edexcel

Specification

Edexcel NVQ/competence-based qualifications

Edexcel Level 3 NVQ Diploma in Electrical and Electronic Engineering (QCF)

For first registration March 2011

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Contents

Qualification title covered by this specification

This specification gives you the information you need to offer the Edexcel Level 3 NVQ Diploma in Electrical and Electronic Engineering (QCF):

Qualification title	Qualification Number (QN)	Accreditation start date
Edexcel Level 3 NVQ Diploma in Electrical and Electronic Engineering (QCF)	600/0722/9	01/03/2011

This qualification has been accredited within the Qualifications and Credit Framework (QCF) and is eligible for public funding as determined by the Department for Education (DfE) under Sections 96 of the Learning and Skills Act 2000.

The qualification title listed above features in the funding lists published annually by the DfE and the regularly updated website. It will also appear on the Learning Aims Reference Application Database (LARA), where relevant.

You should use the QCF Qualification Number (QN), when you wish to seek public funding for your learners. Each unit within a qualification will also have a unique QCF reference number, which is listed in this specification.

The QCF qualification title and unit reference numbers will appear on the learners' final certification document. Learners need to be made aware of this when they are recruited by the centre and registered with Edexcel.

Key features of the Edexcel Level 3 NVQ Diploma in Electrical and Electronic Engineering (QCF)

This qualification:

- is nationally recognised
- is based on the Semta National Occupational Standards (NOS). The NOS, Assessment Strategy and qualification structure are owned by Semta.

The Edexcel Level 3 NVQ Diploma in Electrical and Electronic Engineering (QCF) has been approved as a component for the Semta Advanced Apprenticeship framework.

What is the purpose of this qualification?

This qualification is appropriate for employees in the engineering sector working across a broad range of areas. It is designed to assess occupational competence in the workplace where learners are required to demonstrate skills and knowledge to a level required in the engineering sector.

Who is this qualification for?

This qualification is for all learners aged 16 and above who are capable of reaching the required standards.

Edexcel's policy is that the qualification should:

- be free from any barriers that restrict access and progression
- ensure equality of opportunity for all wishing to access the qualification.

What are the benefits of this qualification to the learner and employer?

This qualification allows learners to demonstrate competence against National Occupational Standards which are based on the needs of the engineering sector as defined by Semta, the Sector Skills Council. As such it contributes to the development of skilled labour in the sector. The qualification may contribute towards the competence element of an Apprenticeship.

What are the potential job roles for those working towards this qualification?

- Electrical engineer
- Electronics engineer
- Electrician
- Electrical engineering technician
- Electronic engineering technician
- Electronics assembler

What progression opportunities are available to learners who achieve this qualification?

This qualification allows learners to demonstrate competence in electrical and electronic engineering at a level required by the engineering industry. Learners can progress across the level and size of the engineering competence and knowledge qualifications and into other occupational areas such as team leading and management.

Further information is available in *Annexe A*.

What is the qualification structure for the Edexcel Level 3 NVQ Diploma in Electrical and Electronic Engineering (QCF)?

Individual units can be found in the *Units* section. The QCF level and credit value are given on the first page of each unit.

To achieve the **Edexcel Level 3 NVQ Diploma in Electrical and Electronic Engineering (QCF)** learners must complete a minimum of 90 credits.

Learners must complete all mandatory units in Group A (15 credits) and then choose one of the following pathways:

Edexcel Level 3 NVQ Diploma in Electrical and Electronic Engineering - Designing Electronic Circuits (QCF) Learners must complete all the units in Group B1, for a minimum total of 165 credits.

Edexcel Level 3 NVQ Diploma in Electrical and Electronic Engineering - Controlling Semiconductor Manufacturing Processes (QCF) Learners must complete all the units in Group C1 and a minimum of one unit in Group C2, for a minimum total of 100 credits.

Edexcel Level 3 NVQ Diploma in Electrical and Electronic Engineering - Controlling Printed Circuit and Allied Circuit Assembly (QCF) Learners must complete all the units in Group D1 and a minimum of one unit in Group D2, for a minimum total of 93 credits.

Edexcel Level 3 NVQ Diploma in Electrical and Electronic Engineering - Leading Electronic Component Manufacture (QCF) Learners must complete all the units in Group E1 and a minimum of one unit in Group E2, for a minimum total of 103 credits.

Edexcel Level 3 NVQ Diploma in Electrical and Electronic Engineering - Leading Printed Circuit and Allied Circuit Assembly (QCF) Learners must complete all the units in Group F1 and a minimum of one unit in Group F2, for a minimum total of 108 credits.

Edexcel Level 3 NVQ Diploma in Electrical and Electronic Engineering - Leading Electronics Assembly (QCF) Learners must complete all the units in Group G1 and a minimum of one unit in Group G2, for a minimum total of 98 credits.

Edexcel Level 3 NVQ Diploma in Electrical and Electronic Engineering - Testing Electronic Circuits (QCF) Learners must complete all the units in Group H1 and a minimum of one unit in Group H2, for a minimum total of 108 credits.

Edexcel Level 3 NVQ Diploma in Electrical and Electronic Engineering - Manufacturing Transformers and Inductors (QCF) Learners must complete a minimum of two units in Group I1, for a minimum total of 75 credits.

Edexcel Level 3 NVQ Diploma in Electrical and Electronic Engineering - Manufacturing Electrical Motors and Generators (QCF) Learners must complete a minimum of four units in Group J1, for a minimum total of 100 credits.

Edexcel Level 3 NVQ Diploma in Electrical and Electronic Engineering - Manufacturing Electrical Control Systems Equipment (QCF) Learners must complete all the units in Group K1, for a minimum total of 133 credits.

Edexcel Level 3 NVQ Diploma in Electrical and Electronic Engineering - Testing Electrical Equipment (QCF) Learners must complete all the units in Group L1, for a minimum total of 120 credits.

A - Mandatory units

Learners must complete all the units in Group A.

A/601/5013 - Complying with statutory regulations and organisational safety requirements

Y/601/5102 - Using and interpreting engineering data and documentation

K/601/5055 - Working efficiently and effectively in engineering

B - Designing Electronic Circuits

Learners must complete all the units in Group B1.

B1 - Mandatory units

D/502/9265 - Designing electronic circuit board layouts using CAD tools

D/502/9234 - Evaluating and recommending circuit design options

H/502/9235 - Providing technical guidance to others

C - Controlling Semiconductor Manufacturing Processes

Learners must complete all the units in Group C1 and a minimum of one unit in Group C2.

C1 - Mandatory units

Learners must complete all the units in Group C1.

K/502/9236 - Identifying and following clean room/clean work area protocols

H/502/9266 - Monitoring and analysing data from semiconductor processes

K/502/9267 - Adjusting and sustaining semiconductor processes

C2 - Optional units

Learners must complete a minimum of one unit in Group C2.

M/502/9237 - Selecting and preparing materials and components for manufacturing

T/502/9238 - Preparing manufacturing systems equipment for operations

H/502/9235 - Providing technical guidance to others

D - Controlling Printed Circuit and Allied Circuit Assembly

Learners must complete all the units in Group D1 and a minimum of one unit in Group D2.

D1 - Mandatory units

Learners must complete all the units in Group D1.

A/502/9239 - Monitoring and analysing data from electronic circuit manufacturing processes

T/502/9241 - Adjusting and sustaining electronic circuit manufacturing processes

D2 - Optional units

Learners must complete a minimum of one unit in Group D2.

M/502/9237 - Selecting and preparing materials and components for manufacturing

T/502/9238 - Preparing manufacturing systems equipment for operations

H/502/9235 - Providing technical guidance to others

E - Leading Electronic Component Manufacture

Learners must complete all the units in Group E1 and a minimum of one unit in Group E2.

E1 - Mandatory units

Learners must complete all the units in Group E1.

H/502/9235 - Providing technical guidance to others

A/502/9242 - Processing electronic components within the manufacturing system

E2 - Optional units

Learners must complete a minimum of one unit in Group E2.

M/502/9237 - Selecting and preparing materials and components for manufacturing

T/502/9238 - Preparing manufacturing systems equipment for operations

F/502/9243 - Checking the compliance of electronic components against the specification

F - Leading Printed Circuit and Allied Circuit Assembly

Learners must complete all the units in Group F1 and a minimum of one unit in Group F2.

F1 - Mandatory units

Learners must complete all the units in Group F1.

H/502/9235 - Providing technical guidance to others

M/502/9240 - Assembling and checking printed and allied electronic circuits

F2 - Optional units

Learners must complete a minimum of one unit in Group F2.

M/502/9237 - Selecting and preparing materials and components for manufacturing

T/502/9238 - Preparing manufacturing systems equipment for operations

G - Leading Electronics Assembly

Learners must complete all the units in Group G1 and a minimum of one unit in Group G2.

G1 - Mandatory units

Learners must complete all the units in Group G1.

H/502/9235 - Providing technical guidance to others

L/502/9245 - Assembling and wiring electronic equipment and systems

G2 - Optional units

Learners must complete a minimum of one unit in Group G2.

M/502/9237 - Selecting and preparing materials and components for manufacturing

T/502/9238 - Preparing manufacturing systems equipment for operations

H - Testing Electronic Circuits

Learners must complete all the units in Group H1 and a minimum of one unit in Group H2.

H1 - Mandatory units

Learners must complete all the units in Group H1.

R/502/9246 - Testing post-production electronic components and circuits

Y/502/9247 - Locating and diagnosing faults in post-production electronic components and circuits

H2 - Optional units

Learners must complete a minimum of one unit in Group H2.

D/502/9248 - Preparing facilities for testing electronic components and circuits

H/502/9249 - Writing specifications for testing electronic components or circuits

H/502/9235 - Providing technical guidance to others

I - Manufacturing Transformers and Inductors

Learners must complete a minimum of two units in Group I1.

I1 - Optional units

Y/502/9250 - Assembling large transformer and inductor cores

D/502/9251 - Winding transformer and inductor coils

H/502/9252 - Assembling transformers and inductors

K/502/9253 - Fitting small transformer and inductor cores

J - Manufacturing Electrical Motors and Generators

Learners must complete a minimum of four units in Group J1.

J1 - Optional units

M/502/9254 - Assembling rotor and armature windings

T/502/9255 - Assembling stator windings

A/502/9256 - Assembling and fitting commutators

F/502/9257 - Balancing assembled rotors or armatures

J/502/9258 - Assembling and fitting electrical rotating equipment

K - Manufacturing Electrical Control Systems Equipment

Learners must complete all the units in Group K1.

K1 - Mandatory units

L/502/9259 - Mounting electrical components in enclosures

F/502/9260 - Wiring electrical components and equipment in enclosures

J/502/9261 - Selecting and preparing materials and components for electrical assembly

L - Testing Electrical Equipment

Learners must complete all the units in Group L1.

L1 - Mandatory units

L/502/9262 - Carrying out functional tests on electrical equipment

R/502/9263 - Locating and diagnosing faults in electrical systems and equipment

Y/502/9264 - Checking the compliance of electrical equipment against the specification

How is the qualification graded and assessed?

The overall grade for the qualification is a 'pass'. The learner must achieve all the required units within the specified qualification structure.

To pass a unit the learner must:

- achieve **all** the specified learning outcomes
- satisfy **all** the assessment criteria by providing sufficient and valid evidence for each criterion
- show that the evidence is their own.

The qualification is designed to be assessed:

- in the workplace or
- in conditions resembling the workplace, as specified in the Assessment Strategy for the sector, or
- as part of a training programme.

Assessment Strategy

The Assessment Strategy for this qualification has been included in *Annexe D*. It has been developed by Semta in partnership with employers, training providers, awarding organisations and the regulatory authorities. The Assessment Strategy includes details on:

- criteria for defining realistic working environments
- roles and occupational competence of assessors, expert witnesses, internal verifiers and standards verifiers
- quality control of assessment
- evidence requirements.

Evidence of competence may come from:

- **current practice** where evidence is generated from a current job role
- a **programme of development** where evidence comes from assessment opportunities built into a learning/training programme whether at or away from the workplace
- the **Recognition of Prior Learning (RPL)** where a learner can demonstrate that they can meet the assessment criteria within a unit through knowledge, understanding or skills they already possess without undertaking a course of learning. They must submit sufficient, reliable and valid evidence for internal and standards verification purposes. RPL is acceptable for accrediting a unit, several units or a whole qualification
- a **combination** of these.

It is important that the evidence is:

Valid	relevant to the standards for which competence is claimed
Authentic	produced by the learner
Current	sufficiently recent to create confidence that the same skill, understanding or knowledge persist at the time of the claim
Reliable	indicates that the learner can consistently perform at this level
Sufficient	fully meets the requirements of the standards.

Types of evidence (to be read in conjunction with the Assessment Strategy in *Annexe D*)

To successfully achieve a unit the learner must gather evidence which shows that they have met the required standard in the assessment criteria. Evidence can take a variety of different forms including the examples below. Centres should refer to the Assessment Strategy for information about which of the following are permissible.

- direct observation of the learner's performance by their assessor (O)
- outcomes from oral or written questioning (Q&A)
- products of the learner's work (P)
- personal statements and/or reflective accounts (RA)
- outcomes from simulation, where permitted by the Assessment Strategy (S)
- professional discussion (PD)
- assignment, project/case studies (A)
- authentic statements/witness testimony (WT)
- expert witness testimony (EPW)
- evidence of Recognition of Prior Learning (RPL).

The abbreviations may be used for cross-referencing purposes.

Learners can use one piece of evidence to prove their knowledge, skills and understanding across different assessment criteria and/or across different units. It is, therefore, not necessary for learners to have each assessment criterion assessed separately. Learners should be encouraged to reference the assessment criteria to which the evidence relates.

Evidence must be made available to the assessor, internal verifier and Edexcel standards verifier. A range of recording documents is available on the Edexcel website www.edexcel.com. Alternatively, centres may develop their own.

Centre recognition and approval

Centre recognition

Centres that have not previously offered Edexcel qualifications need to apply for and be granted centre recognition as part of the process for approval to offer individual qualifications. New centres must complete both a centre recognition approval application and a qualification approval application.

Existing centres will be given 'automatic approval' for a new qualification if they are already approved for a qualification that is being replaced by the new qualification and the conditions for automatic approval are met. Centres already holding Edexcel approval are able to gain qualification approval for a different level or different sector via Edexcel online.

Approvals agreement

All centres are required to enter into an approvals agreement which is a formal commitment by the head or principal of a centre to meet all the requirements of the specification and any linked codes or regulations. Edexcel will act to protect the integrity of the awarding of qualifications, if centres do not comply with the agreement. This could result in the suspension of certification or withdrawal of approval.

Quality assurance

Detailed information on Edexcel's quality assurance processes is given in *Annexe B*.

What resources are required?

Each qualification is designed to support learners working in the engineering sector. Physical resources need to support the delivery of the qualifications and the assessment of the learning outcomes and must be of industry standard. Centres must meet any specific resource requirements outlined in *Annexe D: Assessment Strategy*. Staff assessing the learner must meet the requirements within the overarching assessment strategy for the sector.

Unit format

Each unit in this specification contains the following sections.

Unit title:

The unit title is accredited on the QCF and this form of words will appear on the learner's Notification of Performance (NOP).

Unit reference number:

This code is a unique reference number for the unit.

QCF level:

All units and qualifications within the QCF have a level assigned to them, which represents the level of achievement. There are nine levels of achievement, from Entry level to level 8. The level of the unit has been informed by the QCF level descriptors and, where appropriate, the NOS and/or other sector/professional.

Credit value:

All units have a credit value. The minimum credit value is one, and credits can only be awarded in whole numbers. Learners will be awarded credits when they achieve the unit.

Guided learning hours:

A notional measure of the substance of a qualification. It includes an estimate of the time that might be allocated to direct teaching or instruction, together with other structured learning time, such as directed assignments, assessments on the job or supported individual study and practice. It excludes learner-initiated private study.

Unit summary:

This provides a summary of the purpose of the unit.

Assessment requirements/evidence requirements:

The assessment/evidence requirements are determined by the SSC. Learners must provide evidence for each of the requirements stated in this section.

Assessment methodology:

This provides a summary of the assessment methodology to be used for the unit.

Learning outcomes:	Assessment criteria:	Evidence type:	Portfolio reference:	Date:
			The learner should use this box to indicate where the evidence can be obtained eg portfolio page number.	The learner should give the date when the evidence has been provided.

Learning outcomes state exactly what a learner should know, understand or be able to do as a result of completing a unit.

The assessment criteria of a unit specify the standard a learner is expected to meet to demonstrate that a learning outcome, or a set of learning outcomes, has been achieved.

Learners must reference the type of evidence they have and where it is available for quality assurance purposes. The learner can enter the relevant key and a reference. Alternatively, the learner and/or centre can devise their own referencing system.

Units

Unit 1: Complying with statutory regulations and organisational safety requirements

Unit reference number: A/601/5013

QCF level: 2

Credit value: 5

Guided learning hours: 35

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to deal with statutory regulations and organisational safety requirements. It does not deal with specific safety regulations or detailed requirements it does, however, cover the more general health and safety requirements that apply to working in an industrial environment.

The learner will be expected to comply with all relevant regulations that apply to their area of work, as well as their general responsibilities as defined in the Health and Safety at Work Act etc. The learner will need to be able to identify the relevant qualified first aiders and know the location of the first-aid facilities. The learner will have a knowledge and understanding of the procedures to be adopted in the case of accidents involving injury and in situations where there are dangerous occurrences or hazardous malfunctions of equipment, processes or machinery. The learner will also need to be fully conversant with their organisation's procedures for fire alerts and the evacuation of premises.

The learner will also be required to identify the hazards and risks that are associated with their job. Typically, these will focus on their working environment, the tools and equipment that they use, the materials and substances that they use, any working practices that do not follow laid-down procedures, and manual lifting and carrying techniques.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
1 Complying with statutory regulations and organisational safety requirements	1.1 complying with their duties and obligations as defined in the Health and Safety at Work Act 1.2 demonstrate their understanding of their duties and obligations to health and safety by: • applying in principle their duties and responsibilities as an individual under the Health and Safety at Work Act • identifying, within their organisation, appropriate sources of information and guidance on health and safety issues, such as: - eye protection and personal protective equipment (PPE) - COSHH regulations - risk assessments • identifying the warning signs and labels of the main groups of hazardous or dangerous substances • complying with the appropriate statutory regulations at all times 1.3 present themselves in the workplace suitably prepared for the activities to be undertaken 1.4 follow organisational accident and emergency procedures			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.5 comply with emergency requirements, to include: • identifying the appropriate qualified first aiders and the location of first-aid facilities • identifying the procedures to be followed in the event of injury to themselves or others • following organisational procedures in the event of fire and the evacuation of premises • identifying the procedures to be followed in the event of dangerous occurrences or hazardous malfunctions of equipment 1.6 recognise and control hazards in the workplace 1.7 identify the hazards and risks that are associated with the following: • their working environment • the equipment that they use • materials and substances (where appropriate) that they use • working practices that do not follow laid-down procedures 1.8 use correct manual lifting and carrying techniques			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.9 demonstrate one of the following methods of manual lifting and carrying: • lifting alone • with assistance of others • with mechanical assistance 1.10 apply safe working practices and procedures to include: • maintaining a tidy workplace, with exits and gangways free from obstruction • using equipment safely and only for the purpose intended • observing organisational safety rules, signs and hazard warnings • taking measures to protect others from any harm resulting from the work that they are carrying out			
2 Know how to comply with statutory regulations and organisational safety requirements	2.1 describe the roles and responsibilities of themselves and others under the Health and Safety at Work Act, and other current legislation (such as The Management of Health and Safety at Work Regulations, Workplace Health and Safety and Welfare Regulations, Personal Protective Equipment at Work Regulations, Manual Handling Operations Regulations, Provision and Use of Work Equipment Regulations, Display Screen at Work Regulations, Reporting of Injuries, Diseases and Dangerous Occurrences Regulations)			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.2 describe the specific regulations and safe working practices and procedures that apply to their work activities 2.3 describe the warning signs for the seven main groups of hazardous substances defined by Classification, Packaging and Labelling of Dangerous Substances Regulations 2.4 explain how to locate relevant health and safety information for their tasks, and the sources of expert assistance when help is needed 2.5 explain what constitutes a hazard in the workplace (such as moving parts of machinery, electricity, slippery and uneven surfaces, poorly placed equipment, dust and fumes, handling and transporting, contaminants and irritants, material ejection, fire, working at height, environment, pressure/stored energy systems, volatile, flammable or toxic materials, unshielded processes, working in confined spaces) 2.6 describe their responsibilities for identifying and dealing with hazards and reducing risks in the workplace 2.7 describe the risks associated with their working environment (such as the tools, materials and equipment that they use, spillages of oil, chemicals and other substances, not reporting accidental breakages of tools or equipment and not following laid-down working practices and procedures)			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.8 describe the processes and procedures that are used to identify and rate the level of risk (such as safety inspections, the use of hazard checklists, carrying out risk assessments, COSHH assessments) 2.9 describe the first-aid facilities that exist within their work area and within the organisation in general; the procedures to be followed in the case of accidents involving injury 2.10 explain what constitute dangerous occurrences and hazardous malfunctions, and why these must be reported even if no one is injured 2.11 describe the procedures for sounding the emergency alarms, evacuation procedures and escape routes to be used, and the need to report their presence at the appropriate assembly point 2.12 describe the organisational policy with regard to fire fighting procedures; the common causes of fire and what they can do to help prevent them 2.13 describe the protective clothing and equipment that is available for their areas of activity 2.14 explain how to safely lift and carry loads, and the manual and mechanical aids available 2.15 explain how to prepare and maintain safe working areas; the standards and procedures to ensure good housekeeping			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.16 describe the importance of safe storage of tools, equipment, materials and products 2.17 describe the extent of their own authority, and to whom they should report in the event of problems that they cannot resolve			

Learner name: ______________________________ Date: ____________________

Learner signature: ______________________________ Date: ____________________

Assessor signature: ______________________________ Date: ____________________

Internal verifier signature: ______________________________ Date: ____________________
(*if sampled*)

Unit 2: Using and interpreting engineering data and documentation

Unit reference number: Y/601/5102

QCF level: 2

Credit value: 5

Guided learning hours: 25

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to make effective use of text, numeric and graphical information, by interpreting and using technical information extracted from documents such as engineering drawings, technical manuals, reference tables, specifications, technical sales/marketing documentation, charts or electronic displays, in accordance with approved procedures. The learner will be required to extract the necessary information from the various documents, in order to establish and carry out the work requirements, and to make valid decisions about the work activities based on the information extracted.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
1 Use and interpret engineering data and documentation	1.1 use the approved source to obtain the required data and documentation 1.2 use the data and documentation and carry out all of the following: • check the currency and validity of the data and documentation used • exercise care and control over the documents at all times • correctly extract all necessary data in order to carry out the required tasks • seek out additional information where there are gaps or deficiencies in the information obtained • deal with or report any problems found with the data and documentation • make valid decisions based on the evaluation of the engineering information extracted from the documents • return all documents to the approved location on completion of the work • complete all necessary work-related documentation such as production documentation, installation documentation, maintenance documentation, planning documentation 1.3 correctly identify, interpret and extract the required information			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.4 extract information that includes three of the following: • materials or components required • dimensions • tolerances • build quality • installation requirements • customer requirements • timescales • financial information • operating parameters • surface texture requirements • location/orientation of parts • process or treatments required • dismantling/assembly sequence • inspection/testing requirements • number/volumes required • repair/service methods • method of manufacture • weld type and size • operations required • connections to be made • surface finish required • shape or profiles			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	• fault finding procedures • safety/risk factors • environmental controls • specific data (such as component data, maintenance data, electrical data, fluid data) • resources (such as tools, equipment, personnel) • utility supply details (such as electricity, water, gas, air) • location of services, including standby and emergency backup systems • circuit characteristics (such as pressure, flow, current, voltage, speed) • protective arrangements and equipment (such as containment, environmental controls, warning and evacuation systems and equipment) • other specific related information 1.5 use the information obtained to ensure that work output meets the specification			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.6 use information extracted from documents to include one from the following: • drawings (such as component drawings, assembly drawings, modification drawings, repair drawings, welding/fabrication drawings, distribution and installation drawings) • diagrams (such as schematic, fluid power diagrams, piping, wiring/circuit diagrams) • manufacturers' manuals/drawings • approved sketches • technical illustrations • photographic representations • visual display screen information • technical sales/marketing documentation • contractual documentation • other specific drawings/documents			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.7 use information extracted from related documentation, to include two from the following: • instructions (such as job instructions, drawing instructions, manufacturers' instructions) • specifications (such as material, finish, process, contractual, calibration) • reference materials (such as manuals, tables, charts, guides, notes) • schedules • operation sheets • service/test information • planning documentation • quality control documents • company-specific technical instructions • national, international and organisational standards • health and safety standards relating to the activity (such as COSHH) • other specific related documentation 1.8 deal promptly and effectively with any problems within their control and report those which cannot be solved 1.9 report any inaccuracies or discrepancies in documentation and specifications			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Know how to use and interpret engineering data and documentation	2.1	explain what information sources are used for the data and documentation that they use in their work activities			
		2.2	explain how documents are obtained, and how to check that they are current and valid			
		2.3	explain the basic principles of confidentiality (including what information should be available and to whom)			
		2.4	describe the different ways/formats that data and documentation can be presented (such as drawings, job instructions, product data sheets, manufacturers' manuals, financial spreadsheets, production schedules, inspection and calibration requirements, customer information)			
		2.5	explain how to use other sources of information to support the data (such as electronic component pin configuration specifications, reference charts, standards, bend allowances required for material thickness, electrical conditions required for specific welding rods, mixing ratios for bonding and finishing materials, metal specifications and inspection requirements, health and safety documentation)			
		2.6	describe the importance of differentiating fact from opinion when reviewing data and documentation			
		2.7	describe the importance of analysing all available data and documentation before decisions are made			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.8 describe the different ways of storing and organising data and documentation to ensure easy access 2.9 describe the procedures for reporting discrepancies in the data or documentation, and for reporting lost or damaged documents 2.10 describe the importance of keeping all data and documentation up to date during the work activity, and the implications of this not being done 2.11 explain the care and control procedures for the documents, and how damage or graffiti on documents can lead to scrapped work 2.12 explain the importance of returning documents to the designated location on completion of the work activities 2.13 explain what basic drawing conventions are used and why there needs to be different types of drawings (such as isometric and orthographic, first and third angle, assembly drawings, circuit and wiring diagrams, block and schematic diagrams) 2.14 explain what types of documentation are used and how they interrelate (such as production drawings, assembly drawings, circuit and wiring diagrams, block and schematic diagrams) 2.15 explain the imperial and metric systems of measurement; tolerancing and fixed reference points			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.16 describe the meaning of the different symbols and abbreviations found on the documents that they use (such as surface finish, electronic components, weld symbols, linear and geometric tolerances, pressure and flow characteristics) 2.17 describe the extent of their own responsibility, when to act on their own initiative to find, clarify and evaluate information, and to whom they should report if they have problems that they cannot resolve			

