Unit 16: Testing Electronic Equipment and Circuits

Level: 3

Guided learning hours: 500

Unit overview

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

This unit will help to inform the training and development required in order that the apprentice can demonstrate that they are competent in being able to carry out inspections and tests on electronic equipment and circuits, in accordance with approved procedures. They will be required to carry out tests on a range of electronic equipment, such as power supply systems, motor control systems, sensors and actuators, digital circuits and systems, analogue circuits and systems, hybrid circuits and systems, to establish that they are functioning at optimal level and to specification. They will be required to carry out inspections and tests which will include voltage and current levels, resistance values, waveform, clock/timer switching, pulse width/rise time, open/short circuit, logic state, frequency modulation/demodulation, and signal-to-noise ratio/interference levels.

Their responsibilities will require them to comply with organisational policy and procedures for carrying out the testing activities, and to report any problems with these activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. They will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

Their underpinning knowledge will provide a good understanding of the procedures for carrying out the required inspections and tests, and will provide an informed approach to applying the necessary test procedures. They will understand the equipment being worked on, the test equipment being used, and the various testing procedures and their application, in adequate depth to provide a sound basis for carrying out the activities safely and correctly and ensuring that the equipment remains compliant with all standards and regulations. In addition, they will be expected to review the outcome of the tests, compare the results with appropriate specifications, determine the action required, and record/report the results in the appropriate format.

They will understand the safety precautions required when carrying out the inspection and testing activities, especially those for isolating the equipment and

the necessary safeguards to protect themselves and others against direct and indirect electric shock. They will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

They will be able to apply the appropriate occupational behaviours required in the workplace to meet the job profile and overall company objectives, including logical approach, problem solving orientation, quality focus, personal responsibility and resilience, clear communicator, team player, applies lean manufacturing principles, adaptability, self-motivation, willingness to learn and commitment.

Assessment requirements

Assessment requirements for this unit are set down in the Advanced Manufacturing Engineering Assessment Strategy and can be found in *Annexe A* of the associated qualification specification. These requirements have been developed by employers for Advanced Manufacturing Engineering.

Additional information

Although all of the content and assessment requirements must be met in full, employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems.

This will allow each organisation to develop their own specific and tailored training programme whilst meeting their own business requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers.

Performance requirements

The apprentice must be able to:

P1 Work safely at all times, complying with health and safety and other relevant regulations and guidelines

P2 Demonstrate the required occupational behaviours in line with the job role and company objectives

P3 Follow the appropriate procedures for use of tools and equipment to carry out the required tests

P4 Set up and carry out the tests using the correct procedures and within agreed timescales

P5 Record the results of the tests in the appropriate format

P6 Review the results and carry out further tests if necessary

Skills

The apprentice must be able to:

S1 Carry out **all** of the following during the testing activities:

- 1.1 plan the inspection and testing activities to cause minimal disruption to normal working
- 1.2 obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
- 1.3 adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
- 1.4 ensure the safe isolation of equipment
- 1.5 provide and maintain safe access and working arrangements for the testing area
- 1.6 carry out the inspection and testing activities using appropriate techniques and procedures
- 1.7 take electrostatic precautions when handling sensitive components and circuit boards
- 1.8 re-connect and return the equipment to service on completion of the testing activities
- 1.9 dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

S2 Carry out inspections and tests on **four** of the following types of electronic equipment:

- 2.1 power supply systems (such as switched mode, series regulation, shunt regulation)
- 2.2 motor control systems (such as closed-loop servo/proportional, inverter control)

Skills

The apprentice must be able to:

2.3 sensors and actuators (such as linear, rotational, temperature, level, photo-optic, pressure, flow)

2.4 digital circuits and systems (e.g., programmable controller, microprocessor, ROM/RAM, logic gates)

2.5 analogue circuits and systems (e.g., frequency modulation/demodulation, amplifiers, filters, oscillators)

2.6 hybrid circuits and systems (e.g., analogue to digital convertors [ADC], d-to-a convertors [DAC])

