning knowledge will provide an understanding of your work, and will enable you to apply appropriate assembly techniques and procedures safely for electronic components and circuits. You will understand the assembly methods and procedures used, and their application, and will know about the various components used to produce the circuits, to the required depth to provide a sound basis for carrying out the activities to the required specification.

You will understand the safety precautions required when carrying out the electronic component assembly activities, and with using the associated tools and equipment. You will be required to demonstrate safe working practices throughout, and will understand the responsibility you owe to yourself and others in the workplace.

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Assembling electronic circuits

Specific Standard Requirements

At least one of the electronic circuits produced must include a combination of components and assembly techniques and procedures, for example: by assembling a circuit that includes fixed and variable resistors, capacitors, diodes, integrated circuits and cable connectors.

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Performance criteria

- You must be able to:*
- P1 work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines
 - P2 obtain the correct tools and equipment for the assembly operations, and check that they are in a safe and usable condition
 - P3 use the appropriate methods and techniques to assemble the electronic components in their correct positions
 - P4 secure the components, using the specified connectors, securing devices and soldering techniques
 - P5 wire and terminate cables to the appropriate connections on the circuit boards
 - P6 check the completed assembly to ensure that all operations have been completed, and that the finished assembly meets the required specification
 - P7 report any difficulties or problems that may arise with the electronic assembly and wiring activities, and carry out any agreed actions
 - P8 leave the work area in a safe and tidy condition on completion of the assembly activities

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Knowledge and understanding

You need to know and understand:

- K1 the specific safety practices and procedures that you need to observe when assembling electronic circuits (including any specific legislation, regulations or codes of practice for the activities, equipment or materials)
- K2 the hazards associated with assembling electronic circuits (such as heat from soldering irons, toxic fumes, static electricity, using sharp instruments for stripping cable insulation), and how they can be minimised
- K3 the importance of wearing appropriate protective clothing and equipment (PPE), and keeping the work area safe and tidy
- K4 the precautions to be taken to prevent electrostatic discharge (ESD) damage to electronic circuits and components (such as use of earthed wrist straps, anti-static mats, special packaging and handling areas)
- K5 what constitutes a hazardous voltage and how to recognise victims of electric shock
- K6 how to reduce the risks of a phase to earth shock (such as insulated tools, rubber mating and isolating transformers)
- K7 how to use and extract information from circuit diagrams, block and schematic diagrams, equipment manuals, data sheets and instructions (to include symbols and conventions to appropriate BS or ISO standards) in relation to work undertaken
- K8 the various types of circuit boards used (such as printed circuit boards, thin film, thick film and flexible film circuitry)
- K9 how to recognise, read the values and identify polarity and any other orientation requirements for the electronic components being used in the assemblies (such as capacitors, diodes, transistors, integrated circuit chips, and other discrete through-hole or surface-mounted components)
- K10 the preparation requirements for components to be used in the assembly (such as pre-forming and cleaning component pins/legs)
- K11 methods of mounting and securing electronic components to various surfaces (such as the use of manual soldering techniques, surface mount technologies and mechanical fixing devices, use of heat sinks/shunts)
- K12 methods of attaching markers/labels to components or cables to assist with identification (such as colour coding conductors, using coded tabs)
- K13 the use of specifications, and other, regulations when selecting wires and cables
- K14 the importance of making visual checks of the completed assembly (such as visual examination for excessive solder or solder spikes which may allow short circuits to occur, correct orientation of components for pin configuration or polarity, obvious signs of damage (such as heat damage) or strain on terminations)

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- K15 how to remove and replace faulty components without causing damage to circuit boards or surrounding components
- K16 the tools and equipment used in the electronic assembly activities (including the use of cable stripping tools, crimping tools, soldering irons, specialist assembly tools)
- K17 the importance of ensuring that all tools are in a safe and serviceable condition, are used correctly and are returned to their correct location on completion of the assembly activities
- K18 when to act on your own initiative and when to seek help and advice from others
- K19 the importance of leaving the work area in a safe and clean condition on completion of the electronic assembly activities (such as returning tools and equipment to the designated location, cleaning the work area, removing and disposing of waste)

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Additional Information

Scope/range related to performance criteria

You must be able to:

1. Carry out **all** of the following during the electronic assembly activities:
 - 1.1 adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations
 - 1.2 follow job instructions, assembly drawings and assembly procedures at all times
 - 1.3 ensure that the components are free from damage, dirt or other contamination
 - 1.4 prepare the electronic components for the assembly operations (such as pre-forming and cleaning pins)
 - 1.5 use safe and approved techniques to mount the electronic components on the circuit boards
 - 1.6 check that tools and equipment to be used are in a safe, tested and usable condition
 - 1.7 where appropriate, apply procedures and precautions to eliminate electrostatic discharge (ESD) hazards (such as the use of grounded wrist straps and mats)
 - 1.8 follow clean work area protocols, where appropriate
 - 1.9 return all tools and equipment to the correct location on completion of the assembly activities

2. Assemble **one** of the following circuit types:
 - 2.1 single-sided circuit
 - 2.2 thick film circuit
 - 2.3 flexible circuit
 - 2.4 double-sided circuit
 - 2.5 thin film circuit
 - 2.6 hybrid circuit

3. Assemble electronic components, using **one** of the following:
 - 3.1 manual soldering techniques
 - 3.2 surface mount techniques
 - 3.3 mechanical fixing methods

4. Assemble circuits, using **four** of the following tools:
 - 4.1 heat shunts/tweezers
 - 4.2 component forming devices

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- 4.3 mechanical fasteners (screwdriver, spanners)
 - 4.4 snipe or long nosed pliers
 - 4.5 wire strippers
 - 4.6 anti-static packaging, mats and straps
 - 4.7 sleeving pliers
 - 4.8 side or end cutters
 - 4.9 specialised assembly tools/equipment
5. Assemble circuits to the required specification, to include using **ten** of the following types of component:
- 5.1 fixed resistors
 - 5.2 transistors
 - 5.3 encoders or resolvers
 - 5.4 variable resistors
 - 5.5 thyristors
 - 5.6 inverters or servo controllers
 - 5.7 potentiometers
 - 5.8 thermistors
 - 5.9 edge connectors
 - 5.10 light dependant resistors (LDR)
 - 5.11 analogue or digital integrated circuits
 - 5.12 wiring pins/tags/wire links
 - 5.13 fixing spacers
 - 5.14 fixed capacitors
 - 5.15 surface mount packages
 - 5.16 insulators
 - 5.17 variable capacitors
 - 5.18 rectifiers
 - 5.19 small heat sinks
 - 5.20 electrolytic capacitors
 - 5.21 switches
 - 5.22 cables
 - 5.23 diodes
 - 5.24 mini transformers
 - 5.25 cable connectors
 - 5.26 Zener diodes
 - 5.27 decoders
 - 5.28 protection devices
 - 5.29 light emitting diodes
 - 5.30 regulators
 - 5.31 opto-electronics/optical fibre components
 - 5.32 relays
 - 5.33 inductors
 - 5.34 other specific electronic components
6. Assemble electronic components to produce **two** of the following types

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- of circuit:
 - 6.1 audio amplifiers
 - 6.2 filters
 - 6.3 regulated power supplies
 - 6.4 signal converters
 - 6.5 microprocessor based applications (such as PIC chips)
 - 6.6 logic function controls
 - 6.7 signal generators
 - 6.8 comparators
 - 6.9 display circuits
 - 6.10 counter/timers
 - 6.11 power amplifiers
 - 6.12 ADC and DAC hybrid circuits
 - 6.13 oscillators
 - 6.14 motor control
 - 6.15 sensor/actuator circuit (such as linear, rotational, temperature, photo-optic, flow, level, pressure)
 - 6.16 digital circuit (such as process control, microprocessor, logic devices, display devices)
 - 6.17 signal processing circuit (such as frequency modulating/demodulating, amplifiers, filters)
 - 6.18 alarms and protection circuits
 - 6.19 other specific circuit

- 7. Carry out visual checks on the completed circuits, to include **all** of the following:
 - 7.1 soldered joints are clean, shiny, free from solder spikes, bridges, holes, excess solder and flux
 - 7.2 components are correctly mounted for best physical support, and are correctly orientated
 - 7.3 excess component leads have been trimmed off safely to the standard required
 - 7.4 circuit tracks are free from faults (such as lifting, breaks, bridges, hot spots)
 - 7.5 there are no obvious signs of damage to components or to the substrate
 - 7.6 all required connectors, wire links, spacers and other ancillary items are in place

- 8. Produce electronic circuits in compliance with **one** of the following:
 - 8.1 BS or ISO standards and procedures
 - 8.2 customer standards and requirements
 - 8.3 company standards and procedures
 - 8.4 other international standards

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