Date: ____________________________

Learner name: ____

Learner signature: ____ Date: ____________________________

Assessor signature: ____ Date: ____________________________

Internal verifier signature: ____________________________________ Date: ____________________________

(*if sampled*)

Unit 3: Working efficiently and effectively in engineering

Unit reference number: K/601/5055

QCF level: 3

Credit value: 5

Guided learning hours: 25

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to work efficiently and effectively in the workplace, in accordance with approved procedures and practices. Prior to undertaking the engineering activity, the learner will be required to carry out all necessary preparations within the scope of their responsibility. This may include preparing the work area and ensuring that it is in a safe condition to carry out the intended activities, ensuring they have the appropriate job specifications and instructions and that any tools, equipment, materials and other resources required are available and in a safe and usable condition.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
1 Work efficiently and effectively in engineering	1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 prepare the work area to carry out the engineering activity 1.3 prepare to carry out the engineering activity, taking into consideration all of the following, as applicable to the work to be undertaken: • the work area is free from hazards and is suitably prepared for the activities to be undertaken • any required safety procedures are implemented • any necessary personal protection equipment is obtained and is in a usable condition • tools and equipment required are obtained and checked that they are in a safe and usable condition • all necessary drawings, specifications and associated documentation is obtained • job instructions are obtained and understood • the correct materials or components are obtained • storage arrangements for work are appropriate • appropriate authorisation to carry out the work is obtained			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.4 check that there are sufficient supplies of materials and/or consumables and that they meet work requirements 1.5 ensure that completed products or resources are stored in the appropriate location on completion of the activities 1.6 complete work activities, to include all of the following: • completing all necessary documentation accurately and legibly • returning tools and equipment • returning drawings and work instructions • identifying, where appropriate, any unusable tools, equipment or components • arranging for disposal of waste materials 1.7 tidy up the work area on completion of the engineering activity 1.8 deal promptly and effectively with problems within their control and report those that cannot be resolved			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.9 deal with problems affecting the engineering process, to include two of the following: • materials • tools and equipment • drawings • job specification • quality • people • timescales • safety • activities or procedures 1.10 contribute to and communicate opportunities for improvement to working practices and procedures 1.11 make recommendations for improving to two of the following: • working practices • working methods • quality • safety • tools and equipment • supplier relationships • internal communication • customer service • training and development • teamwork • other			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.12 maintain effective working relationships with colleagues to include two of the following: • colleagues within own working group • colleagues outside normal working group • line management • external contacts 1.13 review personal training and development as appropriate to the job role 1.14 review personal development objectives and targets to include one of the following: • dual or multi-skilling • training on new equipment/technology • increased responsibility • understanding of company working practices, procedures, plans and policies • other specific requirements			
2 Know how to work efficiently and effectively in engineering	2.1 describe the safe working practices and procedures to be followed while preparing and tidying up their work area 2.2 describe the correct use of any equipment used to protect the health and safety of themselves and their colleagues 2.3 describe the procedure for ensuring that all documentation relating to the work being carried out is available and current, prior to starting the activity			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.4 describe the action that should be taken if documentation received is incomplete and/or incorrect 2.5 describe the procedure for ensuring that all tools and equipment are available prior to undertaking the activity 2.6 describe the checks to be carried out to ensure that tools and equipment are in full working order, prior to undertaking the activity 2.7 describe the action that should be taken if tools and equipment are not in full working order 2.8 describe the checks to be carried out to ensure that all materials required are correct and complete, prior to undertaking the activity 2.9 describe the action that should be taken if materials do not meet the requirements of the activity 2.10 explain whom to inform when the work activity has been completed 2.11 describe the information and/or documentation required to confirm that the activity has been completed			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.12 explain what materials, equipment and tools can be reused 2.13 explain how any waste materials and/or products are transferred, stored and disposed of 2.14 explain where tools and equipment should be stored and located 2.15 describe the importance of making recommendations for improving working practices 2.16 describe the procedure and format for making suggestions for improvements 2.17 describe the benefits to organisations if improvements can be identified 2.18 describe the importance of maintaining effective working relationships within the workplace 2.19 describe the procedures to deal with and report any problems that can affect working relationships 2.20 describe the difficulties that can occur in working relationships 2.21 describe the regulations that affect how they should be treated at work (such as Equal Opportunities Act, Race and Sex Discrimination, Working Time Directive) 2.22 describe the benefits of continuous personal development 2.23 describe the training opportunities that are available in the workplace			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.24 describe the importance of reviewing their training and development 2.25 explain with whom to discuss training and development issues 2.26 describe the extent of their own responsibility and to whom they should report if they have any problems that they cannot resolve			

Learner name: ____

Learner signature: ______________________________________

Assessor signature: _____________________________________

Internal verifier signature: _______________________________
(*if sampled*)

Unit 4: Designing electronic circuit board layouts using CAD tools

Unit reference number: D/502/9265

QCF level: 3

Credit value: 60

Guided learning hours: 126

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to design printed circuit boards, and thick, thin or flexible film circuits, using computer-aided design (CAD) hardware and software tools, in accordance with approved procedures. The learner will be required to access the relevant design requirements and to extract all necessary information in order to carry out circuit layout operations. The learner will be required to use CAD tools to complete circuit layout designs, ensuring that the operational requirements are met. In the CAD design work, the learner will be expected to take into account all relevant fit, form and function aspects of the specified design, such as physical dimensions, materials to be used, position of circuit elements, access space for connectors/test points, connections between components, and any special labelling.

The learner's responsibilities will require them to comply with organisational policy and procedures for the CAD activities undertaken and to report any problems with these activities that they cannot personally resolve, or are outside their permitted authority, to the relevant person. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying design procedures for the circuit types described above. The learner will understand the CAD design process, and its application, and will know about the circuit production processes in adequate depth to provide a sound basis for carrying out the CAD design activities to the required specification.

The learner will understand the safety precautions required when using CAD equipment and tools. 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.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
1 Design electronic circuit board layouts using CAD tools	1.1 produce designs that meet agreed requirements 1.2 create CAD circuit designs which meet all of the following requirements: • the target dimensions of the circuit • has built-in test points • can facilitate access for local repair/maintenance • has appropriate connections required to/from the circuit • uses pitches appropriate to the specified components • has tracks of an appropriate thickness and width • has appropriate separation between conductive tracks • has bends in the tracks, of appropriate radius to the circuit requirements (eg speed, current) • meets required signal integrity parameters (such as capacitance, inductance, resistance, insulation voltages) • meets specified operating conditions (such as temperature, humidity, shock and vibration) • takes account of component orientation			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	• takes into account any assembly schedule constraints (such as proximity of sensitive components to hot running items) • takes into account any financial constraints on the type of circuit or components to be used 1.3 create designs for one of the following types of circuit: • printed circuit board • flexible circuit • thick film circuit • thin film circuit 1.4 create one of the following circuit configurations: • single sided • double sided • multi-layer • flexi-rigid 1.5 ensure the CAD design is compatible with both of the following production systems: • re-flow or wave soldering • hand soldering 1.6 complete designs within agreed timescales 1.7 make a record of issues addressed in the development of designs			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.8 make sure that the design meets health and safety, other relevant regulations, standards and guidelines 1.9 produce designs to one of the following standards: • organisational guidelines and codes of practice • CAD software standards • BS and ISO standards • other international standards 1.10 make sure that designs are properly registered and filed 1.11 record details of the finished design in the company's database, to meet all of the following requirements: • all relevant guidance/instructions for the circuit to be made • the circuit/project title, date, version/issue number • component list/wiring schedule • confirmation that the design meets the customer requirements			
2 Know how to design electronic circuit board layouts using CAD tools	2.1 describe the specific safety precautions to be taken when working with computer-aided design (CAD) equipment (such as work environment ergonomics, repetitive strain injury (RSI), visual display unit (VDU) regulations)			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.2 describe the principles of electronic circuit layout design 2.3 explain how electronic circuit designs should embrace fit, form and function principles 2.4 describe the types of drawing that can be produced by the CAD software (such as component drawings, assembly drawings, circuit diagrams, block diagrams, wiring diagrams, circuit board designs 2.5 describe the symbols and abbreviations used in the design process 2.6 explain how to set out the track designs 2.7 explain how to use the CAD equipment design packages and tools to assist with the circuit design processes 2.8 describe the characteristics of the components and materials that are used in circuit designs 2.9 describe the manufacturing processes for making unpopulated electronic circuits 2.10 describe the manufacturing processes for populating circuits with components, and the processes used to finish the complete assembly 2.11 describe the difficulties that poor design can created for manufacturing processes 2.12 explain how the finished circuit will be used by the customer 2.13 explain how to meet the requirements set out in the design specification			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.14 describe the company's procedures, standards and guidelines to be followed for CAD-based electronic circuit design 2.15 explain how to access, recognise and use a wide range of standard electronic component symbol libraries from the CAD equipment 2.16 describe the national and international legislation, statutory and non-statutory regulations, industry and national standards, industry guidelines and professional codes that apply to CAD-based electronic design activities 2.17 explain how to formally register, record, store and protect (legally and physically) newly-completed circuit designs in the company's documentation system 2.18 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve			

Learner name: ______________________ Date: ______________

Learner signature: ______________________ Date: ______________

Assessor signature: ______________________ Date: ______________

Internal verifier signature: ______________________ Date: ______________
(*if sampled*)

Unit 5: Evaluating and recommending circuit design options

Unit reference number: D/502/9234

QCF level: 3

Credit value: 70

Guided learning hours: 154

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to evaluate circuit design options, and to make recommendations on which option(s) should be implemented, in accordance with approved procedures. The learner will be required to evaluate and recommend design options for printed circuit board, thick, thin or flexible film circuitry. The design options could be for circuits such as power supplies, motor control systems, sensor/actuator circuits, digital control circuits, signal processing circuits, alarms and protection circuits, ADC and DAC hybrid circuits, or any other type of system that requires some form of printed circuit.

The learner's responsibilities will require them to comply with organisational policy and procedures for evaluating and recommending printed circuit designs, and to report any problems with these activities that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking full responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to evaluating and recommending printed circuit design options. The learner will understand the design requirements, and their application, and will know about the printed circuit design process, in adequate depth to provide a sound basis for agreeing the design specifications at the required level of detail.

The learner will understand the safety requirements and any health or safety implications of the circuit design options. 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.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
1 Evaluate and recommend circuit design options	1.1 evaluate, prioritise and recommend design options according to intended use 1.2 take into account all of the following when evaluating printed circuit design options: • the budget for the design • any safety, legal or environmental considerations • the target dimensions of the circuit • substrate material to be used • quality standards to be achieved • type of circuit (such as digital, analogue, hybrid) • the design function and operation • connections required to/from the circuit • any built-in test points • accessibility requirements for servicing • any special types of components to be used • any design constraints • the technology of the circuit design (such as single sided, double sided, multi-layer, flexible or rigid) • operating conditions (such as temperature, humidity, shock and vibration) 1.3 obtain relevant information on the circuit design options from one of the following sources: • the client • industry standards • technical journals • technical manuals/handbooks			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.4 evaluate printed circuit design options for one of the following: • power supplies (such as switched mode, series regulation, shunt regulation) • motor control systems (such as closed loop servo system, inverter control) • sensor/actuator circuits (such as linear, rotational, temperature, photo-optic, flow, level, pressure) • digital circuits (such as process control, microprocessor, logic devices, display devices) • signal processing circuits (such as frequency modulating/demodulating, amplifiers, filters) • alarms and protection circuits • analogue to digital conversion/digital to analogue conversion hybrid circuits • other circuit types (specify) 1.5 evaluate and recommend design options for one of the following: • printed circuit boards • flexible film circuits • thick film circuits • thin film circuits			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.6 present recommended design options clearly and in the required format, by the following methods: • verbal report Plus one other method from the following: • electronic mail • computer-based presentation • written/typed report 1.7 confirm that the design options are acceptable and note feedback for further design work 1.8 assess the impact of their design in all relevant areas 1.9 ensure that the recommended designs conform to one of the following standards: • organisational guidelines and codes of practice • client format and standards • IEE wiring regulations • BS and ISO standards			
2 Know how to evaluate and recommend circuit design options	2.1 describe the specific health and safety implications associated with various design concepts for the specified circuits (such as hazards associated with particular forms of manufacture, the need to specify the use of non-toxic chemicals wherever possible, the use of lead-free solders where applicable, heat and dirt, safe disposal of waste products)			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.2 explain how to establish the detailed requirements for the circuit design 2.3 describe the basic principles of how the electronic circuit functions, its operating sequence, the function/purpose of individual units/components, and how they interact 2.4 describe the component and material characteristics relevant to the circuit design 2.5 explain how to identify relevant sources of information about the circuit design options, and how to obtain the information 2.6 explain how to establish and compare the costs associated with given design options 2.7 describe the evaluation methods, and how to use them to evaluate the various design options 2.8 describe the level of detail needed to prepare a recommendation for given designs 2.9 explain how to present their circuit design recommendations (using drawings, Boolean algebra, truth tables, logic symbols, circuit diagrams, or other appropriate forms of presentation) 2.10 describe the techniques that can be used for presenting technical information (such as verbally, one to one, one to many, in written form, using diagrams, drawings or other technical information)			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.11 describe the types of drawing that can be used for circuit designs (such as component drawings, assembly drawings, circuit diagrams, block diagrams, wiring diagrams, circuit board designs) 2.12 describe the legislation, regulations, standards and guidelines that apply to the recommended design options, and to the implementation of the options 2.13 describe the extent of their own responsibility, and to whom they should report if they have problems that they cannot resolve			

Learner signature: ______________________________ Date: ____________________

Assessor signature: ______________________________ Date: ____________________

Internal verifier signature: ______________________________ Date: ____________________
(*if sampled*)

Unit 6: Providing technical guidance to others

Unit reference number: H/502/9235

QCF level: 3

Credit value: 35

Guided learning hours: 70

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to provide guidance to others on work-related technical matters, in accordance with approved procedures. The learner will be expected to provide technical guidance to others who may be involved in a range of activities, such as electronic design, production, operational support, maintenance, or equipment capability/performance measurement. The learner will be required to identify suitable opportunities for offering technical guidance, to plan and apply appropriate methods for providing guidance, and to keep their methods under review so that they can modify their approach when necessary.

The learner's responsibilities will require them to comply with organisational policy and procedures when providing the technical guidance, and to report any problems with these activities that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the guidance that they give.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to the methods, techniques and procedures for providing technical guidance. The learner will understand the electronic design and/or manufacturing processes being used, and their application, in adequate depth to provide a sound basis for giving technical guidance at the appropriate times.

The learner will understand the safety precautions to be observed in the workplace where they provide technical guidance. 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.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
1 Provide technical guidance to others	1.1 work safely in accordance with the regulations for their work environment 1.2 assess work methods and procedures for their suitability and technical feasibility 1.3 provide colleagues with valid and up-to-date information, advice and guidance as necessary 1.4 provide technical guidance for one of the following groups of people: • colleagues in the same work group • those in associated work teams • others working on related technical activity areas 1.5 provide technical guidance for one of the following electronic activities: • design activities (such as electronic components, printed circuit boards, thick, thin or flexible film circuits) • production activities (such as semiconductor wafer processing, die assembly/test, component manufacture, circuit assembly) • operational activities (such as movement of materials, quality systems and audit, scheduled safety audits and risk assessments) • maintenance activities (such as planned preventive maintenance, part/sub-assembly exchange, breakdown response, maintenance records systems, line setting) • equipment capability/performance measurement			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.6 provide technical guidance for all of the following situations: • ensuring the continued supply and efficient use of resources • ensuring that the most appropriate work methods are used • verifying that materials used in the design or processing activities are within specification requirements • clarifying technical details with others for the design or processing activities • monitoring outputs of the engineering process and comparing these with the specifications • confirming that all relevant regulations and guidelines are complied with • anticipating and preventing operational problems, where possible • analysing and solving any unforeseen operational problems 1.7 provide technical guidance by the following methods: • verbally Plus by one other method from the following: • electronic mail • computer-based presentation • written/typed report			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.8 anticipate potential problems and choose which action to take to deal with them 1.9 analyse problems in full and choose effective solutions that will maintain the quality and progress of the work 1.10 carry out both of the following: • reporting problems found during the monitoring process • recording deviations from agreed plans and schedules			
2 Know how to provide technical guidance to others	2.1 describe the specific safety precautions to be taken in the work areas where technical guidance is being given to others 2.2 describe the importance of wearing protective clothing and other appropriate safety equipment in hazardous or clean room environments when giving technical guidance 2.3 explain how to obtain the relevant personal protective equipment (PPE), and how check that it is in a safe and usable condition 2.4 describe the regulations and guidelines that are relevant to the workplace activities, and how to specify them 2.5 explain how to obtain information on regulations and guidelines			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.6 explain how to obtain and interpret drawings, charts, specifications and other documents that can be used when giving technical guidance 2.7 explain how to identify opportunities for giving technical guidance and support 2.8 explain how to plan and prepare for providing technical guidance 2.9 describe the methods and techniques involved in problem solving 2.10 explain how to review and adjust approaches to the provision of technical guidance in the light of experiences gained (such as offering written summaries of guidance) 2.11 describe the techniques that can be used for providing or presenting technical guidance (such as verbally, one to one, one to many, in written form, using diagrams, drawings or other technical information, electronic presentations) 2.12 describe the organisational reporting processes and procedures to be observed 2.13 describe the extent of their own responsibility, and to whom they should report if they have problems that they cannot resolve			

Learner name: ______________________________ Date: ____________________

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(*if sampled*)

Unit 7: Identifying and following clean room/clean work area protocols

Unit reference number: K/502/9236

QCF level: 3

Credit value: 7

Guided learning hours: 28

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to identify and follow clean room and/or clean work area protocols, in accordance with approved procedures. The clean rooms and clean work areas will include wafer processing or die assembly and test facilities. In particular, the learner will be expected to follow any prescribed preparatory activities for the clean work area, to use work methods that satisfy organisational and industry protocols, to wear and care for appropriate personal protective clothing, and to follow requirements in relation to their own clothing and accessories.

The learner's responsibilities will require them to comply with organisational policy and procedures relating to working in clean rooms and clean work areas, and to report any problems with the protocols, that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking full responsibility for their own actions and ensuring that they comply with approved organisational procedures relating to the clean room and clean work areas.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to complying with approved clean room and clean work area procedures. The learner will understand the organisational protocols for clean room and clean work areas, and their application, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

The learner will understand the health, safety and cleanliness precautions required when working in a clean room or clean work area environment, and with the associated equipment. 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.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
1 Identify and follow clean room/clean work area protocols	1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 complete all of the following preparatory tasks prior to working in a clean room or clean work area: • use the correct issue of job instructions and specifications • follow risk assessment procedures and COSHH regulations • ensure that they are appropriately dressed and uncontaminated before entering the area • carry out activities in line with organisational procedures • store records of their activities, in accordance with appropriate procedures 1.3 use clean room/work area protocols for one of the following wafer processing or die assembly/test activities: • photolithography • etching (wet/dry) • diffusion • deposition • implantation • final inspection/probe • wafer saw • die fix • wire bond			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	• mould • trim/form • debled mark/plate • test 1.4 recognise industrial processes, tools, equipment and materials that have the potential to cause harm 1.5 check for hazards in the workplace in line with agreed and approved procedures 1.6 identify any potential hazards and take appropriate action to minimise the risk from them 1.7 identify potential hazards and follow all company clean room/clean work area regulations/procedures relating to: • process contamination from body lotions (such as makeup, deodorants, perfumes, aftershaves) • loose clothing and jewellery (in proximity to machines, processes and sensitive materials) • process contamination from wearing their own clothing • the potential for losing contact lenses • introduction of dirt and contaminants from external footwear			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.8 identify and follow protocol methods and procedures that satisfy all of the following: • the safety of people • contamination/integrity of the product • contamination/integrity of the clean room/work area • appropriate industry standards and protocols 1.9 satisfy all of the following company clean room/clean work area methods and procedures: • use appropriate clothing/personal protective equipment (PPE) (such as suits, gowns, coats, hoods, hats, caps, helmets, other headwear, boots, overshoes, other forms of footwear, safety goggles, visors, gloves) • comply with hazard protection (such as breathing apparatus, gloves, apron/smock, other forms of PPE or clothing required) • deal appropriately with damaged or dirty clothing/PPE (such as reporting damage, replacement, safe removal and cleaning or disposal, subjected to acid/hazardous substance spills, damaged/dirty labelling) • store specified clothing/PPE correctly when not in use • ensure the proper cleaning/laundering/ maintenance of clothing/PPE • report any hazards breaches of protocol			

Learning outcomes	**Assessment criteria**	**Evidence type**	**Portfolio reference**	**Date**
	1.10 report any hazards identified and any actions they have taken			
2 Know how to identify and follow clean room/clean work area protocols	2.1 describe the specific safety precautions to be taken when working in a clean room or clean work area environment 2.2 describe the correct fitting and use of clothing and personal protective equipment that must be worn in a clean room or clean work area (such as for body, hands, eyes, ears, feet, mouth and face) 2.3 describe the hazards associated with working in a clean room or clean work area, with manufacturing/processing equipment (such as heat, radiation, chemicals, static electricity, high voltages, trapping points on equipment) 2.4 explain how to identify and deal with hazards and their consequences (such as escape of gases, acids, hazardous chemicals, hazardous equipment or processes, heat and radiation) 2.5 explain how to obtain the necessary authority to enter the clean room or clean work area, and any specific permit-to-work procedures that are required 2.6 describe the classification of the relevant clean room or clean work area, and how this impacts upon them 2.7 describe the industry standards/classifications for clean rooms and clean work areas			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.8 describe the company requirements for clothing and personal protective equipment required, and the reasons why such clothing and equipment must be used			
	2.9 describe the procedures and methods for maintaining issued clothing and personal protective equipment			
	2.10 explain how to apply procedures for dealing with damaged or dirty clothing and personal protective equipment			
	2.11 explain how to store issued clothing and personal protective equipment correctly			
	2.12 describe the laundering/cleaning/maintenance procedures relating to the issued clothing and personal protective equipment			
	2.13 describe the policy and procedures relating to personal items (such as body lotions, makeup, jewellery, contact lenses, footwear, own clothing)			
	2.14 explain how certain body lotions can contaminate the manufacturing process and seriously affect the quality of the finished product			
	2.15 describe the company reporting procedures, and how to complete the necessary documentation			
	2.16 describe the sources of expert help if they have problems with the activities that they cannot resolve or are outside their permitted authority			
	2.17 describe the extent of their own responsibility, and to whom they should report if they have problems that they cannot resolve			

Learner name: ______________________________ Date: ____________________

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Assessor signature: ______________________________ Date: ____________________

Internal verifier signature: ______________________________ Date: ____________________
(*if sampled*)

Unit 8: Monitoring and analysing data from semiconductor processes

Unit reference number: H/502/9266

QCF level: 3

Credit value: 35

Guided learning hours: 77

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to monitor and analyse data from semiconductor manufacturing processes, in accordance with approved procedures. The learner will be required to access the appropriate specifications, to check that they are of the latest issue, and to extract all necessary information, in order to monitor and analyse data from a wafer fabrication or die assembly and test process. The learner will be expected to use approved organisational procedures to collect and analyse the semiconductor process data, and to present this in an approved format.