2.7 power supply systems (such as switched mode, series regulation, shunt regulation)

S3 Carry out tests using a range of tools and test equipment, to include **three** of the following:

3.1 oscilloscope

3.2 signal tracer

3.3 computer-aided diagnostic equipment

3.4 ammeter

3.5 signal generator

3.6 special purpose testing equipment

3.7 logic analyser

3.8 multimeter

3.9 temperature measuring devices

3.10 logic probe

3.11 automatic test equipment

S4 Carry out **all** of the following tests/measurements, as applicable to the equipment being tested:

4.1 logic states

4.2 pulse width/rise time

4.3 frequency modulation/demodulation

4.4 DC voltage/current levels

4.5 open/short circuit

4.6 performance of circuit

4.7 AC voltage/current levels

4.8 resistance

4.9 condition of assemblies and components

4.10 clock/timer switching

4.11 heat dissipation

4.12 signal noise/interference level

Skills

The apprentice must be able to:

S5 Carry out **all** of the following checks to ensure the accuracy and quality of the tests carried out:

- 5.1 the test equipment is correctly calibrated
- 5.2 test equipment used is appropriate for the tests being carried out
- 5.3 take applicable precautions to avoid damaging equipment or components
- 5.4 test procedures to be used are up-to-date and follow laid-down procedures
- 5.5 test equipment is operated within its specified range

S6 Provide a record/report of the test outcome using **one** of the following:

- 6.1 preventative maintenance log/report
- 6.2 inspection schedule
- 6.3 company-specific reporting procedure
- 6.4 specific test report

Knowledge and understanding

The apprentice must:

K1 Describe the health and safety requirements of the area in which the testing activity is to take place, and the responsibility these requirements place on them

K2 Explain their responsibilities under regulations relevant to the electronic testing activities being undertaken, including the electricity at work regulations

K3 Describe the isolation and lock-off procedure or permit-to-work procedure that applies to the testing activities (such as electrical isolation, locking off switchgear, removal of fuses, placing of warning notices, proving the isolation has been achieved and secured)

K4 Describe the isolation procedure(s) unique or specific to the electronic circuits

K5 Explain the specific safety precautions to be taken when carrying out formal inspection, safety and circuit testing of electronic equipment

K6 Describe the hazards associated with testing electronic equipment and circuits, and with the equipment that is used, and how to minimise these and reduce any risks

K7 Explain the importance of wearing protective clothing, and other appropriate safety equipment, during the testing activities

K8 Explain the importance of applying the appropriate occupational behaviours in the workplace and the implications for both the apprentice and the business if these are not adhered to

Knowledge and understanding *The apprentice must:*
K9 Explain the importance of keeping the work area clean, tidy and free from waste and surplus materials
K10 Describe how the testing activities may affect the work of others, and the procedure for informing them of the work carried out
K11 Describe the procedures and precautions to be adopted to eliminate/protect against electrostatic discharge
K12 Describe how to obtain and interpret drawings such as Boolean algebra, truth tables, logic symbols, circuit diagrams, specifications, manufacturers' manuals, test procedures, and state the documents needed to carry out the tests
K13 Explain the basic principles of how the electronic circuit functions, the operation sequence, the function/purpose of individual units/components, and discuss how they interact relevant to the equipment being maintained
K14 Describe how to determine the most suitable test points within the circuit
K15 Describe how to set up and apply the appropriate test equipment
K16 Describe how to check that tools and equipment are free from damage or defects, are in a safe and usable condition, and are configured correctly for their intended purpose
K17 Describe how to ensure that test equipment is correctly calibrated
K18 Describe the various testing methods and procedures, and describe how to apply them to different operating conditions
K19 Describe how to analyse test results, and use comparison and sequential techniques
K20 Explain the environmental control requirements and company operating procedures relating to functional testing
K21 Explain the documentation required, and the procedures to be followed, at the conclusion of the test
K22 Assess the extent of their own authority and to whom they should report if they have problems that they cannot resolve