The learner will also be expected to produce reports of their monitoring and analysis of data (which may include functional D°, process yield, process capability (Cpk), cycle time), which was collected using appropriate tools and methods (such as statistical process control (SPC) and failure mode and effect analysis (FMEA)).

The learner's responsibilities will require them to comply with organisational policy and procedures for the monitoring and analysing semiconductor processes, and to report any problems with these activities, that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying monitoring/analysis procedures to semiconductor manufacturing processes. The learner will understand the organisational requirements and procedures for monitoring and analysing data, and their application, and they will know about the specific semiconductor process being monitored, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

The learner will understand the safety precautions required when working in a semiconductor-processing environment, and with the equipment that is used. 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.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
1 Monitor and analyse data from semiconductor processes	1.1 work safely in accordance with the regulations for their work environment 1.2 ensure that they have the necessary test data on which to conduct the analysis 1.3 carry out all of the following during the data monitoring and analysis activities: • use the correct issue of drawings, job instructions and specifications • follow risk assessment procedures and COSHH regulations • follow clean room/work area protocols • carry out all activities in line with organisational procedures • store records of the data analysis in accordance with appropriate procedures 1.4 resolve promptly any inconsistencies in the data 1.5 analyse the data using approved methods and procedures 1.6 check that the data analysis is accurate and thorough and takes account of the test conditions 1.7 compare the analysis against the product or asset specification and identify any faults or variations from specification 1.8 record the results of the analysis in the appropriate format			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.9 monitor and analyse data for one of the following wafer processing or die assembly/test area processes: • photolithography • etching (wet/dry) • diffusion • deposition • implantation • final inspection/probe • wafer saw • die fix • wire bond • mould • trim/form • debled mark/plate • test 1.10 use monitoring and analysis methods and procedures which satisfy all of the following: • quality requirements (such as statistical process control (SPC), failure mode effect analysis (FMEA)) • the frequency of the monitoring and analysis required • the aspects, characteristics and complexity of data being monitored/analysed (such as functional D°, process yield, process capability (Cpk), cycle time) • applying various designed experiments			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.11 prepare reports for monitoring/analysis purposes, which include three of the following: • customer reports • design of experiments • manufacturing data • process control data • quality control data 1.12 present reports of activities by the following methods: • verbally plus one other method from the following: • electronic mail • computer-based presentation • written/typed report			
2 Know how to monitor and analyse data from semiconductor processes	2.1 describe the specific safety precautions to be taken when undertaking monitoring/analysis of semiconductor processes 2.2 describe the personal protective equipment to be worn while carrying out the monitoring and analysis activities (such as protective suits, rubber gloves, eye protection) 2.3 describe the hazards associated with working in a semiconductor-processing environment (such as heat, radiation, chemicals, static electricity)			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.4 explain how to obtain the necessary authority to enter the relevant work areas, and any specific permit-to-work procedures that are used 2.5 explain how to obtain and use specifications for the product, assets or processes being monitored/analysed 2.6 describe the basic operating principles of other semiconductor processes, and how they relate to the particular area in the process being monitored and analysed 2.7 describe the related processes in other areas of a semiconductor facility undertaking wafer processing and die assembly/test processes 2.8 describe the tools, methods and techniques used to monitor and analyse semiconductor processes, and how to use them for the process being monitored and analysed (such as statistical process control (SPC), failure mode effect analysis (FMEA)) 2.9 explain how to explain the terms, and how to calculate mean, median, mode, standard deviation, range and variance 2.10 explain how to explain and calculate process capability (Cp and Cpk) 2.11 describe the meaning of a failure mode, failure effect or failure cause			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.12 describe the rating scale used in potential failure modes and effects projects (to include the severity rating scale, the occurrence rating scale and the detection rating scale) 2.13 explain how to calculate and use risk priority numbers (RPN) 2.14 explain how to carry out a design of experiment project, and the tools and techniques used 2.15 explain where to obtain the data required to carry out the design of experiment 2.16 explain how to calculate the sample size to be used in the design of experiment 2.17 explain what is meant by Alpha risk and Beta risk 2.18 describe the formats and levels of detail required for recording and preparing reports for the relevant categories of data being monitored/analysed 2.19 describe the suitable methods for the presentation of data (such as in tables, charts, graphically) 2.20 explain how and why experiments are designed and implemented, and by whom 2.21 describe the problems that can occur with the data monitoring and collection activities, and how they can be avoided 2.22 describe the sources of expert help if they have problems with the activities that they cannot resolve or are outside their permitted authority			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.23 describe the extent of their own responsibility, and to whom they should report if they have problems that they cannot resolve			

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(*if sampled*)

Unit 9: Adjusting and sustaining semiconductor processes

Unit reference number: K/502/9267

QCF level: 3

Credit value: 40

Guided learning hours: 77

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to adjust and sustain semiconductor-manufacturing processes, in accordance with approved procedures. The learner will be required to access the appropriate specifications, to check that they are of the latest issue, and to extract all necessary information, in order to adjust and sustain a wafer fabrication or die assembly/test process. The learner will be expected to carry out a range of general support tasks, to use appropriate process adjustment methods, and to report and record data on their work in suitable form such as charts, tables and narrative. The learner will be expected to use approved organisational procedures for adjusting and sustaining semiconductor processes, and they will be expected to communicate the details of their activities to the relevant people.

The learner's responsibilities will require them to comply with organisational policy and procedures for adjusting and sustaining the semiconductor processes, and to report any problems with these processes that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking full responsibility for their own actions and for the quality and accuracy of the work that they undertake.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to adjusting and sustaining semiconductor-manufacturing processes. The learner will understand the organisational requirements and procedures for adjusting and sustaining the semiconductor processes, and their application, and they will know about the semiconductor processes being adjusted/sustained, in adequate depth to provide a sound basis for carrying out the activities, correcting out-of-specification processes and ensuring that the output is to the required specification.

The learner will understand the safety precautions required when working in a semiconductor-processing environment, and with the associated equipment. 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.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
1 Adjust and sustain semiconductor processes	1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 follow all relevant setting up and operating specifications for the products or assets being configured 1.3 follow the defined procedures and set up the equipment correctly ensuring that all operating parameters are achieved 1.4 carry out all of the following during the adjusting and sustaining activities: • use the correct issue of drawings, job instructions and specifications • follow risk assessment procedures and COSHH regulations • follow clean room/work area protocols • carry out activities in line with organisational procedures • store records in accordance with appropriate procedures			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.5 adjust and sustain one of the following wafer processing or die assembly/test area processes: • photolithography • etching (wet or dry) • diffusion • deposition • implantation • final inspection/probe • wafer saw • die fix • wire bond • mould • trim/form • debled mark/plate • test 1.6 adjust and sustain semiconductor processes, taking account of all of the following: • organisational requirements (such as batch size, instructions and guidelines) • customer requirements • equipment/process guidelines/ specifications/process recipe/instructions • frequency of adjustments required • characteristics and complexity of the semiconductor processes being adjusted/sustained			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.7 deal promptly and effectively with problems within their control and report those that cannot be solved 1.8 check that the configuration is complete and that the equipment operates to specification 1.9 complete all relevant documentation accurately and legibly 1.10 prepare information related to sustaining semiconductor processes in two of the following categories: • manufacturing progress reports/charts/data • process control reports/charts/data • quality control reports/charts/data 1.11 present reports of the activities by the following methods: • verbally plus one other method from the following: • electronic mail • computer-based presentation • written/typed report			
2 Know how to adjust and sustain semiconductor processes	2.1 describe the specific safety precautions to be taken when undertaking adjusting or sustaining of semiconductor processes 2.2 describe the personal protective equipment (PPE) to be worn while adjusting or sustaining semiconductor processes (such as protective suits, rubber gloves, eye protection, special equipment for dealing with hazardous chemicals)			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.3 describe the hazards associated with working in a semiconductor-processing environment (such as heat, radiation, chemicals, static electricity, high voltages, trapping points) 2.4 explain how to obtain the necessary authority to enter the relevant work areas, and any specific permit-to-work procedures that are used 2.5 describe the configuration and operating specifications that are used for adjusting and sustaining equipment in the wafer processing or die assembly/test area, where they are responsible for these activities 2.6 explain how to obtain and use process specifications, and/or equipment manuals and specifications, for adjusting and sustaining wafer processing or die assembly/test processes 2.7 describe the basic operating principles of the semiconductor processes, and how they relate to the area being adjusted/sustained 2.8 explain how all the other principal areas of a semiconductor facility function within the overall spectrum of device fabrication/die assembly and test processes 2.9 describe the organisational procedures for undertaking the prescribed adjusting/sustaining activities, and how to implement them in the given work area			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.10 describe the importance of carrying out the activities without causing unnecessary disruption to the manufacturing activities 2.11 describe the formats and levels of detail required, for recording and reporting adjusting/sustaining activities and their outcomes 2.12 describe the problems that can occur as a result of adjusting/sustaining activities, and how they can be avoided 2.13 describe the sources of expert help if they have problems with the activities that they cannot resolve or are outside their permitted authority 2.14 describe the extent of their own responsibility, and to whom they should report if they have problems that they cannot resolve			

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Unit 10: Selecting and preparing materials and components for manufacturing

Unit reference number: M/502/9237

QCF level: 3

Credit value: 18

Guided learning hours: 63

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to select and prepare materials and components for wafer processing, die assembly/test, printed circuit board manufacture, printed circuit assembly, electronic component manufacture, flexible film circuitry, thin film circuitry, or thick film circuitry work, in accordance with approved procedures. The learner will be required to access the appropriate specifications, to check that they are of the latest issue, and to extract all necessary information, in order to identify which materials (consumables and components) are needed and to obtain them in the quantities required. The learner will be expected to check the condition of components and materials against manufacturing operation requirements. The learner will also review the need for and undertake any required specific treatments or preparatory actions.

The learner's responsibilities will require them to comply with organisational policy and procedures for the selection and preparation activities undertaken, and to report any problems with these activities that they cannot personally resolve, or are outside their permitted authority, to the relevant person. The learner will be expected to undertake these activities with a minimum of supervision, 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 a good understanding of their work, and will provide an informed approach to applying material selection and preparation procedures. The learner will understand the work requirement, and its application, and will know about the overall manufacturing operations, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

The learner will be expected to know about specific safety precautions as they relate to the activities they are involved with, and how they, in turn, link with nationally recognised regulations like those associated with COSHH. In addition, the learner will be aware of potential hazards and the precautions that can be taken to minimise associated risks. 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.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
1 Select and prepare materials and components for manufacturing	1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 carry out all of the following during the selection and preparation of the materials and components: • use the correct issue of drawings, job instructions and procedures • follow clean work area protocols, where appropriate • use grounded wrist straps and other electrostatic discharge (ESD) precautions, as appropriate • requisition/obtain all materials/parts • use relevant COSHH sheets and risk assessments • deal with any problems within their capability/authority, and report any problems that they cannot solve 1.3 obtain the required materials and check them for quantity and quality 1.4 select and prepare materials and components for one of the following manufacturing processes: • wafer processing • die assembly/test • printed circuit board manufacture • printed circuit board assembly • electronic component manufacture • flexible film circuitry • thick film circuitry • thin film circuitry			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.5 determine how the materials need to be prepared 1.6 obtain material/component specifications from company information sources, to include all of the following: • documentation (such as work orders, contracts, memos, plans/designs, purchase orders) • standard operating procedures (such as process control sheets/charts, quality standards) • material/component supplier information • schedules 1.7 carry out the preparations using suitable equipment 1.8 prepare all of the following materials/components for the manufacturing operations: • consumable materials (such as chemicals for cleaning, solutions for gold, silver or nickel plating, fluxes, solder, wire, strapping, wipes) • components/materials to be used in the manufacture (such as plastic housings, connector pins, test point receptacles, capacitors, resistors, inductors, silicon semiconductor wafers, edge connectors)			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.9 carry out all of the following preparations on the materials/components to be used: • check condition of components and materials (such as types as specified, freedom from obvious signs of damage, within specified use dates) • conduct any preparatory treatments of components (such as cleaning with chemical solutions, plating, heat treatments) • set out materials and components for use (such as surface mount components for printed circuit board assembly in suitable cassettes, wafers/parts in trays/special jigs) 1.10 report the completion of preparations to the relevant people, in line with organisational procedures, using the following methods: • verbally plus one more method from the following: • electronic mail • computer-based • written/typed 1.11 deal promptly and effectively with problems within their control and report those that cannot be solved			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
2. Know how to select and prepare materials and components for manufacturing	2.1 describe the specific safety precautions to be taken when selecting and preparing materials and components for defined manufacturing operations 2.2 describe the personal protective equipment (PPE) to be worn while selecting and preparing materials and components, and where to obtain it 2.3 describe the hazards associated with working in operational environments within electronic component manufacture, manufacturing processes or assembly and wiring (such as heat, radiation, chemicals, static electricity, high voltages, projected cut wire ends, equipment trapping points) 2.4 describe the specific materials that are needed for the manufacturing operations 2.5 explain how to identify the materials that are to be used 2.6 explain how to obtain and use the organisations' material and components requirements information for their selection and preparation activities 2.7 describe the factors that would make the materials unusable in the manufacturing operations 2.8 describe the preparations to be carried out on the materials and components prior to the manufacturing operations 2.9 describe the safe handling requirements for the materials and consumables, and how they relate to COSHH regulations (such as chemicals giving off fumes)			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.10 describe the problems that can occur when selecting and preparing materials and components for the work areas and activities concerned, and what can be done about them 2.11 describe the preparations required for the area of work concerned, and how to undertake such preparations 2.12 describe the handling requirements for the selected materials and components 2.13 explain how to obtain the necessary authority to enter the relevant work areas, and any specific permit-to-work procedures that are used 2.14 explain how to record the completion of the selection and preparation activities, and to whom to report this within the organisation 2.15 describe the extent of their own responsibility, and to whom they should report if they have problems that they cannot resolve			

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(*if sampled*)

Unit 11: Preparing manufacturing systems equipment for operations

Unit reference number: T/502/9238

QCF level: 3

Credit value: 18

Guided learning hours: 63

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to prepare manufacturing systems equipment for a semiconductor wafer processing or die assembly/test operation, printed circuit board manufacture, printed circuit assembly operation, electronic component manufacture, or thin film, thick film or flexible film circuitry manufacture, in accordance with approved procedures. In particular, the learner will be expected to prepare the specific system for operation, to conduct a number of generalised preparations that support manufacture, to review the equipment/system set-up information, to check all key safety aspects, and to report the completion of their preparation activities. The equipment and systems covered include those used for electronic component manufacture, manufacturing processing or wiring and assembly activities.

The learner's responsibilities will require them to comply with organisational policy and procedures for the preparation activities undertaken, and to report any problems with those activities to the relevant authority. The learner will be expected to work with a minimum of supervision, taking responsibility for their own actions and for the quality and accuracy of the work that they produce.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the equipment preparation procedures. The learner will understand the equipment used and the preparations required, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

The learner will understand the safety precautions to be taken when working in the manufacturing environment, and with the associated equipment. 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.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
1 Prepare manufacturing systems equipment for operations	1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 carry out all of the following in preparing the manufacturing system for operation: • use the correct issue of drawings, job instructions and procedures • follow clean work area protocols, where appropriate • use grounded wrist straps and other electrostatic discharge (ESD) precautions, as appropriate • use relevant COSHH sheets and risk assessments 1.3 obtain data for the systems/equipment preparation from appropriate company information sources, to include all of the following: • documentation (such as work orders, contracts, memos, plans/designs, purchase orders) • standard operating procedures (such as process control sheets/charts, quality standards) • equipment operating instructions • schedules 1.4 obtain all the required equipment and ensure that it is in safe and usable condition 1.5 make sure that required safety arrangements are in place to protect other workers from activities likely to disrupt normal working 1.6 carry out the necessary preparations to equipment in line with work requirements			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.7 prepare the equipment for one of the following manufacturing processes: • semiconductor wafer processing • die assembly/test operations • printed circuit board manufacture • printed circuit board assembly • electronic component manufacture • flexible film circuitry • thick film circuitry • thin film circuitry 1.8 review the equipment/system set-up information and complete all of the following: • setting up all basic relevant parameters (such as entering data items from the process recipe, temperatures, dwell times, vacuum/pressure levels, current/voltage levels) • preparing all related equipment jigs and fixtures for the operations to be conducted • checking that all safety interlocks are in place and in good working order • checking that the equipment/system is configured for the specific use Plus two more from the following: • cleaning the equipment housings and work fixings • connecting process gases/load consumables • loading the components to be processed • posting warning notices/setting up protective guards			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.9 report completion of the preparations to the relevant people, in line with organisational procedures, using the following method: • verbally Plus one more method from the following: • electronic mail • computer-based presentation • written/typed report 1.10 deal promptly and effectively with problems within their control and report those that cannot be solved			
2 Know how to prepare manufacturing systems equipment for operations	2.1 describe the specific safety precautions to be taken when preparing equipment and systems used in electronic component manufacture, manufacturing processes or assembly and wiring 2.2 describe the hazards associated with the work area and equipment/systems involved (such as heat, radiation, chemicals, static electricity, high voltages, projected cut wire ends, equipment trapping points), and how to take appropriate precautions to minimise their impact 2.3 describe the personal protective clothing and equipment (PPE) needed for the preparations being undertaken, and how to use them (such as overalls, gloves, face masks, eye protection, special footwear)			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.4 explain how to obtain the necessary authority to enter the relevant work areas, and any specific permit-to-work procedures that are used 2.5 explain how to check equipment/systems relevant to the work activities, to ensure that they are available and in good and safe working order (such as equipment status logs checked, all associated safety devices in place and in good order, warning lights functioning, equipment/system reports/records checked) 2.6 explain how to set up and prepare different types of equipment/systems for specific use, allied to given operational needs (such as diffusion furnaces, ion implanters, vacuum coating equipment, plating systems, wave soldering equipments, automated back-plane termination systems, contact insertion/PCB assembly equipment) 2.7 describe the problems that can occur with the equipment/systems preparations being undertaken, and how to deal effectively with them 2.8 describe the company reporting and recording systems and procedures 2.9 describe the extent of their own responsibility, and to whom they should report if they have problems that they cannot resolve			

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(*if sampled*)

Unit 12: Monitoring and analysing data from electronic circuit manufacturing processes

Unit reference number:	A/502/9239
QCF level:	3
Credit value:	35
Guided learning hours:	77

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to monitor and analyse data from manufacturing processes associated with the fabrication and assembly of electronic circuitry, based on printed board, thick, thin or flexible film technologies, in accordance with approved procedures. In particular, the learner will be expected to satisfy a range of generalised activity support requirements, such as observing permit-to-work procedures, following any clean work area protocols, selecting and using suitable analytical tools, recording data and preparing reports.

The learner will be expected to use approved organisational procedures to monitor, collect, analyse and report on their interpreted findings from at least one of the areas of circuitry processing activity outlined. The learner will also be expected to produce reports of their monitoring and analysis of data (which may include functional D°, process yield, process capability (Cpk), cycle time), which was collected using appropriate tools and methods (such as statistical process control (SPC) and failure mode and effect analysis (FMEA)).

The learner's responsibilities will require them to comply with organisational policy and procedures for the monitoring and analysing of electronics manufacturing activities, and to report any problems with these activities that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking full responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying data monitoring and analysis procedures. The learner will understand the organisational needs for such data, and will know about the relevant circuit processing techniques, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

The learner will understand the safety precautions required when working in an electronic circuit manufacturing environment, and with the associated equipment. 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.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
1 Monitor and analyse data from electronic circuit manufacturing processes	1.1 work safely in accordance with the regulations for their work environment 1.2 ensure that they have the necessary test data on which to conduct the analysis 1.3 comply with all of the following support requirements during the data monitoring and analysis activities: • use the correct issue of drawings, job instructions and specifications • follow risk assessment procedures and COSHH regulations • follow clean work area protocols, where appropriate • use grounded wrist straps and other electrostatic (ESD) precautions, as appropriate • carry out all activities in line with organisational procedures • create and store records of monitoring and analysing data, in accordance with appropriate procedures 1.4 resolve promptly any inconsistencies in the data 1.5 analyse the data using approved methods and procedures			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.6 monitor and analyse data for one of the following manufacturing processes: • printed circuit boards • thin film circuits • thick film circuits • flexible film circuits • screen printing • component masking • auto-insertion/placement • flow/re-flow soldering • circuit cleaning • hand soldering • laser trimming • glazing 1.7 use monitoring and analysis methods and procedures that satisfy all of the following: • quality requirements (such as statistical process control (SPC), failure mode effect analysis (FMEA)) • the required frequency of the monitoring and analysis • the aspects, characteristics and complexity of data being monitored/analysed (such as functional D°, process yield, process capability (Cpk), cycle time) • applying various designed experiments			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.8 check that the data analysis is accurate and thorough and takes account of the test conditions 1.9 compare the analysis against the product or asset specification and identify any faults or variations from specification 1.10 prepare reports of findings covering three of the following categories, and record the results in the appropriate format: • customer reports • designed experiment • manufacturing data • process control data • quality control data 1.11 present reports of activities using the following method: • verbally Plus one more method from the following: • electronic mail • computer-based presentation • written/typed report			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
2 Know how to monitor and analyse data from electronic circuit manufacturing processes	2.1 describe the specific safety precautions to be taken when undertaking monitoring/analysis activities in an electronics manufacturing environment			
	2.2 describe the personal protective equipment (PPE) to be worn while carrying out the monitoring and analysis activities (such as protective suits, rubber gloves, eye and ear protection, respiratory devices)			
	2.3 describe the hazards associated with working in a electronics manufacturing environment (such as heat, radiation, chemicals, static electricity), and how they can be minimised			
	2.4 explain how to obtain and use specifications for the product, assets or processes being monitored/analysed			
	2.5 explain how circuitry and its features are specified, and the limitations of the different types of materials used			
	2.6 describe the basic operation of the associated processes and process equipment, and how they relate to the particular area of the process being monitored and analysed			
	2.7 describe the problems that can arise in the processing of the types of circuitry involved			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.8 describe the monitoring/analysis tools, methods and techniques used by the organisation for the relevant work, and how to implement them in the given work areas (such as FMEA, Cpk measures, function D°, process yield, cycle times) 2.9 explain how to explain the terms, and how to calculate mean, median, mode, standard deviation, range and variance 2.10 explain how to explain and calculate process capability (Cp and Cpk) 2.11 describe the meaning of a failure mode, failure effect or failure cause 2.12 describe the rating scale used in potential failure modes and effects projects, to include the severity rating scale, the occurrence rating scale, and the detection rating scale 2.13 explain how to calculate and use risk priority numbers (RPN) 2.14 explain how to carry out a design of experiment project, and the tools and techniques used 2.15 explain where to obtain the data required to carry out the design of experiment 2.16 explain how to calculate the sample size to be used in the design of experiment 2.17 explain what is meant by Alpha risk and Beta risk			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.18 describe the problems that can occur with the monitoring and analysis activities, and how they can be avoided 2.19 describe the formats for recording and preparing reports for the relevant categories of data being monitored/analysed, and the levels of detail required 2.20 describe the suitable methods for the presentation of data (such as in tables, charts, graphically) 2.21 explain how to obtain the necessary authority to enter the relevant work areas, and any specific permit-to-work procedures that are used 2.22 describe the extent of their responsibility, and to whom they should report if they have problems that they cannot resolve			

Learner name: ______________________ Date: ______________

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(*if sampled*)

Unit 13: Adjusting and sustaining electronic circuit manufacturing processes

Unit reference number:	T/502/9241
QCF level:	3
Credit value:	40
Guided learning hours:	77

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to adjust and sustain electronic circuit manufacturing processes, in accordance with approved procedures. The learner will be required to access the appropriate specifications, to check that they are of the latest issue and to extract all necessary information, in order to adjust and sustain a manufacturing process for printed circuit boards, thin, thick and flexible film circuitry. The learner will be expected to carry out a range of general support tasks, use appropriate process adjustment methods, and to report and record appropriate data in a suitable form, such as charts, tables and narrative. The learner will be expected to use approved organisational procedures for adjusting and sustaining electronic circuit manufacturing processes, and they will be expected to communicate reports of their activities to the relevant people.

The learner's responsibilities will require them to comply with organisational policy and procedures for adjusting and sustaining the electronics circuit manufacturing activities, and to report any problems with these activities that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking full responsibility for their own actions and for the quality and accuracy of the work that they undertake.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying configuration techniques, which are unique to particular products and processes, within their work environment. The learner will understand the relevant production processes, and their applications, in adequate depth to provide a sound basis for carrying out the activities, correcting out-of-specification processes and ensuring that the final output is to the required specification. The learner will understand the safety precautions required when working in an electronics-manufacturing environment, and with the associated equipment. 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.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
1 Adjust and sustain electronic circuit manufacturing processes	1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 carry out all of the following during the adjusting and sustaining activities: • use the correct issue of drawings, job instructions and specifications • follow risk assessment procedures and COSHH regulations • use grounded wrist straps and other electrostatic (ESD) precautions, as appropriate • carry out activities in line with organisational procedures • create and store records, in accordance with appropriate procedures 1.3 follow all relevant setting up and operating specifications for the products or assets being configured 1.4 follow the defined procedures and set up the equipment correctly ensuring that all operating parameters are achieved			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.5 adjust and sustain one of the following manufacturing processes: • printed circuit board circuitry • thin film circuitry • thick film circuitry • flexible film circuitry • screen printing • component masking • auto-insertion/placement • flow/re-flow soldering • circuit cleaning • hand soldering • laser trimming • glazing 1.6 adjust and sustain electronics manufacturing processes, taking account of all of the following: • organisational requirements (such as batch size, instructions and guidelines) • customer requirements • production/process equipment, items, tools and jigs to be used • frequency of adjustments required • system equipment adjustments needed (such as software program set-up, solder temperatures, component positioning, conductive ink deposition)			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.7 deal promptly and effectively with problems within their control and report those that cannot be solved 1.8 check that the configuration is complete and that the equipment operates to specification 1.9 complete all relevant documentation accurately and legibly 1.10 prepare information related to sustaining electronic manufacturing, in two of the following categories: • manufacturing progress reports/charts/data • process control reports/charts/data • quality control report/charts/data 1.11 present reports of the activities using the following method: • verbally plus one more method from the following: • electronic mail • computer-based presentation • written/typed report			
2 Know how to adjust and sustain electronic circuit manufacturing processes	2.1 describe the specific safety precautions to be taken when undertaking set-up configuration activities in a processing environment for the production of printed and allied circuits, covering substrate production and assembly			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.2 describe the personal protective equipment (PPE) to be worn while carrying out the set-up adjustment activities (such as protective suits, rubber gloves, eye and ear protection, respiratory devices) 2.3 describe the hazards associated with working in a circuitry manufacturing processing environment (such as heat, radiation, chemicals, static electricity, trapping points on equipment), and how they can be minimised 2.4 explain how to obtain the necessary authority to enter the relevant work areas, and any specific permit-to-work procedures that are used 2.5 explain how to obtain and use the organisation's specifications for the product and/or process-related assets being configured, with particular reference to any special information needs of customers 2.6 explain how circuitry and its features are specified, and the limitations of different types of materials used 2.7 describe the basic operation of the production processes and the process equipment that is being adjusted, and how they relate to the area being adjusted and sustained 2.8 describe the problems that can arise in the processing of the types of circuitry involved			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.9 describe the adjustment methods and techniques used by the organisation for the relevant set-up work, and how to implement them safely and carefully in the given work areas (such as inputting software programme instructions, adjusting and fitting jigs and fixtures, setting system equipment parameters eg time, temperature profiling) 2.10 describe the importance of carrying out adjustments without causing unwanted disruption to other activities 2.11 describe the formats and levels of detail required for reports, for recipients with differing needs 2.12 describe the suitable methods for the presentation of the data (such as in tables, charts, graphically) 2.13 explain how and why experimentation is used, and by whom, for this area of activity 2.14 describe the problems that can occur with configuration activities, and how they can be avoided 2.15 describe the company reporting formats and associated procedures 2.16 describe the extent of their own responsibility, and to whom they should report if they have problems that they cannot resolve			

Learner name: ______________________________ Date: ____________________

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Assessor signature: ______________________________ Date: ____________________

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(*if sampled*)

Unit 14: Processing electronic components within the manufacturing system

Unit reference number: A/502/9242

QCF level: 3

Credit value: 50

Guided learning hours: 126

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to process discrete electronic components through various stages of the company's manufacturing system, in accordance with approved procedures. In particular, the learner will be expected to carry out general preparatory activities, obtain and interpret work instructions from appropriate sources, conduct specific preparations on materials, components and equipment, carry out the production processes, monitor their work and record its completion. The electronic components produced will include capacitors, resistors, inductors, interconnection devices, sensors, optical devices, visual display tubes, switching components, microwave components, spark gaps and a variety of charge coupled devices.

The learner's responsibilities will require them to comply with organisational policy and procedures for the processing activities undertaken, and to report any problems with these activities that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking full responsibility for their own actions and for the quality and accuracy of the work that they undertake.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying electronic component manufacturing procedures. The learner will understand the particular manufacturing process used, and the organisation's requirements and procedures for processing the electronic components, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

The learner will understand the safety precautions required when working in the electronic component-processing environment, and with the associated equipment. 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.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in Annexe D.

Assessment methodology

Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
1 Process electronic components within the manufacturing system	1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 ensure that the materials to be processed are suitably prepared for the processing operations to be carried out 1.3 carry out all of the following during the processing of the electronic components: • obtain any necessary permission/work permits for the processing operations to be conducted • follow risk assessment procedures and COSHH regulations • follow clean work area protocols, where appropriate • carry out any preparations of materials and components, in line with organisational procedures 1.4 use appropriate sources to access work-related instructions, to include three of the following: • assembly route cards • assembly/process stage instructions • CD-based multimedia packages • other electronic means • written instructions • diagrams/drawings			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.5 obtain and interpret work instructions for electronic component-processing operations, for one type of component from the following: • capacitors (such as ceramic disc, multi-layer ceramic, surface mount, trimmer disc, connector filtering) • resistors (such as oxide film, surface mount, wirewound) • inductors (various types including, surface mount) • interconnection devices (such as edge connectors, test points, insulated chassis connectors) • sensor devices (such as are used for process control and environmental monitoring applications) • optical devices (such as optical fibre, optical waveguides, optical backplanes, optical interconnection) • visual display tubes (such as are used for PC screens) • switching components (such as klystrons, thyratrons) • microwave components (such as magnetrons, travelling wave tubes, other microwave components) • spark gaps (such as are used in electromagnetic pulse surge protection and high energy switching applications) • charge coupled devices (such as are used in image detection type applications)			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.6 obtain and prepare materials, component parts and equipment for processing, to include carrying out all of the following: • receive or requisition kits of parts and/or materials for assembly/processing • obtain, prepare or modify standard parts as needed • prepare assembly jigs/aids • set out components for efficient working • prepare production equipment for assembly/process (such as set parameters, temperature profiles, times, speeds, pressures, vacuum, test settings) • obtain chemicals as required (such as solders/fluxes, plating solutions) 1.7 check and monitor that the processing equipment is set up and maintained at satisfactory operating conditions throughout the processing operations 1.8 carry out the process in accordance with operating procedures and the work piece specification requirements			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.9 process electronic components, to include completing two of the following: • follow stage-by-stage instructions for the assembly/process recipe stages involved • hand assemble/join/interconnect parts • use automated assembly/processing equipment • plate on combinations of nickel/silver/gold to form component terminations • ink screens to prepare component layers, and cut, release and fire components (where appropriate) • apply coatings/glazes to seal/finish the components • tape and reel components into standardised cassette receptacles • pump vacuums to required specification, and seal the component • seal component housings 1.10 carry out the processing of electronic components, to meet one of the following quality and accuracy standards: • company standard and procedures • BS or ISO standards and procedures • other international standards • customer standards and requirements			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.11 monitor the components, during and on completion of the processes, and carry out two of the following: • conduct basic functional/dimensional/security checks, in line with procedures • sample check the work at each stage • conduct self-generated, ad-hoc inspection checks • apply quality improvement controls and techniques (such as statistical process control (SPC), failure mode effect analysis (FMEA)) • check vacuum levels 1.12 ensure that the processed workpiece achieves the required characteristics and meets the processing specification 1.13 deal promptly and effectively with problems within their control and report those that they cannot solve 1.14 dispose of waste and excess materials in line with agreed organisational procedures 1.15 shut down the processing equipment to a safe condition on completion of the processing activities 1.16 present reports of the processing activities, using the following method: • verbally Plus one more method from the following: • electronic mail • computer-based presentation • written/typed report			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
2 Know how to process electronic components within the manufacturing system	2.1 describe the specific safety precautions to be taken while carrying out the processing electronic components, including any specific legislation, regulations or codes of practice relating to the activities, equipment or materials 2.2 describe the health and safety requirements of the work area in which they are carrying out the processing activities, and the responsibility these requirements place on them 2.3 describe the COSHH regulations with regard to the substances used in the process activities 2.4 describe the hazards associated with processing electronic components, and how they can be minimised 2.5 describe the personal protective equipment and clothing to be worn during the processing activities 2.6 explain how to extract and use information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS or ISO standards), in relation to work undertaken 2.7 explain how to recognise and deal effectively with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first-aid resuscitation)			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.8 explain how to interpret the company's information for the appropriate manufacturing assembly/processing stage (such as diagrams, drawings and specifications, information from computer-based files) 2.9 describe the relevant assembly/manufacturing processing techniques, their ordering and how they are applied 2.10 explain how to recognise of defects/problems (such as manufacturing stages, components to be assembled/processed) 2.11 describe the component types being processed/assembled, and the different values and ratings of the components used (such as resistance, capacitance, inductance values and tolerances, voltage and current ratings, insulation resistance) 2.12 explain how to set up/programme and use the tooling and equipment involved in the relevant assembly/process stages being undertaken 2.13 describe the quality control procedures to be followed during the processing operations 2.14 explain how to conduct any necessary checks to ensure the accuracy, position, security, function and completeness of the processed component 2.15 describe the defects and problems likely to be encountered in the various component manufacturing processes			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.16 explain how to deal safely and effectively with any waste/surplus materials and chemicals from the processing 2.17 describe the extent of their own responsibility, and to whom they should report if they have problems that they cannot resolve			

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Unit 15: Checking the compliance of electronic components against the specification

Unit reference number: F/502/9243

QCF level: 3

Credit value: 20

Guided learning hours: 56

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to carry out checking and inspection of electronic components during or on completion of the manufacturing process, to ensure that they conform to specification, in accordance with approved procedures. The learner will be expected to review specifications to determine checks needed at various stages of manufacture, to establish compliance by making those checks, and to report and record any significant variances.

The learner's responsibilities will require them to comply with organisational policy and procedures for the post-production inspection and checking activities undertaken, and to report any problems with the activities that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking full responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the necessary checking and inspection procedures. The learner will know how to set up and use effectively any associated checking equipment. The learner will understand the purpose of the checks and inspection points, and their application, and will know about the newly manufactured electronic products, in adequate depth to provide a sound basis for carrying out the activities, identifying faulty or out-of-specification components and taking the required action to correct this.

The learner will understand the safety precautions required when working in the electronic component-processing environment, and with the associated inspection equipment. The learner will be expected to know about any hazards associated with such checks, and what precautions to take to minimise the risks involved. 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.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
1 Check the compliance of electronic components against the specification	1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 follow and make appropriate use of the specifications for the product or asset being checked 1.3 use all the correct tools and inspection equipment and check that they are in usable condition 1.4 carry out all of the following during the checking activities: • use the correct issue of drawings, job instructions and specifications • check the calibration dates of tools and measuring instruments to be used • use grounded wrist straps and other electrostatic (ESD) precautions, as appropriate • use appropriate and safe inspection and checking techniques at all times • create and store records of compliance checks, in accordance with appropriate procedures • leave the work area in a safe and tidy condition 1.5 carry out the checks in an appropriate sequence using approved methods and procedures			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.6 check components using two of the following instruments: • oscilloscope • signal generator • multimeter • continuity tester • measuring instrument or gauge • logic probe • signal tracer • automatic test equipment • other specific test equipment 1.7 conduct compliance checks on one of the following types of component: • capacitors (such as ceramic disc, multi-layer ceramic, surface mount, trimmer disc, connector filtering) • resistors (such as oxide film, surface mount, wirewound) • inductors (various types including surface mount) • interconnection devices (such as edge connectors, test points, insulated chassis connectors) • sensor devices (such as are used for process control and environmental monitoring applications)			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	• Optical devices (such as optical fibre, optical waveguides, optical backplanes, optical interconnection) • Visual display tubes (such as are used for PC screens) • Switching components (such as klystrons, thyratrons) • Microwave components (such as magnetrons, travelling wave tubes, other microwave components) • Spark gaps (such as are used in electromagnetic pulse surge protection and high energy switching applications) • Charge coupled devices (such as is used in image detection type applications) 1.8 ensure that the completed electronic components are within specification, using two of the following checks: • fixed test • under power • fully operational • inspection 1.9 check that electronic components comply with one of the following quality and accuracy standards: • BS or ISO standards and procedures • customer standards and requirements • company standards and procedures • other international standards			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.10 identify and assess any defects or variations from the specification and take appropriate action 1.11 report completion of compliance activities in line with organisational procedures 1.12 present reports of activities using the following method: • verbally Plus one more method from the following: • electronic mail • computer-based presentation • written/typed report			

Learning outcomes	Assessment criteria		Evidence type	Portfolio reference	Date
2 Know how to check the compliance of electronic components against the specification	2.1	describe the specific safety precautions to be taken when working with newly manufactured products to check their conformance with specified requirements			
	2.2	describe the specific safety precautions to be taken to protect themselves and others when conducting the prescribed checks on particular categories of newly manufactured electronic components equipment/systems			
	2.3	describe the personal protective equipment to be worn while carrying out the checking and inspection activities concerned, for both personal protection and protection of the components and circuits (such as protective clothing, eye and hearing protection, anti-static devices)			
	2.4	describe the hazards associated with the checks being conducted (such as heat, radiation, chemicals, static electricity, high voltages points on equipment exposed to contact during tests, trapping points on equipment), and how they can be minimised			
	2.5	explain how to obtain and use specifications for the compliance checks being undertaken (such as component drawings, assembly drawings, block diagrams, wiring diagrams, manufacturing procedures)			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.6 describe the importance of ensuring that tools and equipment are set up correctly and are in a safe and usable condition 2.7 describe the procedure and methods used to check that tools and equipment are within calibration date 2.8 explain how to use the range of equipment items needed for the compliance checks (such as logic and waveform analysis equipment, storage oscilloscopes, signal generators, sensing and measuring devices, current, voltage and impedance measuring instruments, environmental simulation chambers and similar devices) 2.9 describe the basic operating principles of the electronic components being checked (such as capacitors, resistors, inductors, interconnection devices, sensor devices, optical devices, visual display tubes, switching components, microwave components, spark gaps, charge-coupled devices) 2.10 describe the types of defect that can be found on electronic components, and why they occur (such as dimensional errors in electronic connectors and their housings, lack of plating thickness in critical areas) 2.11 explain how to identify manufacturing defects, and what to do to rectify them 2.12 describe the factors to be considered when determining if a component should be scrapped or modified			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.13 describe the quality control procedures to be followed when checking the electronic component 2.14 describe the precautions to be taken to prevent electrostatic discharge (ESD) damage to electronic components (such as the use of wrist straps, special packaging and handling areas) 2.15 describe the documentation to be completed to confirm that the component (item or batch) has been properly checked 2.16 describe the importance of ensuring that all tools and equipment are returned to their correct location on completion of the checking activities 2.17 describe the extent of their own responsibility, and to whom they should report if they have problems that they cannot resolve			

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(*if sampled*)

Unit 16: Assembling and checking printed and allied electronic circuits

Unit reference number: M/502/9240

QCF level: 3

Credit value: 55

Guided learning hours: 98

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to assemble and check printed and allied circuit types, which include printed circuit boards (PCBs), thick film, thin film and flexible film circuitry, in accordance with approved procedures. The learner will be expected to assemble a range of 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.

The learner's responsibilities will require them to comply with organisational policy and procedures for the assembly activities undertaken, and to report any problems with the assembly activities that they cannot personally resolve, or are outside their permitted authority, to the relevant people. In particular, the learner will be expected to complete a number of general support tasks relating to their assembly work, to review the instructions and associated guidance, to prepare and complete the assembly activities, and to keep records of their work output. The learner will be expected to work with a minimum of supervision, taking full responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying electronic assembly procedures. The learner will understand the electronic assembly processes, and their application, and will know about the components used, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

The learner will understand the safety precautions required when working in an electronic component assembly environment, and with the associated tools and equipment. 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.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
1 Assemble and check printed and allied electronic circuits	1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 follow the relevant instructions, assembly drawings and any other specifications 1.3 ensure that the specified components are available and that they are in a usable condition 1.4 carry out all of the following during the assembly and checking activities: • use the correct issue of drawings, job instructions and specifications • follow relevant risk assessment procedures and COSHH regulations • follow clean work area protocols, where appropriate • use grounded wrist straps and other electrostatic (ESD) precautions, as appropriate • leave the work area in a safe and tidy condition 1.5 use the appropriate methods and techniques to assemble the components in their correct positions 1.6 secure the components using the specified connectors and securing devices			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.7 assemble one of the following circuit types: • single-sided circuit • flexible circuit • thick film circuit • double-sided circuit • thin film circuit • hybrid circuit 1.8 assemble circuits using four of the following tools: • soldering iron • heat shunts/tweezers • snipe or long-nosed pliers • sleeving pliers • forming/bending jigs/tools • side or end cutters • wire strippers • bolt fasteners (screwdriver, spanners) • anti-static packaging, mats and straps			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.9 assemble circuits to the required specification, to include using seven of the following types of component: • resistors (fixed/variable) • capacitors (fixed/variable) • transistors, thyristors, etc • switches • diodes • integrated circuits • mini transformers • indicators • edge connectors • plugs/sockets • wiring pins/tags • wire links • brackets • fixing spacers • insulators • small heat sinks 1.10 assemble circuits using two of the following aids: • workholding devices • jigs and fixtures • component forming devices • specialised assembly tools/equipment			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.11 check the completed assembly to ensure that all operations have been completed and the finished assembly meets the required specification 1.12 carry out checks on the completed circuits, to ensure all of the following: • soldered joints are clean, shiny, free from solder spikes, bridges, holes, excess solder and flux • components are correctly mounted for best physical support, and are correctly orientated • excess component leads have been trimmed off to the standard required • circuit tracks are free from faults (such as lifting, breaks, bridges, hot spots) • there are no obvious signs of damage, to components or to the substrate • all required connectors, wire links, spacers and other ancillary items are in place 1.13 produce circuits that comply with one of the following quality and accuracy standards: • BS or ISO standards and procedures • customer standards and requirements • company standards and procedures • other international standards			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.14 deal promptly and effectively with problems within their control and report those that cannot be solved 1.15 report any assembly problems using the following method: • verbally Plus one other method from the following: • electronic mail • written/typed report • computer-based presentation			
2 Know how to assemble and check printed and allied electronic circuits	2.1 describe the specific safety precautions to be taken when working with electronic assembly systems for printed and allied circuit types (such as printed circuit boards, thin film, thick film and flexible film circuitry) 2.2 describe the COSHH regulations with regard to the substances used in the assembly process 2.3 describe the hazards associated with assembling electronic circuits (such as heat, toxic fumes, spilled/splashed chemicals/solder, radiation, static electricity, trapping points on equipment), and how they can be minimised 2.4 describe the personal protective equipment (PPE) to be worn while carrying out the electronic assembly activities concerned, for both personal protection and protection of the components and circuits (such as protective outer clothing, eye and hearing protection, anti-static devices)			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.5 describe 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) 2.6 describe the clean work area protocols, what they involve, and how to follow them (where appropriate) 2.7 explain how to extract and use information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS or ISO standards) in relation to work undertaken 2.8 explain how to use the organisational specifications for the post-production assembly checks being undertaken 2.9 describe the preparation requirements for components to be used in the assembly 2.10 explain how to prepare, operate and care for the production system/equipment for the electronic assembly 2.11 explain how to recognise, read the values and identify polarity and any other orientation requirements for all electronic components being used in the subject assemblies (such as capacitors, resistors, inductors, diodes, transistors, integrated circuit chips, and other discrete through-hole or surface-mounted components)			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.12 explain how to check the set-up and preparation of the production assembly system 2.13 describe the quality procedures to be followed during the assembly processes 2.14 explain how to check the output quality of assemblies produced (such as appearance of soldered joints, security of components, track faults in PCBs, appearance of substrates, and freedom from signs of obvious damage) 2.15 describe the importance of ensuring that all tools are used correctly and are in a safe and serviceable condition 2.16 describe the importance of ensuring that all tools, equipment and components are accounted for and returned to their correct location on completion of the assembly activities 2.17 describe the basic operating function of the electronic components being assembled 2.18 describe the problems that can occur during the assembly, and the actions needed to deal with them 2.19 describe the reporting and documentation requirements relating to electronic assembly, and how to use them 2.20 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve			

Learner name: ________________________ Date: ________________

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Unit 17: Assembling and wiring electronic equipment and systems

Unit reference number: L/502/9245

QCF level: 3

Credit value: 45

Guided learning hours: 84

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to assemble and wire up electronic products, inclusive of components, sub-assemblies, or completed equipment/systems, in accordance with approved procedures. The learner will be required to interpret the associated working instructions, to obtain and prepare all resources for any essential pre-wiring assembly aspects of the product, to obtain and prepare the resources to be used specifically for electronic wiring, then to wire up, interconnect and conduct limited preliminary checks on finished items. The learner will also be expected to maintain a record of the work undertaken, and to hand over the work on completion of the assembly activities.

The learner's responsibilities will require them to comply with organisational policy and procedures for the electronic assembly and wiring activities undertaken, and to report any related problems that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking full responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will also provide them with an informed approach to applying the correct assembly and wiring procedures. The learner will understand the principles of electronic wiring and assembly work, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

The learner will understand the safety precautions required when working in an electronic assembly and wiring environment, and with the associated equipment and tools. 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.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
1 Assemble and wire electronic equipment and systems	1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 carry out all of the following during the assembly and wiring of the electronic equipment/systems: • use the correct issue of drawings, job instructions and specifications • follow risk assessment procedures and COSHH regulations • follow clean work area protocols, where appropriate • use grounded wrist straps and other electrostatic (ESD) precautions, as appropriate • carry out the assembling and wiring activities in line with organisational procedures • create and store records of the activities, in accordance with appropriate procedures 1.3 follow the relevant instructions, assembly drawings and any other specifications 1.4 use two of the following documents during the assembly activities: • assembly drawings and charts • schedules of specified components • wire running lists • interconnection net diagrams • wiring specifications			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.5 ensure that the specified components are available and that they are in a usable condition 1.6 obtain, check and prepare components, and complete the preparatory assembly, to include carrying out all of the following: • use hand tools/automated tools for securing all fastenings • assemble sub-units to support housings/brackets • assemble connectors and allied devices 1.7 obtain, check and prepare consumables and specialised tools to be used for the wiring and interconnection, to include all of the following: • solder and any associated fluxes (such as sufficient quantity, right type, good condition) • wire strippers and cutters (such as right size, good condition) • authorised crimp tooling and attachments (such as checked for sizes, calibration and condition) • cables and individual wiring/fibre optic links (such as correct sizes and types, good condition) • cable strapping obtained and cut to nominal length (such as right sizes and sufficient quantities) 1.8 use the appropriate methods and techniques to assemble the components in their correct positions 1.9 secure the components using the specified connectors and securing devices			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.10 assemble and wire the equipment, using five of the following methods and techniques: • set up, programme and use automated wiring termination equipment (where appropriate) • set out/position interconnection wiring • cut wires to required length • strip insulation from ends of wires • attach wire terminations by appropriate method/s (such as soldering, crimping) • bundle/strap/tie wiring looms and cables • set out and terminate any fibre optic links 1.11 produce assembled equipment that complies with one of the following quality and accuracy standards: • BS or ISO standards and procedures • customer standards and requirements • company standards and procedures • other international standards 1.12 check the completed assembly to ensure that all operations have been completed and the finished assembly meets the required specification			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.13 make preliminary checks on the completed work for all of the following: • security of all assembled and interconnected items • insulation resistance between housing assembly and interconnection wiring • continuity of all interconnections • unwanted short circuits between wires 1.14 deal promptly and effectively with problems within their control and report those that cannot be solved 1.15 complete one of the following company records, and hand over the work for final quality checks: • manual records • computer records • build cards • job cards • traveller documents			
2 Know how to assemble and wire electronic equipment and systems	2.1 describe the specific safety precautions to be taken when working with soldering and crimping equipment/tools and wiring aids within an electronics assembly and wiring environment (such as avoiding hot solder splashes and flying ends from cut wires)			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.2 describe the personal protective equipment (PPE) to be worn while carrying out the electronic wiring activities concerned, for both personal protection and protection of the components and circuits (such as protective outer clothing, eye and hearing protection, anti-static devices) 2.3 describe the regulations and standards that are relevant to electronic wiring and assembly being undertaken (such as the latest IEE wiring regulations, environmental legislation) 2.4 explain how mechanical assembly instructions are represented, and how to interpret them 2.5 describe the general principles of wiring and assembly, the range of methods used, and key features of each (such as tin/lead soldering, lead-free soldering systems, no-wash fluxing, crimping) 2.6 explain how the different types of electronic wiring and insulation are coded and specified 2.7 explain how information on wiring interconnections is specified, with particular reference to the role of wiring schedules, wire-running lists, backplane net interconnect lists 2.8 describe the various methods used for securing electronic wiring (such as heat shrink sleeves, strapping, cable ties, p-clips)			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.9 describe the care and selection of tools and aids used in wiring and assembly work (such as soldering tools and equipment, crimp tools, testing and checking equipment for continuity, short circuit testing, joint/crimp ‘pull-off’ security, insulation resistance) 2.10 explain how to recognise wiring types and sizes, their identification, coding and range of termination methods 2.11 explain how to identify the types and read the values of electronic components (resistors, capacitors, diodes, integrated circuits) with particular reference to their polarity, orientation, colour coding, value, tolerance, working voltage/current 2.12 explain how to take anti-static precautions in relation to component handling during the wiring and assembly of electronic products, and when such precautions are needed 2.13 describe the handling requirements and termination methods used for fibre-optic links 2.14 describe the range of checks and tests used within wiring and assembly work (such as insulation resistance, flashover testing, continuity, short circuit testing) 2.15 describe the calibration requirements for tools and equipment used in wiring (such as crimp tool test and selection for wire sizes, ‘pull-off’ limits, meters for continuity and insulation resistance checks)			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.16 describe the documentation completion requirements for the work undertaken 2.17 describe the problems that can occur with wiring and assembly work, and how they can be avoided 2.18 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve			

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Internal verifier signature: ______________________ Date: ______________
(*if sampled*)

Unit 18: Testing post-production electronic components and circuits

Unit reference number:	R/502/9246
QCF level:	3
Credit value:	45
Guided learning hours:	77

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to carry out post-production tests on electronic components or circuits, in accordance with approved procedures. The learner will be required to carry out all preliminary essentials like obtaining risk assessment/permits to work, following clean work area protocols where appropriate. In addition, the learner will be expected to review and check the currency of the testing requirements, to set up and prepare the testing facilities for use, to conduct prescribed tests, to consider the implications of results obtained, and to record and report their findings.

The learner's responsibilities will require them to comply with organisational policy and procedures for the testing activities undertaken, and to report any problems with these activities or with the tools and equipment used, that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking full responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying test procedures for electronic components and circuits. The learner will understand the basic operating principles of the items being tested, their main parameters and their application, in adequate depth to provide a sound basis for carrying out the activities, recognising when circuits/components do not meet the required specification.

The learner will understand the safety precautions required when working in a test environment for electronic components and circuits, and with the test equipment used. 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.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
1 Test post-production electronic components and circuits	1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 carry out all of the following during the testing of the electronic components and circuits: • use the correct issue of drawings, test instructions and specifications • follow risk assessment procedures and COSHH regulations • follow clean work area protocols, where appropriate • use grounded wrist straps and other electrostatic (ESD) precautions, as appropriate • provide safe access and working arrangements for the testing area • carry out the testing activities in line with organisational procedures • review the test results and store records, in accordance with appropriate procedures • dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition 1.3 follow the appropriate procedures for use of tools and equipment to carry out the required tests 1.4 set up and carry out the tests using the correct procedures and within agreed timescales			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.5 test one of the following manufactured electronic components or circuits: • capacitors • resistors • inductors • interconnection devices • sensor devices • optical devices • visual display tubes/screens • switching components • microwave components • spark gaps • charge-coupled devices • printed circuit board/assembly • thin film circuitry • thick film circuitry • flexible film circuitry			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.6 carry out two of the following tests: • pulse train sequencing and pulse rise time • waveform shape, frequency and amplitude checks • component value tests (such as resistance, capacitance, inductance) • continuity, open and short circuit tests • shock and vibration withstanding tests • humidity, temperature and salt spray withstanding tests • insulation resistance 1.7 record the results of the tests in the appropriate format 1.8 review the results and carry out further tests if necessary 1.9 collect and review test information, using two of the following: • test instrument measurements (such as from a multimeter, oscilloscope, logic probe, pulse sequencing analyser, signal generator/tracer) • circuit meters • circuit self-diagnosis • recording devices (such as for shock, vibration, humidity, temperature) • sensory input (such as sight, sound, smell, touch)			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.10 carry out all of the following checks to ensure the accuracy and quality of the tests carried out: • test equipment used is appropriate for the tests being carried out • the test equipment is correctly calibrated • test equipment is operated within its specified range • test procedures to be used are up to date and follow laid-down procedures • electrostatic discharge (ESD) precautions and procedures are applied 1.11 carry out tests which comply with one of the following standards: • BS or ISO standards and procedures • customer standards and requirements • company standards and procedures • other international standards 1.12 record and report the test results, using one of the following: • computer-based format • manual format • company-specific reporting procedure • specific test report			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
2 Know how to test post-production electronic components and circuits	2.1 describe the specific safety precautions to be taken to protect themselves and others when conducting the prescribed tests on particular categories of electronic components/circuits (such as the use of protective barriers, displaying of warning notices)			
	2.2 describe the personal protective equipment (PPE) to be worn while carrying out the testing activities concerned, both for personal protection and protection of the components or circuits (such as protective clothing, eye and hearing protection, anti-static devices)			
	2.3 describe the hazards associated with the tests being conducted (such as heat, radiation, chemicals, static electricity, high voltage points on equipment exposed to contact during tests, trapping points on equipment)			
	2.4 explain how to obtain the necessary authority to conduct the testing, the relevant work areas and any specific permit-to-work procedures that are used			
	2.5 explain how to recognise and deal effectively in the workplace with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first-aid resuscitation)			
	2.6 describe the clean work area protocols that should be used, in appropriate cases			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.7 explain how to obtain and use data/specifications for the post-production tests being undertaken 2.8 explain how to read and interpret circuit diagrams and related symbols 2.9 explain how to recognise and read component values and, where appropriate, the polarity of electronic components 2.10 explain how to check the calibration status of authorised test facilities and equipment to be used 2.11 explain how to set up and use the range of test equipment items for the post-production tests (such as logic and waveform analysis equipment, storage oscilloscopes, signal generators, sensing and measuring devices, current, voltage and resistance measuring instruments) 2.12 describe the importance of using the appropriate test points in the circuit, and how these are identified 2.13 describe the types of test used to verify the correct functioning of electronic equipment 2.14 describe the basic operating principles of the electronic components/circuits being tested 2.15 explain how to analyse and evaluate the results of the testing carried out 2.16 describe the problems that can occur during the testing activities, and the actions needed to deal with them			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.17 describe the reporting and documentation requirements relating to testing activities, and how to use them 2.18 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve			

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Unit 19: Locating and diagnosing faults in post-production electronic components and circuits

Unit reference number: Y/502/9247

QCF level: 3

Credit value: 45

Guided learning hours: 77

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to investigate, locate and diagnose the causes of faults in electronic components or circuits, on completion of or during the production stages, in accordance with approved procedures. The learner will be required to diagnose faults on a range of electronic components and circuits, such as capacitors, resistors, inductors, sensor devices, optic devices display tubes/screens, switching devices, microwave components, printed circuit board assemblies and thin, thick and flexible film circuitry. The learner will be expected to use a variety of fault diagnosis methods and techniques, and to utilise a number of diagnostic aids and equipment. The learner will be required to review the fault symptoms, interpret technical data, apply systematic fault finding procedures, and fully record and report their findings.

The learner's responsibilities will require them to comply with organisational policy and procedures for the fault diagnostic and fault location activities undertaken, and to report any problems with these activities, or with the tools and equipment used, that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying fault diagnosis procedures on electronic components and circuits. The learner will know about the electronic products being produced, and will understand the various fault diagnosis methods and techniques used, and their application. The learner will also know how to apply and interpret the information obtained from diagnostic aids and equipment, in adequate depth to provide a sound basis for carrying out the activities and for identifying faults or conditions that are outside the required specification.

The learner will understand the safety precautions required when carrying out the fault diagnosis activities, especially those for isolating the equipment. The learner 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.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
1 Locate and diagnose faults in post-production electronic components and circuits	1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 carry out all of the following during the fault location/diagnosis activities on the electronic components and circuits: • use the correct issue of drawings, job instructions and specifications • follow risk assessment procedures and COSHH regulations • follow clean work area protocols, where appropriate • use grounded wrist straps and other electrostatic discharge (ESD) precautions, as appropriate • carry out the fault location/diagnosis activities, in line with organisational procedures • create and store records, in accordance with appropriate procedures 1.3 review and use all relevant information on the symptoms and problems associated with the products or assets 1.4 investigate and establish the most likely causes of the faults			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.5 conduct fault diagnosis on one of the following manufactured components or circuits: • capacitors • resistors • inductors • interconnection devices • sensor devices • optical devices • visual display tubes/screens • switching components • microwave components • spark gaps • charge-coupled devices • printed circuit board/assembly • thin film circuitry • thick film circuitry • flexible film circuitry 1.6 find two of the following types of fault: • intermittent component/circuit failure • partial failure/reduced performance • complete component/circuit failure 1.7 select, use and apply diagnostic techniques, tools and aids to locate faults			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.8 collect fault diagnosis evidence from two of the following sources: • test instrument measurements (such as multimeter, oscilloscope, logic probe, pulse sequencing analyser, signal generator/tracer) • circuit meters • circuit self-diagnosis • recording devices (such as for shock, vibration, humidity, temperature) • sensory input (such as sight, sound, smell, touch) 1.9 use technical information to assist with fault finding activities, by referring to two of the following: • technical manuals • flow charts/fault algorithms • logic diagrams • fault finding/trouble shooting guides 1.10 use two of the following fault diagnostic techniques: • half-split technique • input/output technique • six point technique • unit substitution • injection and sampling • emergent sequence • function testing			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.11 use all of the following fault diagnosis procedures: • visual inspection (such as for breakages, signs of overheating, missing parts, loose fitting, dry joints) • operation (such as manual switching off and on, automatic switching/timing/sequencing, outputs) • measurement (such as voltage, current, continuity, logic states, noise, frequency, signal shape and level) 1.12 complete the fault diagnosis within the agreed time and inform the appropriate people when this cannot be achieved 1.13 determine the implications of the fault for other work and for safety considerations 1.14 use the evidence gained to draw valid conclusions about the nature and probable cause of the fault 1.15 record details on the extent and location of the faults in an appropriate format 1.16 prepare fault diagnosis reports using one of the following: • customer report • company specific report			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
2 Know how to locate and diagnose faults in post-production electronic components and circuits	2.1 describe the specific safety precautions to be taken when working with fault location and diagnosis on the particular categories of newly manufactured electronics equipment/systems and components concerned 2.2 describe the personal protective equipment (PPE) to be worn while carrying out the fault diagnosis activities for both personal protection and protection of the components and circuits (such as protective clothing, eye and hearing protection, anti-static devices) 2.3 describe the hazards associated with the electronic components, equipment and systems being investigated (such as heat, radiation, chemicals, static electricity, high voltage points on equipment exposed to contact during tests, trapping points on equipment) 2.4 explain how to recognise and deal effectively in the workplace with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first-aid resuscitation) 2.5 explain how to obtain the necessary authority to conduct fault location and diagnosis, the relevant work areas and any specific permit-to-work procedures that are used			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.6 describe the clean work area protocols that should be used, in appropriate cases 2.7 explain how to obtain and use data that relates to the post-production fault problems 2.8 explain how to check the calibration status of authorised test facilities and equipment to be used 2.9 describe the various fault diagnosis and location techniques (such as six point technique, emergent problem, input/output, half-split techniques and algorithm charts/tables), what they are, how to use them, and the associated risks 2.10 explain how to set up, care for and use the range of test equipment items for the post-production fault location (such as logic and waveform analysis equipment, oscilloscopes, signal generators, sensing and measuring devices, current, voltage and resistance measuring instruments) 2.11 explain how to read and interpret circuit diagrams and related symbols 2.12 explain how to recognise, read values and, where appropriate, the polarity of electronic components 2.13 describe the basic operating principles of the electronic components, systems/equipment being diagnosed			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.14 describe the component types being processed/assembled and the different values and ratings of the component used (such as resistance, capacitance/inductance value and tolerances, voltages and current ratings, insulation resistance) 2.15 explain how to analyse and evaluate the results of the fault diagnosis checks carried out 2.16 describe the faults that can occur, and the typical actions needed to deal with them (such as short and open circuits, problems at the hardware/software interface in equipments with embedded software) 2.17 describe the reporting and documentation requirements relating to fault investigation, and how to use them 2.18 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve			

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Unit 20: Preparing facilities for testing electronic components and circuits

Unit reference number: D/502/9248

QCF level: 3

Credit value: 18

Guided learning hours: 63

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to prepare facilities for the testing of electronic components and circuits, in accordance with approved procedures. In particular, the learner will be expected to undertake a number of test-related generalised preparations, to review all the requirements for testing, to obtain and prepare all standard and special test equipment and facilities for use, complete all pre-test preparations on the components or circuits to be tested, and to report the completion of the preparations to the appropriate people.

The learner's responsibilities will require them to comply with organisational policy and procedures for the preparation activities undertaken, and to report any problems with the activities or with the tools and equipment to be used, that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking full responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying test preparation procedures. The learner will understand the tests being prepared for, and their application, and will know about the operation of the items to be tested, in adequate 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 preparation activities in a test environment for electronic components and circuits, and with the associated test equipment used. 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.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
1 Prepare facilities for testing electronic components and circuits	1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 review the testing requirements, to include all of the following: • obtain and check the testing specification details • identify all standard facilities/equipment needed for the testing • identify any special facilities/equipment/tools for testing • check whether any special safety measures are needed 1.3 obtain all the required equipment and ensure that it is in safe and usable condition 1.4 obtain and prepare three of the following types of equipment for the testing: • oscilloscopes • logic analysers • waveform analysers • signal generators • Q meters • oscillators • power supplies • voltage meter • current meter • resistance meter • temperature meter • humidity meter			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.5 make all of the following checks, to ensure that: • the equipment is correctly calibrated • testing aids/facilities are suitable (such as condition, status, availability) • test interfaces/leads are suitable (such as condition, availability) • items to be tested are ready 1.6 carry out the necessary preparations to equipment in line with work requirements 1.7 complete all of the preparations for testing of equipment/systems/components: • use the correct issue of drawings, job instructions and specifications • follow risk assessment procedures and COSHH regulations • follow clean work area protocols, where appropriate • use grounded wrist straps and other electrostatic (ESD) precautions, as appropriate • provide safe access and working arrangements for the test area, where appropriate • prepare the testing facilities, in line with organisational procedures • create and store records, in accordance with appropriate procedures			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.8 prepare facilities for testing one of the following manufactured electronic components or circuits: • capacitors • resistors • inductors • interconnection devices • sensor devices • optical devices • visual display tubes/screens • switching components • microwave components • spark gaps • charge-coupled devices • printed circuit board/assembly • thin film circuitry • thick film circuitry • flexible film circuitry 1.9 make sure that required safety arrangements are in place to protect other workers from activities likely to disrupt normal working			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.10 complete all preparations on the equipment/systems/components to be tested: • connect the equipment/systems/components to be tested to any required mains/utilities, ensuring they are initially all safely isolated • make all the test connections required to conduct the specified tests/checks • erect barriers and warning notices, where appropriate 1.11 report the completion of preparations, verbally plus using one of the following methods, to the relevant people, in line with organisational procedures: • electronic mail • computer-based presentation • written/typed report 1.12 deal promptly and effectively with problems within their control and report those that cannot be solved			
2 Know how to prepare facilities for testing electronic components and circuits	2.1 describe the specific safety precautions to be taken when preparing for the testing of newly manufactured electronic equipment/systems/components			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.2 describe the personal protective equipment (PPE) to be worn while carrying out the preparations for the specific testing activities concerned, for both personal protection and protection of the components or circuits (such as protective clothing, eye and hearing protection, anti-static devices) 2.3 describe the hazards associated with the tests being prepared for, and how to take appropriate precautions (such as heat, radiation, chemicals, static electricity, exposed high voltage contact points during tests, trapping points on equipment) 2.4 describe the isolation and lock-off procedure that applies to the testing activities (such as electrical isolation, removal of fuses, placing of warning notices, proving the isolation has been achieved and secured) 2.5 explain how to deal effectively with victims of electric shock in the workplace (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first-aid resuscitation) 2.6 explain how to obtain authority to conduct the test preparations, the relevant work areas and any specific permit-to-work procedures that are used 2.7 describe the clean work area protocols that should be used, in appropriate cases			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.8 explain how to obtain and use the organisation/customer specifications for the post-production tests 2.9 explain how to check the calibration status of the authorised test facilities and equipment to be used 2.10 explain how to set up and use the range of test equipment items for the post-production tests (such as logic and waveform analysis equipment, oscilloscopes, signal generators, sensing and measuring devices, current, voltage and resistance measuring instruments) 2.11 describe the importance of keeping the work area clean, tidy and free from waste and surplus materials 2.12 explain how to prepare the newly manufactured products for testing 2.13 describe the precautions to be taken to prevent electrostatic discharge (ESD) damage to electronic circuits and components (such as use of wrist straps, special packaging and handling areas) 2.14 explain 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 2.15 describe the basic operating principles of the electronic components/systems/equipment to be tested			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.16 describe the company reporting formats, and how to use them 2.17 describe the extent of their own responsibility, and to whom they should report if they have problems that they cannot resolve			

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Unit 21: Writing specifications for testing electronic components or circuits

Unit reference number:	H/502/9249
QCF level:	3
Credit value:	30
Guided learning hours:	70

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to write test specifications for newly manufactured electronic components or circuits, in accordance with approved procedures. The learner will be expected to review the operating requirements of the electronic components or circuits, to decide which tests are needed, and to specify the tests, the test equipment and facilities to be used, and their order and conditions in which they are to be conducted. In addition, the learner will be expected to write test specifications in an approved format and against a required standard.

The learner's responsibilities will require them to comply with organisational policy and procedures for writing the test specifications, and to report any problems with these activities that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking full responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying procedures for writing test specifications for electronic products. The learner will understand the basic operating principles of the components and circuits for which the test procedures are specified, in adequate depth to provide a sound basis for carrying out this activity to the required standard.

The application of safe working practices will be a key issue throughout, and the learner will understand the safety precautions required when working in an electronic component manufacturing and testing environment, and with the associated equipment that is used. 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.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
1 Write specifications for testing electronic components or circuits	1.1 produce specifications that are clear and accurate and contain all relevant data 1.2 produce specifications in formats that meet organisational and customer requirements 1.3 carry out all of the following for the components or circuits to be tested: • review the operating and set-up specification for the product • check the working range or limits to be met (such as temperature, voltage/current/ impedance, boundary conditions for frequency, pulse rise times, amplitudes, minimum and maximum power supply limits) • identify the testing methods, processes and procedures required to test the component or circuit's full function • identify and schedule the logical order for conducting the tests			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.4 review the operating requirements and prepare test specifications for one of the following: • capacitors • resistors • inductors • interconnection devices • sensor devices • optical devices • visual display tubes/screens • switching components • microwave components • spark gaps • charge-coupled devices • printed circuit board/assembly • thin film circuitry • thick film circuitry • flexible film circuitry			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.5 specify tests that require the use of two of the following: • circuit meters • circuit self-diagnosis • sensory input (such as sight, sound, smell, touch) • test instrument measurements (such as multimeter, oscilloscope, logic probe, pulse sequencing analyser, signal generator/tracer) • sensing/recording devices (such as for shock, vibration, humidity, temperature) 1.6 produce test specifications detailing two of the following types of test: • pulse train sequencing and pulse rise time • waveform shape, frequency and amplitude checks • component value tests (such as resistance, capacitance, inductance) • continuity, open and short circuit tests • shock and vibration withstanding tests • humidity, temperature and salt spray withstanding tests • insulation resistance 1.7 write test specifications using one of the following formats: • computer-based format • manual format			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.8 ensure that codes and other references used in the specifications follow agreed conventions 1.9 specify tests that comply with one of the following standards: • IEE regulations • company policy and procedures • industry/sector requirement • BS and ISO standards (such as BS150) • customer/client requirements 1.10 pass specifications on to the appropriate people according to the agreed schedule 1.11 store specifications securely in the approved location 1.12 make changes to specifications only within agreed control procedures			
2 Know how to write specifications for testing electronic components or circuits	2.1 describe the specific safety precautions to be taken when testing the particular electronic equipment, systems and components for which the tests are being specified 2.2 describe the personal protective equipment (PPE) to be worn while carrying out the testing activities concerned for both personal protection and protection of the components and circuits (such as protective clothing, eye and hearing protection, anti-static devices) 2.3 describe the clean work area protocols that should be used, in appropriate cases			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.4 describe the hazards associated with the tests being specified (such as heat, radiation, chemicals, static electricity, high voltage points on equipment exposed to contact during tests, trapping points on equipment) 2.5 explain how to obtain the necessary authority to conduct testing, the relevant work areas and any specific permit-to-work procedures required 2.6 describe the types of tests that can be specified for newly manufactured electronic components and circuits 2.7 explain how to obtain and use the organisation/customer specifications in order to determine the post-production tests to be specified 2.8 explain how to check the calibration status of authorised test facilities and test equipment to be specified 2.9 explain how to set up and use the range of test equipment items needed for the post-production tests (such as logic and waveform analysis equipment, oscilloscopes, signal generators, sensing and measuring devices, current, voltage and resistance measuring instruments) 2.10 describe the basic operating principles of the electronic components and circuits to be tested			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.11 explain how to read and interpret circuit diagrams and related symbols (such as technical manuals, flowcharts, component drawings, assembly drawings, circuit diagrams, block diagrams, wiring diagrams, circuit board layouts) 2.12 explain how to recognise and read the values, tolerances and, where appropriate, polarity of electronic components 2.13 explain how the tests being specified will be analysed and evaluated 2.14 describe the problems that can occur during the testing activities, and how to specify the actions needed to deal with them 2.15 describe the format and documentation requirements relating to test specifications, and how to use them 2.16 describe the extent of their own responsibility, and to whom they should report if they have problems that they cannot resolve			

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(*if sampled*)

Unit 22: Assembling large transformer and inductor cores

Unit reference number: Y/502/9250

QCF level: 3

Credit value: 55

Guided learning hours: 126

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to assemble large transformer and inductor cores, in accordance with approved procedures. This will involve selecting the correct components and materials, cutting and forming components, constructing the cores, applying insulation, completing the curing process, and checking electrical and mechanical integrity of the transformer/inductor core. The learner will be required to select the appropriate tools and equipment to use, based on the operations to be performed and type of components to be fitted, and to check that they are in a safe and serviceable condition. In carrying out the operations, the learner will be required to follow laid-down procedures and specific assembly techniques. The assembly activities will also include making all necessary checks and adjustments to ensure that components are correctly positioned and free from damage.

The learner's responsibilities will require them to comply with organisational policy and procedures for the assembly activities undertaken, and to report any problems with the assembly activities, components or equipment that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying assembly techniques and procedures to large transformer or inductor cores. The learner will understand the transformer or inductor core being assembled, and its application, and will know about the assembly techniques, tools and methods, in adequate 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 assembly activities and when using the associated tools and equipment, especially those for lifting and handling the components safely and correctly. 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.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
1 Assemble large transformer and inductor cores	1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 follow the relevant instructions, assembly drawings and any other specifications 1.3 carry out all of the following during the assembly of the transformer or inductor cores: • use the correct assembly drawings, specifications and job instructions • adhere to risk assessment, COSHH and other relevant safety standards • ensure that components are free from damage, foreign objects, dirt or other contamination • check that all tools and equipment are within calibration date, where appropriate • use safe and approved techniques to assemble transformer cores and related components • leave the work area in a safe and tidy condition 1.4 ensure that the specified components are available and that they are in a usable condition			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.5 use all of the following components in the assembly operations: • electrical steels • laminates • core limb binding tape • insulating material • clamps • foundation feet • core and tie bolts • earth strips 1.6 use the appropriate methods and techniques to assemble the components in their correct positions			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.7 assemble transformer or inductor cores, using six of the following methods and procedures: • cutting and forming laminates • orientating and positioning components • aligning components • assembling and clamping • assembling components by pressure • setting clearances • impregnating and curing components • electrical bonding of components • soldering/brazing • securing using mechanical fasteners/threaded devices • torque setting • applying bolt locking methods 1.8 assemble three of the following transformer or inductor core types: • rectangular • multi-step • round • elliptical • plain yokes/limbs • stepped yokes/limbs • multi-limb cores • multi-gap inductor cores • magnetic shields and shunts			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.9 assemble transformer or inductor cores, using three of the following core construction/laying techniques: • butt joints • overlap joints • square junctions • mitred junctions • single lamination • multiple lamination 1.10 secure the components using the specified connectors and securing devices 1.11 assemble transformer or inductor cores using four the following assembly aids and equipment: • cutting and punching machine • workholding devices • laminate cutting machine • lifting and moving equipment • measuring equipment • specialist assembly tools 1.12 check the completed assembly to ensure that all operations have been completed and the finished assembly meets the required specification			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.13 use appropriate equipment to carry out the required quality checks, to include six of the following: • positional accuracy • dimensions • orientation • alignment • electrical continuity • component security • completeness • freedom from damage or foreign objects 1.14 assemble cores which comply with one of the following quality and accuracy standards: • organisational drawings and procedures • customer requirements • BS and ISO standards 1.15 deal promptly and effectively with problems within their control and report those that cannot be solved 1.16 complete the relevant documentation, to include one of the following, and pass it to the appropriate people: • job cards • work authorisation documents • assembly records • acceptance/test documentation			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
2 Know how to assemble large transformer and inductor cores	2.1 describe the health and safety requirements of the area in which the core assembly activity is to take place, and the responsibility these requirements place on the learner 2.2 describe the importance of wearing protective clothing and other appropriate safety equipment during large core assembly activities 2.3 describe the hazards associated with assembling large transformer and inductor cores, and how they can be minimised 2.4 explain how to obtain and interpret drawings, planning sheets and records and other documents needed for the core assembly activities 2.5 describe the factors to consider when selecting steels to fabricate large transformer or inductor cores 2.6 describe the methods and techniques to be used when assembling large transformer or inductor cores 2.7 describe the different types of core insulation used, and the methods used to cut and form them 2.8 describe the various core construction-laying techniques that are used (such as single or multiple laminations, butt or overlap joints, square or mitred junctions) 2.9 describe the methods and techniques used to build yokes and limbs, limb cores, inductor cores and magnetic shields and shunts			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.10 describe the methods used to fit the core clamp 2.11 describe the factors considered when fitting foundation feet, core and tie bolts, and insulation and earth strips 2.12 describe the purpose of core limb banding tape 2.13 describe the different methods used for curing 2.14 describe the procedures to ensure full strength processing in respect of steel banding, removal of core limbs, drying procedure and application of suitable varnish 2.15 describe the methods used to check for electrical insulation of the completed assembly, and the importance of these checks 2.16 describe the visual checks and preparation requirements for components to be used in large transformer or inductor core assembly activities 2.17 describe the methods and equipment used to transport, handle and lift the components into position, and how to check that the equipment is within its current certification dates 2.18 explain 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 the intended purpose			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.19 describe the reporting and documentation requirements relating to large transformer or inductor core assembly, and how to use them 2.20 describe the extent of their own responsibility, and to whom they should report if they have problems that they cannot resolve			

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Assessor signature: ______________________ Date: ______________

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(*if sampled*)

Unit 23: Winding transformer and inductor coils

Unit reference number: D/502/9251

QCF level: 3

Credit value: 45

Guided learning hours: 112

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to wind transformer and inductor coils, in accordance with approved procedures. This will involve selecting the correct components and materials, setting up the coil winding machines, winding and constructing transformer and inductor coils, cutting and forming insulation, making joints and terminations, preparing the coils for processing, and checking the electrical and mechanical integrity of completed assemblies. The learner will be required to select the appropriate tools and equipment to use, based on the operations to be performed and type of components to be fitted, and to check that they are in a safe and serviceable condition. In carrying out the operations, the learner will be required to follow laid-down procedures and specific assembly techniques. The assembly activities will also include making all necessary checks and adjustments to ensure that components are correctly positioned and free from damage.

The learner's responsibilities will require them to comply with organisational policy and procedures for the component assembly activities undertaken. The learner will report any problems with the components or coil winding activities that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with the minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying transformer and inductor coil winding techniques and procedures. The learner will understand the transformer and inductor coil winding processes, their application and the manufacturing techniques. The learner will know about the types of components used, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

The learner will understand the safety precautions required when setting, adjusting and operating the coil winding equipment. 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.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
1 Wind transformer and inductor coils	1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 carry out all of the following during the transformer or inductor coil winding activities: • use the correct drawings, specifications and job instructions • adhere to risk assessment, COSHH and other relevant safety standards • ensure that components are free from damage, foreign objects, dirt or other contamination • check that all tools and equipment are within calibration date, where appropriate • use safe and approved techniques to wind transformer and inductor coils • leave the work area in a safe and tidy condition 1.3 follow the relevant instructions, assembly drawings and any other specifications 1.4 ensure that the specified components are available and that they are in a usable condition			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.5 use twelve of the following materials and components during the coil winding operations: • conducting materials • insulating materials • joining materials • foundation feet • clamps • core and tie bolts • earth strips • coil edge packing • inter-coil wrap • lead-out sleeving • lead-out tape • key ducts • spacers • common end washers • finish/banding tape • lead-out conductors • bobbins • frames • laminations • sleeving • fixing material			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.6 use the appropriate methods and techniques to assemble the components in their correct positions 1.7 use all of the following equipment and tools for the coil winding and assembly operations: • coil winding machine • insulation cutting and forming equipment • tinning equipment • laminate cutting and punching machine • measuring equipment • mechanical hand tools • electrical hand tools 1.8 complete all of the following coil winding and assembly procedures: • select conductors (such as round, rectangular, foil, sheet, hollow section, aluminium, copper, bare, insulated) • select materials (such as insulation, joining) • set coil winding cutting machine (such as wire traverse, pitch, gear ratio and tension, joining tool) • cut and form insulation such as wraps/cylinder, inter-layer/wrap/duct, parallel and tapered coil edge packing, inter-coil wrap/cylinder/duct, lead-out sleeving/tape, key ducts and spacers, common end washers, finish/banding tape)			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	• cut and form lead-out conductors (such as low and high voltage terminations and tappings) • wind coils using different conductors (such as flat and edge wound, multiple stranded) • wind coils using various techniques (such as distributed crossover, helical spiral, disc) • make terminations (such as high voltage insulated, flexible fly leads, tappings, heavy section single and multiple form lead-outs and busbars) • make lead-outs (such as high and low voltage, radial off-coil face, axial from coil ends, left/right, front/back of coil and staggered) • assemble coils (such as multi-sectional, multiple coils, lead-outs, tappings, insulation) • prepare coils for processing (such as impregnating, curing) 1.9 secure the components using the specified connectors and securing devices 1.10 check the completed assembly to ensure that all operations have been completed and the finished assembly meets the required specification			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.11 wind transformer/inductor coils to one of the following quality and accuracy standards: • organisational drawings and procedures • customer drawings and requirements • IEE wiring regulations • BS and ISO standards 1.12 deal promptly and effectively with problems within their control and report those that cannot be solved 1.13 complete the relevant documentation, to include one of the following, and pass it to the appropriate people: • job cards • work authorisation documents • material records • acceptance documentation			
2 Know how to wind transformer and inductor coils	2.1 describe the health and safety requirements of the area in which the coil winding activity is to take place, and the responsibility these requirements place on the learner 2.2 describe the importance of wearing protective clothing and other appropriate safety equipment during the coil winding activities 2.3 describe the hazards associated with the type of coil winding activities being undertaken, and how they can be minimised			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.4 explain how to obtain and interpret drawings, planning sheets, records and other documents needed for the coil winding activities 2.5 describe the factors to consider when selecting conductors to produce transformer and inductor coils (such as round section, rectangular, foil, sheet, hollow section, aluminium, copper, bare, insulated) 2.6 describe the factors that influence the choice of size and type of coil conductors 2.7 describe the methods used to set up the coil winding machine with regard to wire traverse, pitch, gear ration and tension 2.8 describe the methods used to produce helical, spiral, disc, sandwich and distributed crossover types of coil windings 2.9 describe the methods used to minimise magnetic leakage 2.10 describe the procedures for cutting and forming insulations 2.11 describe the purposes of cylinder wraps, wrap/duct inter-layer, parallel and tapered coil edge packing, inter-coil wrap/cylinder/duct, lead-out sleeving tape, key ducts and spacers, common end washers and finishing banding tape pieces 2.12 explain how coils are prepared for impregnating and curing, and the methods used to do this			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.13 describe the methods used to cut lead-out conductors to size and shape 2.14 describe the procedures for cutting the high and low voltage terminations and tappings of the coil winding 2.15 describe the methods used to earth the transformer or inductor coil 2.16 describe the methods used to strip and clean electrical conductors before jointing, and the methods of jointing used 2.17 describe the procedures used when hand-soldering joints, and the hazards associated with using soldering equipment 2.18 describe the visual checks and preparation requirements for components to be used in transformer and inductor coil wining activities 2.19 describe the methods and equipment used to transport, handle and lift the components into position, and how to check that the equipment is within its current certification dates 2.20 explain 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 the intended purpose 2.21 describe the reporting and documentation requirements relating to transformer and inductor coil winding, and how to use them			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.22 describe the extent of their own responsibility, and to whom they should report if they have problems that they cannot resolve			

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Unit 24: Assembling transformers and inductors

Unit reference number: H/502/9252

QCF level: 3

Credit value: 48

Guided learning hours: 119

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to assemble transformers and inductors, in accordance with approved procedures. This will involve selecting the correct components and materials, assembling the transformer or inductor components, connecting the coils, preparing lead-outs, making joints and terminations, and checking the electrical and mechanical integrity of completed assemblies. The learner will be required to select the appropriate tools and equipment to use, based on the operations to be performed and type of components to be fitted, and to check that they are in a safe and serviceable condition. In carrying out the operations, the learner will be required to follow laid-down procedures and specific assembly techniques. The assembly activities will also include making all necessary checks and adjustments to ensure that components are correctly positioned and free from damage.

The learner's responsibilities will require them to comply with organisational policy and procedures for the assembly activities undertaken, and to report any problems with the assembly activities, components or equipment that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying assembly techniques and procedures to transformers and inductors. The learner will understand the transformer or inductor being assembled, and its application, and will know about the assembly techniques, tools and methods, in adequate 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 transformer or inductor assembly activities. 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.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
1 Assemble transformers and inductors	1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 follow the relevant instructions, assembly drawings and any other specifications 1.3 carry out all of the following during the assembly of the transformers or inductors: • use the correct assembly drawings, specifications and job instructions • adhere to risk assessment, COSHH and other relevant safety standards • ensure that components are free from damage, foreign objects, dirt or other contamination • check that all tools and equipment are within calibration date, where appropriate • use safe and approved techniques to assemble transformers and inductors • leave the work area in a safe and tidy condition 1.4 ensure that the specified components are available and that they are in a usable condition			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.5 use all of the following in the assembly activities: • cores • coils • support packing • insulation materials • terminals • connections • foundation feet • frames 1.6 use the appropriate methods and techniques to assemble the components in their correct positions 1.7 use all the following tools and equipment during the assembly operations: • soldering/brazing equipment • electrical measuring equipment • mechanical measuring equipment • mechanical hand tools • electrical hand tools • specialised equipment			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.8 carry out ten of the following assembly procedures: • select the correct components and materials • orientate and position the components correctly • assemble the coils, cores and related components • align the components • set any required clearance • make lead-outs (such as start, finish and intermediate tapping terminations) • insulate the lead-outs • carry out electrical bonding of the components • carry out soldering/brazing of connections • make compression connections (such as crimped) • secure the components using mechanical fasteners/threaded devices • torque setting • apply bolt locking methods 1.9 secure the components using the specified connectors and securing devices 1.10 check the completed assembly to ensure that all operations have been completed and the finished assembly meets the required specification			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.11 use appropriate equipment to carry out the required quality checks, including six of the following: • positional accuracy • dimensions • orientation • alignment • component security • completeness • freedom from damage or foreign objects 1.12 assemble transformer or inductors to one of the following quality and accuracy standards: • organisational drawings and procedures • customer drawings and requirements • BS and ISO standards 1.13 deal promptly and effectively with problems within their control and report those that cannot be solved 1.14 complete the relevant documentation, to include one of the following, and pass it to the appropriate people: • job cards • work authorisation documents • assembly records • acceptance/test documentation			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
2. Know how to assemble transformers and inductors	2.1 describe the health and safety requirements of the area in which the transformer/inductor assembly activity is to take place, and the responsibility these requirements place on the learner 2.2 describe the importance of wearing protective clothing and other appropriate safety equipment during transformer/inductor assembly activities 2.3 describe the hazards associated with the assembly activities being undertaken 2.4 explain how to obtain and interpret drawings, planning sheets and records and other documents needed for the assembly activities 2.5 describe the types of components used, and how to ensure that they are fit to use in the assembly 2.6 describe the preparation requirements for the components to be used in the transformer/inductor assembly activities 2.7 describe the methods used to ensure a firm and rigid transformer/inductor assembly of appropriate mechanical strength 2.8 describe the procedures to ensure correct electrical clearance between coils and earthed parts of the assembly 2.9 describe the faults that can occur and how they can be prevented 2.10 describe the methods used to connect the coils to the terminals, and the importance of the tapping arrangements			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.11 describe the methods used in preparing lead-out conductors, and the methods used to remove insulation and tin them 2.12 describe the procedures and methods used for making coil interconnections (such as delta group connections) 2.13 describe the precautions taken when using soldering and brazing equipment, and the associated dangers 2.14 describe the methods used for re-insulating conductors 2.15 describe the methods used to support the joined conductors, and the common types of support packing 2.16 describe the methods used to earth the transformer/inductor 2.17 describe the methods and equipment used to transport, handle and lift the components into position, and how to check that the equipment is within its current certification dates 2.18 explain 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 the intended purpose 2.19 describe the reporting and documentation requirements relating to transformer/inductor assembly, and how to use them			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.20 describe the extent of their own responsibility, and to whom they should report if they have problems that they cannot resolve			

Learner name: ____________________ Date: ____________________

Learner signature: ____________________ Date: ____________________

Assessor signature: ____________________ Date: ____________________

Internal verifier signature: ____________________ Date: ____________________
(*if sampled*)

Unit 25: Fitting small transformer and inductor cores

Unit reference number: K/502/9253

QCF level: 3

Credit value: 30

Guided learning hours: 112

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to fit commonly used cores in small transformers or inductors, and to check the electrical and mechanical integrity of transformer core assemblies, in accordance with approved procedures. The learner will be required to select the appropriate tools and equipment to use, based on the operations to be performed and type of components to be fitted, and to check that they are in a safe and serviceable condition. In carrying out the operations, the learner will be required to follow laid-down procedures and specific assembly techniques. The assembly activities will also include making all necessary checks and adjustments to ensure that components are correctly positioned and free from damage.

The learner's responsibilities will require them to comply with organisational policy and procedures for the assembly activities undertaken, and to report any problems with the assembly activities, components or equipment that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying assembly techniques and procedures for small transformer and inductor cores. The learner will understand the transformer or inductor being assembled, and its application, and will know about the assembly techniques, tools and methods, in adequate 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 assembly operations. 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.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
1 Fit small transformer and inductor cores	1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 follow the relevant instructions, assembly drawings and any other specifications 1.3 carry out all of the following during the fitting of the small transformer or inductor cores: • use the correct assembly drawings, specifications and job instructions • adhere to risk assessment, COSHH and other relevant safety standards • ensure that components are free from damage, foreign objects, dirt or other contamination • check that all tools and equipment are within calibration date, where appropriate • use safe and approved techniques to assemble transformer cores and related components • leave the work area in a safe and tidy condition 1.4 ensure that the specified components are available and that they are in a usable condition 1.5 fit cores using all of the following components: • insulating material • clamps • foundation feet • clips • core and tie bolts • earth strips • banding strip			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.6 use the appropriate methods and techniques to assemble the components in their correct positions 1.7 fit cores using four of the following methods and procedures: • cutting and forming laminates • orientating and positioning components • aligning components • assembling and clamping • assembling components by pressure • setting clearances • impregnating and curing components • electrically bonding components • soldering/brazing • securing using mechanical fasteners/ threaded devices • torque setting • applying bolt locking methods 1.8 fit all of the following cores to transformers or inductors: • stampings/lamination cores • cut-wound cores • ferrite cores 1.9 secure the components using the specified connectors and securing devices			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.10 check the completed assembly to ensure that all operations have been completed and the finished assembly meets the required specification 1.11 carry out the required quality checks, to include six of the following, using appropriate equipment: • positional accuracy • dimensions • orientation • alignment • component security • completeness • freedom from damage or foreign objects 1.12 fit transformer/inductor cores which comply with one of the following quality and accuracy standards: • organisational drawings and procedures • customer drawings and requirements • BS and ISO standards 1.13 deal promptly and effectively with problems within their control and report those that cannot be solved 1.14 complete relevant documentation, to include one of the following, and pass it to the appropriate people: • job cards • work authorisation documents • assembly records • acceptance/test documentation			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
2 Know how to fit small transformer and inductor cores	2.1 describe the health and safety requirements of the area in which the core fitting activity is to take place, and the responsibility these requirements place on the learner 2.2 describe the importance of wearing protective clothing and other appropriate safety equipment during core fitting activities 2.3 describe the hazards associated with the type of assembly and insulating activities being undertaken, and how these can be minimised 2.4 explain how to obtain and interpret drawings, planning sheets and records and other documents needed for the core fitting activities 2.5 describe the assembly methods and techniques to be used when fitting small transformer/inductor cores 2.6 describe the different types of core that are used 2.7 describe the methods used to fit the core clamp 2.8 describe the factors considered when fitting foundation feet, core and tie bolts, and insulation and earth strips 2.9 describe the purpose of core limb banding tape 2.10 describe the methods used to check for electrical insulation of the completed assembly, and the importance of these checks			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.11 describe the visual checks and preparation requirements for components to be used in small transformer and inductor core fitting activities 2.12 describe the methods and equipment used to handle and fit cores into position, and the procedures to be followed when doing so 2.13 explain 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 the intended purpose 2.14 describe the reporting and documentation requirements relating to small transformer and inductor core fitting, and how to use them 2.15 describe the extent of their own responsibility, and to whom they should report if they have problems that they cannot resolve			

Learner name: ______________________ Date: ______________

Learner signature: ______________________ Date: ______________

Assessor signature: ______________________ Date: ______________

Internal verifier signature: ______________________ Date: ______________
(*if sampled*)

Unit 26: Assembling rotor and armature windings

Unit reference number: M/502/9254

QCF level: 3

Credit value: 25

Guided learning hours: 56

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to assemble rotor and armature windings, in accordance with approved procedures. This will involve selecting the correct components and materials, fitting and insulating components, and fitting and terminating the coil. The learner will be required to select the appropriate tools and equipment to use, based on the operations to be performed and type of components to be fitted, and to check that they are in a safe and serviceable condition. In carrying out the operations, the learner will be required to follow laid-down procedures and specific assembly techniques. The assembly activities will also include making all necessary checks and adjustments to ensure that components are correctly positioned and free from damage.

The learner's responsibilities will require them to comply with organisational policy and procedures for the assembly activities undertaken, and to report any problems with the assembly activities, components or equipment that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying assembly techniques and procedures to rotor and armature windings. The learner will understand the rotor or armature being assembled, and its application, and will know about the assembly techniques, tools and methods, in adequate 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 assembly operations. 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.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
1 Assemble rotor and armature windings	1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 follow the relevant instructions, assembly drawings and any other specifications 1.3 carry out all of the following during the assembly of the rotor and armature windings: • use the correct assembly drawings, specifications and job instructions • adhere to risk assessment, COSHH and other relevant safety standards • ensure that components are free from damage, foreign objects, dirt or other contamination • check that all tools and equipment are within calibration date, where appropriate • use safe and approved techniques to assemble and connect rotor/armature components • leave the work area in a safe and tidy condition 1.4 ensure that the specified components are available and that they are in a usable condition 1.5 use the appropriate methods and techniques to assemble the components in their correct positions			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.6 prepare and assemble windings using all of the following: • rotor/armature wire • preformed coils • insulating material • separating strips • slot wedges • dummy coils • equaliser rings • resin/glass bonding tape • brazing material • solders • fluxes 1.7 use all of the following equipment and tools for the assembly operations: • tinning and soldering equipment • multimeters • impedance tester • drying and baking ovens • insulating resin baths • coil winding machines • lathes • shaft supports			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.8 use all of the following assembly procedures: • prepare components (such as coil ends, wedge length, width, squareness and profile) • insulate (such as slot, shaft, end winding support) • secure windings (such as main, auxiliary, lap, wave, duplex, triplex, multiplex) • band end windings • solder connections (such as risers, coil ends) • check mechanical integrity • check electrical integrity (such as continuity, insulation, voltage withstand) 1.9 secure the components using the specified connectors and securing devices 1.10 check the completed assembly to ensure that all operations have been completed and the finished assembly meets the required specification 1.11 assemble rotating equipment to one of the following quality and accuracy standards: • organisational drawings and procedures • customer drawings and requirements • BS and ISO standards 1.12 deal promptly and effectively with problems within their control and report those that cannot be solved			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.13 complete the relevant documentation, to include one of the following, and pass it to the appropriate people: • job cards • work authorisation documents • assembly records • acceptance/test documentation			
2 Know how to assemble rotor and armature windings	2.1 describe the health and safety requirements of the area in which the electrical assembly and insulating activity is to take place, and the responsibility these requirements place on the learner 2.2 describe the importance of wearing protective clothing and other appropriate safety equipment during electrical assembly and insulating activities 2.3 describe the hazards associated with assembling rotor and armature windings, and how they can be minimised 2.4 explain how to obtain and interpret drawings, planning sheets and records and other documents needed for the assembly activities 2.5 describe the factors to consider when choosing pre-formed coils 2.6 describe the assembly methods and techniques to be used when assembling rotating equipment rotor/armature windings			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.7 describe the common types of winding configuration used for rotor/armature assembly 2.8 describe the methods used to fit slot insulators 2.9 describe the purpose of insulation cuffs 2.10 describe the factors that determine the wedge length, width, squareness and profile 2.11 describe the methods used to mark out and cut materials for the manufacture and trimming of wedges 2.12 describe the methods used to fit wedges into slots 2.13 describe the methods used to splice windings, and the factors that affect the pitch of coils 2.14 describe the procedure for protecting coil ends 2.15 describe the common methods of attaching rotor/armature windings to the commutator 2.16 describe the method used to check the electrical integrity of joints 2.17 describe the methods used to apply insulating varnish, and the types used 2.18 describe the visual checks and preparation requirements for components to be used in electrical assembly activities 2.19 describe the methods and equipment used to transport, handle and lift the components into position, and how to check that the equipment is within its current certification dates			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.20 explain 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 the intended purpose 2.21 describe the reporting and documentation requirements relating to rotor/armature assembly, and how to use them 2.22 describe the extent of their own responsibility, and to whom they should report if they have problems that they cannot resolve			

Learner name: ____________________________ Date: ____________________

Learner signature: ____________________________ Date: ____________________

Assessor signature: ____________________________ Date: ____________________

Internal verifier signature: ____________________________ Date: ____________________
(*if sampled*)

Unit 27: Assembling stator windings

Unit reference number: T/502/9255

QCF level: 3

Credit value: 25

Guided learning hours: 56

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to assemble stator windings, in accordance with approved procedures. This will involve selecting the correct components and materials, fitting and insulating the components, and fitting and terminating the coil windings. The learner will be required to select the appropriate tools and equipment to use, based on the operations to be performed and type of components to be fitted, and to check that they are in a safe and serviceable condition. In carrying out the operations, the learner will be required to follow laid-down procedures and specific assembly techniques. The assembly activities will also include making all necessary checks and adjustments to ensure that components are correctly positioned and free from damage.

The learner's responsibilities will require them to comply with organisational policy and procedures for the assembly activities undertaken, and to report any problems with the assembly activities, components or equipment that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying stator winding assembly techniques and procedures. The learner will understand the stator being assembled, and its application, and will know about the assembly techniques, tools and methods, in adequate 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 assembly operations. 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.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
1 Assemble stator windings	1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 follow the relevant instructions, assembly drawings and any other specifications 1.3 carry out all of the following during the assembly of the stator windings: • use the correct assembly drawings, specifications and job instructions • adhere to risk assessment, COSHH and other relevant safety standards • ensure that components are free from damage, foreign objects, dirt or other contamination • check that all tools and equipment are within calibration date, where appropriate • use safe and approved techniques to assembly and connect stator components • leave the work area in a safe and tidy condition 1.4 ensure that the specified components are available and that they are in a usable condition 1.5 use the appropriate methods and techniques to assemble the components in their correct positions			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.6 prepare and assemble stator windings, using all of the following: • winding wiring • pre-formed coils • insulating material • separating strips • slot wedges • dummy coils • equaliser rings • resin/glass bonding tape • brazing material • solders • fluxes 1.7 use all of the following equipment and tools for the assembly operations: • tinning and soldering equipment • multimeter • impedance tester • drying and baking ovens • coil winding machines • brazing equipment • insulating resin baths			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.8 complete all of the following assembly procedures: • prepare components (such as coil ends, wedge length, width, squareness and profile) • fit windings (such as preformed, wound directly into slot, loop, diamond, concentric) • insulate windings (such as slot, end winding support) • secure windings (such as packings, tapes, cords, wedges) • solder and braze winding connections • check mechanical integrity • check electrical integrity (such as continuity, insulation, voltage withstand) 1.9 secure the components using the specified connectors and securing devices 1.10 check the completed assembly to ensure that all operations have been completed and the finished assembly meets the required specification 1.11 assemble rotating equipment to one of the following quality and accuracy standards: • organisational drawings and procedures • customer drawings and requirements • BS and ISO standards 1.12 deal promptly and effectively with problems within their control and report those that cannot be solved			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.13 complete the relevant documentation, to include one of the following, and pass it to the appropriate people: • job cards • work authorisation documents • assembly records • acceptance/test documentation			
2 Know how to assemble stator windings	2.1 describe the health and safety requirements of the area in which the electrical assembly and insulating activity is to take place, and the responsibility these requirements place on the learner 2.2 describe the importance of wearing protective clothing and other appropriate safety equipment during electrical assembly and insulating activities 2.3 describe the hazards associated with assembling stator windings, and how they can be minimised 2.4 explain how to obtain and interpret drawings, planning sheets and records and other documents needed for the assembly activities 2.5 describe the factors to consider when choosing pre-formed coils 2.6 describe the assembly methods and techniques to be used when assembling rotating equipment stator windings 2.7 describe the common types of winding configuration used for stator assembly			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.8 describe the methods used to fit slot insulators 2.9 describe the purpose of insulation cuffs 2.10 describe the factors that determine the wedge length, width, squareness and profile 2.11 describe the methods used to mark out and cut materials for the manufacture and trimming of wedges 2.12 describe the methods used to fit wedges into slots 2.13 describe the factors to be considered when selecting and fitting coils to multi-phase stators 2.14 describe the factors that influence the selection of coil ends 2.15 describe the method used to check for the electrical integrity of joints 2.16 describe the methods used to apply insulating varnish, and the types used 2.17 describe the common methods used to ensure good varnish penetration when using a dipping bath 2.18 describe the visual checks and preparation requirements for the components to be used 2.19 describe the methods and equipment used to transport, handle and lift the components into position, and how to check that the equipment is within its current certification dates			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.20 explain 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 the intended purpose 2.21 describe the reporting and documentation requirements relating to stator assembly, and how to use them 2.22 describe the extent of their own responsibility, and to whom they should report if they have problems that they cannot resolve			

Learner name: ______________________________ Date: ____________________

Learner signature: ______________________________ Date: ____________________

Assessor signature: ______________________________ Date: ____________________

Internal verifier signature: ______________________________ Date: ____________________
(*if sampled*)

Unit 28: Assembling and fitting commutators

Unit reference number: A/502/9256

QCF level: 3

Credit value: 20

Guided learning hours: 42

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to select components and materials, and to assemble commutator segments and separators, in accordance with approved procedures. The learner will be required to select the appropriate tools and equipment to use, based on the operations to be performed and type of components to be fitted, and to check that they are in a safe and serviceable condition. In carrying out the operations, the learner will be required to follow laid-down procedures and specific assembly techniques. The assembly activities will also include making all necessary checks and adjustments to ensure that components are correctly positioned and free from damage.

The learner's responsibilities will require them to comply with organisational policy and procedures for the assembly activities undertaken, and to report any problems with the assembly activities, components or equipment that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying commutator assembly techniques and procedures. The learner will understand the commutator being assembled, and its application, and will know about the assembly techniques, tools and methods, in adequate 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 assembly operations. 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.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
1 Assemble and fit commutators	1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 carry out all of the following during the assembly of the commutator: • use the correct assembly drawings, specifications and job instructions • adhere to risk assessment, COSHH and other relevant safety standards • ensure that components are free from damage, foreign objects, dirt or other contamination • check that all tools and equipment are within calibration date, where appropriate • use safe and approved techniques to assemble and fit commutator components • leave the work area in a safe and tidy condition 1.3 follow the relevant instructions, assembly drawings and any other specifications 1.4 ensure that the specified components are available and that they are in a usable condition 1.5 use the appropriate methods and techniques to assemble the components in their correct positions 1.6 secure the components using the specified connectors and securing devices			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.7 prepare and assemble commutators using all of the following: • commutator segments • insulating segments • sleeves • hubs • vee rings • tab washers • lock nuts 1.8 use all of the following equipment and tools for the assembly operations: • multimeter • impedance tester • tinning equipment • lathes • cutting tools • shaft supports • peening tools • jigs • clamps • dial test indicators			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.9 complete all of the following assembly procedures: • prepare materials (such as tinning segments) • assemble the components (such as segments and separators) • machine the assembled components • check mechanical integrity (such as longitudinal, radial position) • check electrical integrity (such as segment to segment, segments to hub) 1.10 check the completed assembly to ensure that all operations have been completed and the finished assembly meets the required specification 1.11 assemble rotating equipment to one of the following quality and accuracy standards: • organisational drawings and procedures • customer drawings and requirements • BS and ISO standards 1.12 deal promptly and effectively with problems within their control and report those that cannot be solved 1.13 complete the relevant documentation, to include one of the following, and pass it to the appropriate people: • job cards • work authorisation documents • assembly records • acceptance/test documentation			

Learning outcomes	**Assessment criteria**	**Evidence type**	**Portfolio reference**	**Date**
2 Know how to assemble and fit commutators	2.1 describe the health and safety requirements of the area in which the commutator assembly and insulating activity is to take place, and the responsibility these requirements place on the learner 2.2 describe the importance of wearing protective clothing and other appropriate safety equipment during the commutator assembly and insulating activities 2.3 describe the hazards associated with the type of assembly and insulating being undertaken, and how they can be minimised 2.4 explain how to obtain and interpret drawings, planning sheets and records and other documents needed for the assembly activities 2.5 describe the factors to be considered when choosing materials for commutator segments 2.6 describe the methods of attaching armature wire to the commutator 2.7 describe the methods used to fabricate commutator segments, and the tolerances required 2.8 describe the factors that influence the number of segments used 2.9 describe the procedure for tinning commutator segments 2.10 describe the methods used to machine the separators			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.11 describe the correct procedures for the assembly of segments and insulated separators 2.12 describe the precautions to be taken during assembly, with regard to longitudinal and radial position 2.13 describe the factors that influence the choice of peening tools 2.14 describe the procedures for fitting the assembly to mating components 2.15 describe the methods used to check for electrical integrity of the sub-assembly (such as segment to segment, segments to hub) 2.16 describe the importance of locking fasteners, and the type of fasteners to be used 2.17 describe the visual checks and preparation requirements for the components to be used 2.18 describe the methods and equipment used to transport, handle and lift the components into position, and how to check that the equipment is within its current certification dates 2.19 explain 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 the intended purpose 2.20 describe the reporting and documentation requirements relating to commutator assembly, and how to use them			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.21 describe the extent of their own responsibility, and to whom they should report if they have problems that they cannot resolve			

Learner name: ____________________ Date: ____________

Learner signature: ____________________ Date: ____________

Assessor signature: ____________________ Date: ____________

Internal verifier signature: ____________________ Date: ____________
(*if sampled*)

Unit 29: Balancing assembled rotors or armatures

Unit reference number: F/502/9257

QCF level: 3

Credit value: 30

Guided learning hours: 63

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to carry out static or dynamic balancing of rotor or armature assemblies, in accordance with approved procedures. The learner will be required to balance rotors or armatures from single-phase motors, three-phase motors or alternators. The learner will be required to carry out balancing tasks, select balancing equipment and tools, and to produce balanced rotors or armatures to specification.

The learner's responsibilities will require them to comply with organisational policy and procedures for the balancing activities undertaken, and to report any problems with these activities, or with the tools and equipment used that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a sound understanding of their work, and will provide an informed approach to applying balancing procedures to rotors or armatures. The learner will understand the electrical equipment being worked on, the balancing equipment to be used, and the various balancing procedures, in adequate depth to provide a sound basis for carrying out the activities to the required specification. In addition, the learner will be expected to review the outcome of the balancing activities, to compare the results with appropriate standards, to determine the action required and to record and report the results in the appropriate format.

The learner will understand the safety precautions required when carrying out the balancing activities. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
1 Balance assembled rotors or armatures	1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 carry out all of the following during the balancing activities: • use the correct drawings, specifications or job instructions • adhere to risk assessment, COSHH and other relevant safety standards • ensure that components are free from damage, foreign objects, dirt or other contamination • check that all tools and equipment are within calibration date, where appropriate • use safe and approved techniques to balance assembled rotors or armatures • leave the work area in a safe and tidy condition 1.3 follow the appropriate procedures for use of tools and equipment to carry out the required tests 1.4 set up and carry out the tests using the correct procedures and within agreed timescales			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.5 prepare for the balancing operations by carrying out all of the following: Either: • obtaining the appropriate balancing knives • levelling the balancing knives • mounting and setting the rotor or armature on a suitable mandrel (where appropriate) • placing the assembly on the balancing knives • rotating and checking the assembly for unbalance • marking the position of the unbalance • adding or removing material to produce a balanced assembly • rechecking and confirming that the assembly is within the balance specification Or: • obtaining the appropriate dynamic balancing equipment • checking that the equipment is set up and functioning correctly • mounting and setting the rotor or armature on a suitable mandrel (where appropriate) • securing the assembly on the balancing machine • spinning the assembly and checking the gauges for unbalance • marking the position of any unbalance • adding or removing material to produce a balanced assembly • rechecking and confirming that the assembly is within the balance specification			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.6 carry out balancing activities on two of the following types of electrical assemblies: • rotors • armatures • other rotating electrical assemblies 1.7 carry out balancing of rotor or armature assemblies, using one of the following methods: • static balancing • dynamic balancing 1.8 balance rotating electrical assemblies to one of the following quality and accuracy standards: • organisational requirements • customer requirements • BS and ISO standards 1.9 record the results of the tests in the appropriate format 1.10 complete the relevant documentation, to include one of the following, and pass it to the appropriate people: • job cards • work authorisation documents • material records • acceptance documentation 1.11 review the results and carry out further tests if necessary			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
2 Know how to balance assembled rotors or armatures	2.1 describe the health and safety requirements of the work area where they are carrying out the balancing activities, and the responsibility these requirements place on the learner 2.2 describe the specific safety precautions to be taken when carrying out static or dynamic balancing of rotors/armatures 2.3 describe the importance of wearing protective clothing and other appropriate safety equipment during the balancing activities 2.4 explain how to obtain and interpret drawings, physical layouts, specifications, and other documents needed in the balancing activities 2.5 describe the types of balancing equipment to be used, and their selection for particular types of rotor/armature (to include both static and dynamic types of equipment) 2.6 explain how to ensure that the balancing equipment is maintained and correctly calibrated, in accordance with the appropriate organisational procedures 2.7 explain how to set up the balancing equipment in readiness for the balancing operations 2.8 explain how to connect the appropriate balancing equipment for the measurement of static and dynamic balance 2.9 describe the importance of levelling during the balancing operations			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.10 explain why it is important that all rolling surfaces of balancing machines are clean, free of damage and lubricated 2.11 explain how to display/record balancing results, and describe the documentation to be used 2.12 explain how to interpret the value and significance of the balance/unbalance readings 2.13 describe the maximum residual unbalance permitted in the rotor or armature assemblies 2.14 explain how to identify the area of the assembly that is out of balance 2.15 describe the methods that can be used to add or remove weight to bring the assembly into balance 2.16 describe the importance of ensuring that balancing equipment is used only for its intended purpose and within its specified range and limits 2.17 describe the problems or errors that may occur, which could affect the balancing results, and how they can be avoided 2.18 describe the environmental control and company operating procedures relating to the balancing activities 2.19 describe the documentation required and the procedures to be observed following the balancing activity 2.20 describe the extent of their own responsibility, and to whom they should report if they have problems that they cannot resolve			

Learner name: ________________________________ Date: ______________________

Learner signature: ______________________________ Date: ______________________

Assessor signature: _____________________________ Date: ______________________

Internal verifier signature: _______________________ Date: ______________________
(*if sampled*)

Unit 30: Assembling and fitting electrical rotating equipment

Unit reference number: J/502/9258

QCF level: 3

Credit value: 50

Guided learning hours: 105

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to assemble electrical rotating equipment, such as motors, alternators or generators, in accordance with approved procedures. This will involve the assembly of a range of components, such as stators, bearings, seals, rotors/armatures, bushes, springs, dust covers, end plates, slip ring assemblies and cables with cooling fans, into the final motor or alternator/generator. The learner will be required to select the appropriate tools and equipment to use, based on the operations to be performed and type of components to be fitted, and to check that they are in a safe and serviceable condition. In carrying out the operations, the learner will be required to follow laid-down procedures and specific assembly techniques. The assembly activities will also include making all necessary checks and adjustments to ensure that components are correctly positioned and free from damage.

The learner's responsibilities will require them to comply with organisational policy and procedures for the assembly activities undertaken, and to report any problems with the assembly activities, components or equipment that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying assembly techniques and procedures to electrical rotating equipment. The learner will understand the electrical rotating equipment being assembled, and its application, and will know about the assembly techniques, tools and methods, in adequate 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 assembly operations. 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.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in Annexe D.

Assessment methodology

Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
1 Assemble and fit electrical rotating equipment	1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 carry out all of the following during the assembly and fitting of the electrical rotating equipment: • use the correct assembly drawings, specifications and job instructions • adhere to risk assessment, COSHH and other relevant safety standards • ensure that components are free from damage, foreign objects, dirt or other contamination • check that all tools and equipment are within calibration date, where appropriate • use safe and approved techniques to complete the final assembly and fitting of electrical rotating equipment • leave the work area in a safe and tidy condition 1.3 follow the relevant instructions, assembly drawings and any other specifications 1.4 ensure that the specified components are available and that they are in a usable condition 1.5 use the appropriate methods and techniques to assemble the components in their correct positions 1.6 secure the components using the specified connectors and securing devices			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.7 prepare and assemble electrical rotating equipment, using all of the following: • stators • bearings (such as rolling element, sleeve) • seals (such as lip, labyrinth) • rotors/armatures • cables (such as main, auxiliary) • brushes • springs • dust covers • cooling fans (where appropriate) • end plates • slip ring assemblies • lubricants • sealing compounds • fasteners/fixings 1.8 assemble two of the following types of electrical rotating equipment: • single-phase motors • multi-phase motors • alternators • generators			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.9 use twelve of the following items of equipment and tools for assembly operations: • multimeters • impedance tester • bearing removal devices • spanners • screwdrivers • wire cutters • electrical pliers • shaft supports • hammers or mallets • files • glass paper • spring tension indicator • dial test indicator • arbor press • lifting and slinging equipment			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.10 complete all of the following assembly procedures: • prepare components and materials • assemble components in the correct sequence • align and adjust components • set working clearance • fit bearings • fit seals • fit and adjust brushes • check that the work is to specification (eg freedom of rotation, effectiveness of seals, lubrication, insulation, earth impedance, alignment of bearing and rotor/armature shaft, brush and springs adjustment) 1.11 check the completed assembly to ensure that all operations have been completed and the finished assembly meets the required specification 1.12 assemble rotating equipment to one of the following quality and accuracy standards: • organisational drawings and procedures • customer drawings and requirements • BS and ISO standards 1.13 deal promptly and effectively with problems within their control and report those that cannot be solved			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.14 complete the relevant documentation, to include one of the following, and pass it to the appropriate people: • job cards • work authorisation documents • assembly records • acceptance/test documentation			
2 Know how to assemble and fit electrical rotating equipment	2.1 describe the health and safety requirements of the area in which the electrical assembly is to take place, and the responsibility these requirements place on the learner 2.2 describe the importance of wearing protective clothing and other appropriate safety equipment during the electrical assembly activities 2.3 describe the hazards associated with the type of electrical assembly being undertaken 2.4 explain how to obtain and interpret drawings, planning sheets and records and other documents needed for the assembly activities 2.5 describe the factors to consider when fitting a wound stator into a frame 2.6 describe the factors influencing the choice of bearing components and seals 2.7 describe the correct procedures for the fitting of bearing components and seals, and the grades of lubricant to be used with them			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.8 describe the assembly methods and techniques to be used when assembling rotating equipment (such as alignment, tolerances for fitting bearings, use of arbor press, winding configuration, fitting brushes and springs) 2.9 describe the procedure for fitting slip rings 2.10 describe the factors to be considered when fitting dust covers 2.11 explain why contamination should be avoided when working with lubricants and seals 2.12 describe the methods used to identify the phase configuration of stators 2.13 explain how star-wired and delta-wired stators are identified 2.14 describe the methods and equipment used to measure brush spring tension 2.15 describe the visual checks and preparation requirements for the components to be used 2.16 describe the methods and equipment used to transport, handle and lift the components into position, and how to check that the equipment is within its current certification dates 2.17 explain 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 the intended purpose			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.18 describe the reporting and documentation requirements relating to electrical assembly, and how to use them 2.19 describe the extent of their own responsibility, and to whom they should report if they have problems that they cannot resolve			

Learner name: ________________________ Date: ________________

Learner signature: ________________________ Date: ________________

Assessor signature: ________________________ Date: ________________

Internal verifier signature: ________________________ Date: ________________
(*if sampled*)

Unit 31: Mounting electrical components in enclosures

Unit reference number: L/502/9259

QCF level: 3

Credit value: 55

Guided learning hours: 133

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to mount electrical components in enclosures, in accordance with approved procedures. The final enclosure could be used for distribution equipment, switchgear or control systems. The rated operating voltage of the completed assembly will not exceed 1500 volts DC, or 1000 volts AC, at frequencies not exceeding 1000 Hertz. The learner will be required to select the appropriate tools and equipment to use, based on the operations to be performed and type of components to be installed, and to check that they are in a safe and serviceable condition.

In carrying out the operations, the learner will be required to follow laid-down procedures and specific assembly techniques, in order to mount various components into enclosures, such as component panels, isolator switches, fuses/MCBs, contactors, relays, bases for plug-in devices, rail-mounted terminal blocks, trunking, earthing bonding, and sub-assemblies such as power supplies, card racks, and process controller units. The mounting activities will also include making all necessary checks and adjustments to ensure that components are correctly positioned and free from damage.

The learner's responsibilities will require them to comply with organisational policy and procedures for the assembly activities undertaken, and to report any problems with the activities, components or equipment that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying assembly techniques and procedures to the mounting of electrical components in enclosures. The learner will understand the distribution equipment, switchgear or control systems being assembled, their application and the assembly techniques used. The learner will know about the components used, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

The learner will understand the safety precautions required when mounting electrical components in enclosures. 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.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
1 Mount electrical components in enclosures	1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 carry out all of the following during the mounting of the electrical components: • use the correct assembly drawings, specifications and job instructions • adhere to risk assessment, COSHH and other relevant safety standards • ensure that the components are free from damage, foreign objects, dirt or other contamination • check that all tools and equipment are within calibration date (where appropriate) • prepare the electrical components and enclosures for the assembly operations • use safe and approved techniques to mount the electrical components in the enclosures • leave the work area in a safe and tidy condition 1.3 follow the relevant instructions, assembly drawings and any other specifications 1.4 ensure that the specified components are available and that they are in a usable condition 1.5 use the appropriate methods and techniques to assemble the components in their correct positions 1.6 secure the components using the specified connectors and securing devices			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.7 mount electrical components into enclosures, to include twenty of the following items: • enclosure partitions • component mounting plates • labels component marking • trunking • conduit • contactors • overload and other relays • transformers/chokes • circuit breakers/fuses • panel meters (voltage, current) • terminal blocks/junction boxes • safety interlocks • bases for plug-in devices • switches (push button, toggle) • capacitors • resistors • rectifiers • timers • power supplies • circuit boards • thermistors/thermocouples • indicators (lamps, LEDs) • thermostats			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	• busbars • soft starters • variable speed drives • limit switches • sensors • programmable controllers • plugs/sockets • grommets/grommet strip • lighting fixtures • batteries • connector rails • solenoids • other specific components 1.8 carry out eight of the following activities during the mounting of the electrical components: • setting working clearance • drilling • filing • riveting • sawing/cutting • forming • measuring • aligning components • torque setting			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	• earth bonding • securing using mechanical fasteners / threaded devices • punching • applying sealants/adhesives • clamping • crimping • component marking • making belt connections • making screw connections 1.9 check the completed assembly to ensure that all operations have been completed and the finished assembly meets the required specification 1.10 carry out quality checks, to include seven of the following: • positional accuracy • dimensions • orientation • alignment • component security • completeness • freedom from damage and foreign objects • operating clearance • electrical continuity/earthing checks			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.11 assemble electrical components in enclosures, to one of the following quality and accuracy standards: • organisational drawings and procedures • customer drawings and requirements • IEE wiring regulations • BS and ISO standards 1.12 deal promptly and effectively with problems within their control and report those that cannot be solved 1.13 complete the relevant documentation, to include one of the following, and pass it to the appropriate people: • job cards • work authorisation documents • assembly records • acceptance/test documentation			

Learning outcomes	Assessment criteria		Evidence type	Portfolio reference	Date
2. Know how to mount electrical components in enclosures	2.1	describe the health and safety requirements of the area in which the electrical assembly activity is to take place, and the responsibility these requirements place on the learner			
	2.2	describe the importance of wearing protective clothing and other appropriate safety equipment during electrical component mounting activities			
	2.3	describe the hazards associated with the type of assembly being undertaken			
	2.4	explain how to obtain and interpret drawings, circuit and physical layouts, charts, specifications, graphical electrical symbols, IEE wiring regulations, and other documents needed for the electrical component mounting activities			
	2.5	describe the assembly methods and techniques to be used when mounting electrical distribution equipment, switchgear or control systems (such as soldering, lacing/strapping of wires, crimping)			
	2.6	describe the type of components and sub-assemblies that are used in the assembly activities (such as contactors, relays, circuit breakers/fuses, solenoids, switches, transformers, ballast chokes, terminal blocks, sub-assemblies)			
	2.7	describe the preparations to be undertaken on the components and enclosure, prior to the mounting activities			

Learning outcomes	Assessment criria		Evidence type	Portfolio reference	Date
	2.8	explain how the components are to be aligned and positioned prior to securing, and the tools and equipment that are used			
	2.9	describe the methods of attaching identification markers/labels during electrical assembly activities			
	2.10	explain how to conduct any necessary checks to ensure the accuracy and quality of the assembly produced			
	2.11	describe the visual checks and preparation requirements for components to be used in the electrical assembly activities			
	2.12	explain how to recognise and identify any orientation requirements for all electrical distribution equipment, switchgear or control system components used in the assembly activities			
	2.13	describe the methods and equipment used to transport, handle and lift the components into position, and how to check that the equipment is within its current certification dates			
	2.14	describe the methods and techniques used to prepare enclosures and the electrical distribution equipment, switchgear or control systems equipment to be used in the assembly activities (such as removing and storing enclosure doors, cleaning parts, removing packaging, adding protective covers)			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.15 explain 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 the intended purpose 2.16 describe the reporting and documentation requirements relating to enclosure assembly, and how to use them 2.17 describe the extent of their own responsibility, and to whom they should report if they have problems that they cannot resolve			

Learner name: ______________________________ Date: ____________________

Learner signature: ___________________________ Date: ____________________

Assessor signature: __________________________ Date: ____________________

Internal verifier signature: ____________________ Date: ____________________
(*if sampled*)

Unit 32: Wiring electrical components and equipment in enclosures

Unit reference number: F/502/9260

QCF level: 3

Credit value: 60

Guided learning hours: 147

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to wire electrical components and equipment in enclosures, in accordance with approved procedures. The final enclosure could be used for distribution equipment, switchgear or control systems. The rated operating voltage of the completed assembly will not exceed 1500 volts DC or 1000 volts AC, at frequencies not exceeding 1000 Hertz. The learner will be required to select the appropriate tools and equipment to use, based on the operations to be performed and type of components to be wired, and to check that they are in a safe and serviceable condition.

In carrying out the operations, the learner will be required to follow laid-down procedures and specific assembly techniques, in order to wire various components in enclosures, such as isolator switches, fuses/circuit breakers, contactors, relays, bases for plug-in devices, rail-mounted terminal blocks, trunking, earthing bonding, and sub-assemblies, such as power supplies, card racks, process controller units. The activities will also include making all necessary checks and adjustments to ensure that components are free from damage following the wiring operations.

The learner’s responsibilities will require them to comply with organisational policy and procedures for the wiring activities undertaken, and to report any problems with the activities, components or equipment that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner’s knowledge will provide a good understanding of their work, and will provide an informed approach to applying wiring techniques and procedures to electrical components. The learner will understand the distribution equipment, switchgear or control systems being wired, their application and the wiring techniques used. The learner will know about the components used, in adequate depth to provide a sound basis for carrying out the wiring activities to the required specification.

The learner will understand the safety precautions required when carrying out the wiring operations. 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.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
1 Wire electrical components and equipment in enclosures	1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 carry out all of the following during the wiring activities: • use the correct assembly drawings, specifications and job instructions • adhere to risk assessment, COSHH and other relevant safety standards • ensure that components and equipment used are free from damage, foreign objects, dirt or other contamination • use safe and approved techniques to wire electrical components and equipment in enclosures • leave the work area in a safe and tidy condition 1.3 follow the relevant instructions, assembly drawings and any other specifications 1.4 ensure that the specified components are available and that they are in a usable condition 1.5 use the appropriate methods and techniques to assemble the components in their correct positions 1.6 secure the components using the specified connectors and securing devices			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.7 terminate and join cables/wires to ten of the following components: • contactors • overload and other relays • transformers/chokes • circuit breakers/fuses • panel meters (voltage, current) • terminal blocks/junction boxes • switches (push button, toggle) • capacitors • resistors • rectifiers • timers • power supplies • circuit boards • thermistors/thermocouples • indicators (lamps, LEDs) • thermostats • busbars • soft starters • variable speed drives • bases for plug-in devices • limit switches • programmable controllers			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	• plugs/sockets • lighting fixtures • batteries • sensors • solenoids • other specific components 1.8 use all of the following methods and techniques (and the appropriate tools) during the wiring activities: • cable forming/bending • cable supporting/tying • cable/wire clamping • cable protection (such as sleeving, grommets) • cable/wire crimping • insulation stripping • locking and retaining devices (such as cable ties, clips, proprietary fasteners) • screwed connections • soldering (where appropriate) • cable routing • torque setting of fasteners • connecting pre-formed looms • wire marking/colour coding			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.9 use two of the following cable/wire types: • single core cable • multicore cable • laminated copper • data/communication cable • mineral insulated cable • screened cable • fibre optic • braided copper • twisted pair/ribbon cable • other specialist cable 1.10 check the completed assembly to ensure that all operations have been completed and the finished assembly meets the required specification 1.11 check all of the following on the completed assembly: • location and position of items (such as components, labels, trunking covers, doors, cages) • continuity of cable/wiring connections (such as battery and lamp checks) • function of mechanical interlocks/switches • mechanical operation of overload protection devices • enclosure free of debris (such as cable offcuts/insulation, enclosure/trunking breakouts)			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.12 assemble electrical components in enclosures, to one of the following quality and accuracy standards: • organisational drawings and procedures • customer drawings and requirements • IEE wiring regulations • BS and ISO standards 1.13 deal promptly and effectively with problems within their control and report those that cannot be solved 1.14 complete the relevant documentation, to include one of the following, and pass it to the appropriate people: • job cards • work authorisation documents • assembly records • acceptance/test documentation			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
2 Know how to wire electrical components and equipment in enclosures	2.1 describe the health and safety requirements of the area in which the electrical wiring activity is to take place, and the responsibility these requirements place on the learner 2.2 describe the importance of wearing protective clothing and other appropriate safety equipment during the electrical wiring activities 2.3 describe the hazards associated with the type of assembly being undertaken, and how they can be minimised 2.4 explain how to obtain and interpret drawings, circuit and physical layouts, charts, specifications, graphical electrical symbols, IEE wiring regulations, and other documents needed for the electrical wiring activities 2.5 describe the basic principle of operation of the equipment/circuits being wired, and the purpose of individual components within the circuit 2.6 describe the different types of cabling, and their application (such as multicore cables, single core cables, single insulated, double insulated, steel wire armoured (SWA), mineral insulated (MI), screened cables) 2.7 describe the application and use of a range of electrical components (such as contactors, switches, relays, solenoids junction boxes) 2.8 describe the assembly methods and techniques to be used when wiring electrical distribution equipment, switchgear or control systems (such as cable stripping, soldering, crimping)			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.9 describe the different types, applications, and methods of attaching identification markers/labels during the electrical wiring activities 2.10 describe the visual checks and preparation requirements for the components to be wired 2.11 explain how to identify any orientation requirements, values or polarity for the components used in the electrical wiring activities 2.12 explain how to use appropriate lifting and handling equipment in the electrical wiring activities 2.13 describe the methods and techniques used to prepare the electrical distribution equipment, switchgear or control systems equipment to be wired 2.14 explain how to check that tools and equipment are free from damage or defects, are in a safe and usable condition, and are configured correctly/calibrated for the intended purpose 2.15 describe the reporting and documentation requirements relating to the electrical component and equipment wiring, and how to use them 2.16 describe the extent of their own responsibility, and to whom they should report if they have problems that they cannot resolve			

Learner name: ______________________________ Date: ______________________

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Assessor signature: ______________________________ Date: ______________________

Internal verifier signature: ______________________________ Date: ______________________
(*if sampled*)

Unit 33: Selecting and preparing materials and components for electrical assembly

Unit reference number: J/502/9261

QCF level: 3

Credit value: 18

Guided learning hours: 63

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to select and prepare materials and components for electrical assembly and wiring work, on electrical distribution equipment, switchgear or control systems, in accordance with approved procedures. The learner will be expected to identify which materials and components are needed, to obtain them in the quantities required, to check their condition, review the need for and undertake any specific treatments or preparatory actions which may be required.

The learner's responsibilities will require them to comply with organisational policy and procedures for the material selection and preparation activities undertaken, and to report any problems with the activities, materials, components or equipment that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying material selection and preparation procedures prior to electrical assembly activities. The learner will be expected to know about specific material characteristics, in sufficient depth to determine if the materials are suitable for the intended application. The learner will understand the preparations required to be carried out on the materials, in order to ensure that they are ready for the assembly activities. The learner will understand the work requirement, and its application, and will know about the overall manufacturing operations, in adequate depth to provide a sound basis for carrying out the preparation activities to the required specification.

The learner will understand the safety precautions required when preparing the materials, and will be aware of potential hazards and how to minimise the associated risks. The learner will be expected to apply safe working practices at all times, and will understand the responsibility they owe to themselves and others in the workplace.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
1 Select and prepare materials and components for electrical assembly	1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 carry out all of the following during the selection and preparation of the materials and components: • use the correct issue of specifications, job instructions and procedures • use grounded wrist straps and other electrostatic discharge (ESD) precautions, as appropriate • requisition/obtain all materials/parts • prepare materials and components in line with organisational procedures • use relevant COSHH sheets and risk assessments • pass details of the preparations to the relevant people 1.3 obtain the required materials and check them for quantity and quality 1.4 select and prepare materials and components for the assembly of one of the following electrical systems: • electrical distribution equipment • electrical switchgear • control equipment/systems 1.5 determine how the materials need to be prepared			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.6 obtain all of the following material/component specifications from appropriate company information sources: • documentation (such as work orders, contracts, memos, plans/designs, purchase orders) • standard operating procedures (such as process control sheets/charts, quality standards) • material/component supplier information • production schedules 1.7 carry out the preparations using suitable equipment 1.8 prepare all of the following materials/components for the manufacturing operations: • consumable materials (such as chemicals for cleaning, solder, cable/wire, strapping, wipes, crimps) • components to be used (such as contactors, relays, transformers, switches, fuses, panels, looms, sockets) • materials to be used (such as conduit, trunking, tray work) • fastening devices (such as screws, cable terminations)			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.9 carry out all of the following preparations on the materials/components to be used: • check the condition of materials and components (such as types as specified, freedom from obvious signs of damage, within specified use dates) • conduct preparatory treatments of components (such as cleaning with chemical solutions, removal of packaging) • set out materials and components for use • obtain special purpose tools, where appropriate (such as heavy duty crimping tool, plug/socket crimping tool) 1.10 report completion of preparations in line with organisational procedures 1.11 complete the relevant documentation, to include one of the following, and pass it to the appropriate people: • job cards • work authorisation documents • material records • acceptance documentation 1.12 deal promptly and effectively with problems within their control and report those that cannot be solved			

Learning outcomes	Assessment criteria		Evidence type	Portfolio reference	Date
2 Know how to select and prepare materials and components for electrical assembly	2.1	describe the specific safety precautions to be taken when selecting and preparing materials for electrical assembly and wiring operations			
	2.2	describe the personal protective equipment that be worn while selecting and preparing materials and components (such as protective suits, rubber gloves, eye protection, foot protection, respiratory equipment when handling chemicals)			
	2.3	describe the hazards associated with preparing the materials for the electrical assembly and wiring activities, and how they can be minimised			
	2.4	describe the materials required and preparations needed for the various components and assemblies used in the electrical assembly and wiring operations			
	2.5	describe the safe handling requirements for materials and consumables, and how they relate to COSHH regulations (such as chemicals giving off fumes)			
	2.6	describe the preparation requirements for the selected materials and components			
	2.7	explain how to obtain and use the organisational requirements/information for their electrical assembly and wiring activities			

Learning outcomes		Assessment criteria	Evidence type	Portfolio reference	Date
	2.8	describe the problems that can occur, and what can be done about them when selecting and preparing materials and components for the work areas and activities concerned (such as non-availability of components, obsolete components/materials, and components/materials in poor condition)			
	2.9	describe the preparations required for the area of work concerned, and how to undertake such preparations			
	2.10	explain how to record and report the completion of the selection and preparation activities			
	2.11	describe the extent of their own responsibility, and to whom they should report if they have problems that they cannot resolve			

Date: ____________________________

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Assessor signature: _______________________________________ Date: ____________________________

Internal verifier signature: _________________________________ Date: ____________________________
(*if sampled*)

Unit 34: Carrying out functional tests on electrical equipment

Unit reference number: L/502/9262

QCF level: 3

Credit value: 50

Guided learning hours: 105

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to carry out functional tests on electrical equipment, in accordance with approved procedures. The learner will be required to carry out pre-test inspections, and tests of electrical rotating, power or control equipment, to establish that it is functioning at optimal level and to specification. The learner will be required to select and use a range of electrical test instruments to ensure that the equipment is operating within the defined limits.

The learner's responsibilities will require them to comply with organisational policy and procedures for the testing activities undertaken, and to report any problems with these activities, or with the tools and equipment used that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a sound understanding of their work, and will provide an informed approach to applying test procedures to electrical equipment and circuits. The learner will understand the equipment being worked on, the test equipment to be used, and the various test procedures, in adequate depth to provide a sound basis for carrying out the activities to the required specification. In addition, the learner will be expected to review the outcome of the tests, to compare the results with appropriate standards, to determine the action required, and to record and report the results in the appropriate format.

The learner will understand the safety precautions required when carrying out the inspection and testing activities, especially those for isolating the equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others against direct and indirect electric shock.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
1 Carry out functional tests on electrical equipment	1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 carry out all of the following during the testing activities: • use the correct issue of company and/or manufacturers' drawings and testing documentation • adhere to risk assessment, COSHH and other relevant safety standards • check that test equipment is correctly calibrated and appropriate for the tests to be carried out • provide safe access and working arrangements for the testing area • carry out pre-test inspection, using appropriate techniques and procedures • operate test equipment within its specification range • dispose of waste items in a safe and environmentally acceptable manner • leave the work area in a safe and tidy condition 1.3 follow the appropriate procedures for use of tools and equipment to carry out the required tests			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.4 carry out functional tests using four of following tools and test equipment: • multimeter • ohmmeter • ammeter • voltmeter • oscilloscope • insulation resistance tester • loop impedance tester • current injection tester • residual current device (RCD) tester • portable appliance tester (PAT) • flash tester • specialist test equipment (such as paint thickness meter, EMC meter) 1.5 set up and carry out the tests using the correct procedures and within agreed timescales 1.6 carry out functional tests on one of the following types of electrical equipment: • rotating equipment (such as single/three-phase motors, alternators) • power equipment (such as large transformers/inductors) • control equipment (such as switchgear, distribution equipment)			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.7 use the relevant test equipment to measure and check five of the following: • protective resistance values • insulation resistance values • current levels • voltage detection/levels • earth continuity • power rating • resistance • capacitance • inductance • frequency values • power factor • safety device trip speed • specialised tests (such as speed, sound levels, temperature, interference) 1.8 check that the equipment being tested meets one of the following quality and accuracy standards: • BS or ISO standards and procedures • customer standards and requirements • company standards and procedures • specific system requirement 1.9 record the results of the tests in the appropriate format			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.10 complete the relevant documentation, to include one of the following, and pass it to the appropriate people: • customer report • company report • job card • acceptance documentation 1.11 review the results and carry out further tests if necessary			
2 Know how to carry out functional tests on electrical equipment	2.1 describe the health and safety requirements of the work area where they are carrying out the functional testing activities, and the responsibility these requirements place on the learner 2.2 describe the equipment isolation and lock-off procedure that applies to the functional testing activities 2.3 describe the specific safety precautions to be taken when carrying out functional testing of electrical equipment 2.4 describe the hazards of carrying out functional tests on electrical equipment, and how they can be minimised			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.5 explain how to recognise and deal with victims of electrical shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first-aid resuscitation) 2.6 describe the importance of wearing protective clothing and other appropriate safety equipment during the electrical testing activities 2.7 describe the protection techniques used for electrical systems (such as to prevent burn or fire risk) 2.8 explain how to obtain and interpret drawings, circuit and physical layouts, charts, specifications, manufacturers' manuals, history/maintenance reports, graphical electrical symbols, IEE wiring regulations, and other documents needed for the testing activities 2.9 describe the types of test equipment to be used, and their selection for particular types of tests 2.10 explain how to ensure that the test equipment is maintained and correctly calibrated, in accordance with the appropriate organisational procedures 2.11 explain how to connect the appropriate test equipment (such as for the measurement of resistance, current, voltage, power, capacitance, inductance, frequency, power factor, and protective device disconnection/trip times)			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.12 describe the various testing methods and procedures, as recommended in approved electrical codes of practice, and how to apply them to different operating conditions 2.13 explain how to display/record test results, and describe the documentation to be used 2.14 explain how to interpret the value and significance of the test readings 2.15 explain how to analyse test results, using tables in approved electrical codes of practice, and how to use comparison and sequential techniques 2.16 describe the importance of ensuring that test equipment is used only for its intended purpose, and within its specified range and limits 2.17 describe the problems or errors that could occur and which may affect the test results, and how they can be avoided 2.18 describe the environmental control and company operating procedures relating to the testing activities 2.19 describe the documentation required, and the procedures to be observed following the test 2.20 describe the extent of their own responsibility, and to whom they should report if they have problems that they cannot resolve			

Learner name: ______________________________ Date: ____________________

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Unit 35: Locating and diagnosing faults in electrical systems and equipment

Unit reference number: R/502/9263

QCF level: 3

Credit value: 50

Guided learning hours: 105

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to investigate, locate and diagnose the cause of faults on electrical systems and equipment, in accordance with approved procedures. The learner will be to locate and diagnose faults in electrical rotating, power or control equipment. In addition, the learner will be required to select and use test instruments, review fault symptoms, interpret technical data, apply systematic fault finding procedures, and record their findings.

The learner's responsibilities will require them to comply with organisational policy and procedures for the fault diagnostic activities undertaken, and to report any problems with the activities or with the tools and equipment used, that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision taking full responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying fault diagnostic techniques and procedures. The learner will understand the diagnostic techniques and associated equipment, and their application, and will know about the electronics products, in adequate depth and breadth 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 fault diagnostic activities. 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.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
1 Locate and diagnose faults in electrical systems and equipment	1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 satisfy all of the following requirements during fault location/diagnosis activities on electronic products: • use the correct issue of drawings, job instructions and specifications • follow risk assessment procedures and COSHH regulations • use grounded wrist straps and other electrostatic discharge (ESD) precautions, as appropriate • carry out the fault location/diagnosis activities, in line with organisational procedures • create and store records, in accordance with appropriate procedures 1.3 review and use all relevant information on the symptoms and problems associated with the products or assets 1.4 collect fault diagnosis evidence from two of the following sources: • test instrument measurements • circuit meters • circuit self-diagnosis • recording devices (such as shock, vibration, humidity, temperature) • sensory input (such as sight, sound, smell, touch)			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.5 use two of the following sources of technical information to assist with fault finding activities: • technical manual/specification • engineering drawings • flowcharts/fault algorithms • wiring/circuit diagrams • logic diagrams • fault finding/trouble shooting guides 1.6 investigate and establish the most likely causes of the faults 1.7 select, use and apply diagnostic techniques, tools and aids to locate faults 1.8 use two of the following fault diagnostic techniques: • half-split technique • input/output technique • six point technique • unit substitution • injection and sampling • emergent sequence • function testing			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.9 use all the following fault diagnosis procedures: • inspection (such as breakages, signs of overheating, missing parts, loose fitting, dry joints) • operation (such as manual switching off and on, automatic switching/timing/sequencing, outputs) • measurement (such as voltage, current, continuity, logic states, noise, frequency, signal shape and level) 1.10 identify and locate two of the following categories of fault: • intermittent component/circuit failure • partial failure/reduced performance • complete component/circuit failure 1.11 conduct fault diagnosis on one of the following categories of electrical equipment: • rotating equipment (such as single/three-phase motors, alternators) • power equipment (such as large transformers/inductors) • control equipment (such as switchgear, distribution equipment) 1.12 complete the fault diagnosis within the agreed time and inform the appropriate people when this cannot be achieved			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.13 determine the implications of the fault for other work and for safety considerations 1.14 use the evidence gained to draw valid conclusions about the nature and probable cause of the fault 1.15 record details on the extent and location of the faults in an appropriate format 1.16 complete the relevant paperwork, to include one of the following, and pass it to the appropriate person: • customer report • company report • job card			
2 Know how to locate and diagnose faults in electrical systems and equipment	2.1 describe the specific safety precautions to be taken when carrying out fault location and diagnosis on electrical equipment and systems 2.2 describe the personal protective equipment to be worn while carrying out the fault diagnosis (such as protective clothing, eye and hearing protection, anti-static devices) 2.3 describe the hazards associated with the electrical components equipment and systems being investigated (such as heat, radiation, high voltages on equipment) 2.4 explain how to recognise and deal effectively in the workplace with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first-aid resuscitation)			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.5 explain how to obtain the necessary authority to conduct fault location and diagnosis in the relevant work areas, and any specific permit-to-work procedures that are required 2.6 explain how to obtain and use data that relates to the fault diagnostic activities 2.7 explain how to check the calibration status of authorised test facilities and test equipment to be used 2.8 describe the various fault diagnosis and location techniques that are used (such as six point, emergent problem, input/output, half-split techniques and algorithm charts/tables) 2.9 explain how to set up, care for and use the range of test equipment needed for the fault location (such as logic and waveform analysis equipment, oscilloscopes, signal generators, sensing and measuring devices, current, voltage and resistance measuring instruments) 2.10 explain how to read and interpret circuit diagrams and related symbols 2.11 explain how to recognise, read values and, where appropriate, the polarity of electrical components 2.12 describe the basic operating principles of the electrical components, systems and equipment being diagnosed			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.13 explain how to recognise defects/problems (such as manufacturing stages, components to be assembled/processed) 2.14 explain how to analyse and evaluate the results of the fault diagnosis checks carried out 2.15 describe the faults that can occur, and typical actions needed to deal with them (such as short and open circuits, problems at the hardware/software interface in equipment with embedded software) 2.16 describe the company reporting and documentation requirements relating to fault investigation, and how to use them 2.17 describe the extent of their own responsibility, and to whom they should report if they have problems that they cannot resolve			

Learner name: ________________________ Date: ______________

Learner signature: ________________________ Date: ______________

Assessor signature: ________________________ Date: ______________

Internal verifier signature: ________________________ Date: ______________

(*if sampled*)

Unit 36: Checking the compliance of electrical equipment against the specification

Unit reference number: Y/502/9264

QCF level: 3

Credit value: 20

Guided learning hours: 56

Unit summary

This unit covers the skills and knowledge needed to prove the competences required to carry out compliance checks on electrical equipment, in accordance with approved procedures. The learner will be required to check that electrical rotating, power or control equipment complies with specification, on a system with a single phase, three-phase or direct current power circuit. The learner will be responsible for confirming that the electrical equipment is complete, fit for purpose, and meets the operational performance required by the specification. The learner will also be required to complete any relevant documentation, accurately and legibly.

The learner's responsibilities will require them to comply with organisational policy and procedures for checking the electrical equipment, and to report any problems with the equipment they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to ensure that all tools and equipment used in checking the equipment are correctly accounted for on completion of the activities and returned to the correct location. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying compliance checking techniques and procedures including, where appropriate, to British, European and international quality standards. The learner will understand the electrical equipment being checked, and its application, and will know about the tools and equipment used to check the equipment, in adequate depth to provide a sound basis for carrying out the activities to the required specification. The learner will understand the types of defect that can be found on the equipment, and how critical these defects are in determining the satisfactory performance of the equipment.

The learner will understand the safety precautions required when carrying out the compliance checking activities, especially those for isolating the equipment. 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.

Assessment requirements/evidence requirements

This unit must be assessed in a work environment and must be assessed in accordance with the 'Semta Assessment Strategy'. Detailed information is given in *Annexe D*.

Assessment methodology

Learners can enter the types of evidence they are presenting for assessment and the submission date against each assessment criterion. Alternatively, centre documentation should be used to record this information.

Learning outcomes and assessment criteria

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
1 Check the compliance of electrical equipment against the specification	1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 carry out all of the following during the compliance checking activities: • use the correct issue of drawings, job instructions and specifications • check the calibration dates of tools and measuring instruments to be used • ensure that all components are free from foreign objects, dirt or other contamination • use appropriate and safe inspection and checking techniques at all times • check that electrical system wiring and connections are to specification • leave the work area in a safe and tidy condition 1.3 follow and make appropriate use of the specifications for the product or asset being checked 1.4 use all the correct tools and inspection equipment and check that they are in usable condition			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.5 use the relevant tools, equipment and techniques to measure and check seven of the following: • positional accuracy • dimensions • orientation • alignment • security of component fixing/mounting • equipment completeness • freedom from damage and foreign objects • operating clearance • electrical continuity • resistance/insulation values 1.6 carry out the checks in an appropriate sequence using approved methods and procedures 1.7 check electrical equipment powered by one of the following: • single-phase power circuit • three-phase power circuit • direct current power circuit			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	1.8 carry out compliance checks one of the following types of electrical equipment: • rotating equipment (such as single-/three-phase motors, alternators) • power equipment (such as transformers/inductors) • process control equipment (such as switchgear, distribution equipment) 1.9 identify and assess any defects or variations from the specification and take appropriate action 1.10 check that the electrical equipment complies with one of the following quality and accuracy standards: • BS or ISO standards and procedures • customer standards and requirements • company standards and procedures • specific system requirements 1.11 report completion of compliance activities in line with organisational procedures 1.12 complete the relevant 'sign-off' procedure, using one of the following, and pass it to the appropriate people: • customer report • company report • job card			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
2 Know how to check the compliance of electrical equipment against the specification	2.1 describe the specific safety precautions to be taken while carrying out the electrical compliance checks, including any specific legislation, regulations or codes of practice relating to the activities, equipment or materials			
	2.2 describe the health and safety requirements of the work area in which they are carrying out the compliance checking activities, and the responsibility these requirements place on the learner			
	2.3 explain the COSHH regulations with regard to any substances used in the equipment or the compliance checking process			
	2.4 describe the hazards associated with checking electrical compliance, and how they can be minimised			
	2.5 describe the personal protective equipment and clothing to be worn during the compliance checking activities			
	2.6 explain how to extract and use information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS or ISO standards) in relation to the work undertaken			
	2.7 describe the use of British, European and International standards in determining if electrical equipment is fit for purpose			
	2.8 describe the general principles of quality assurance systems and associated procedures			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.9 describe the various stages when the electrical equipment should be checked, and to what level 2.10 describe the preparations to be undertaken before the equipment is checked 2.11 describe the application of the various tools and equipment used to check the compliance of the electrical equipment 2.12 describe the importance of ensuring that tools and equipment are set up correctly, and are in a safe and usable condition 2.13 describe the procedures and methods used to check that tools and equipment are within their calibration dates 2.14 describe the quality control procedures to be followed when checking the compliance of the electrical equipment 2.15 explain how to conduct any necessary checks to ensure the safety, accuracy, position, security, function and completeness of the electrical equipment 2.16 describe the types of defect that can be found on electrical equipment, why they occur, and how they can be avoided 2.17 explain how to detect assembly defects in electrical equipment, and what to do to rectify them			

Learning outcomes	Assessment criteria	Evidence type	Portfolio reference	Date
	2.18 describe the documentation to be completed to confirm that the electrical equipment has been properly checked 2.19 describe the importance of ensuring that all tools and equipment are returned to their correct location on completion of the compliance checking activities 2.20 describe the extent of their own responsibility, and to whom they should report if they have problems that they cannot resolve			

Learner name: ______________________ Date: ______________

Learner signature: ______________________ Date: ______________

Assessor signature: ______________________ Date: ______________

Internal verifier signature: ______________________ Date: ______________
(*if sampled*)

Further information

Our customer service numbers are:

BTEC and NVQ	0844 576 0026
GCSE	0844 576 0027
GCE	0844 576 0025
The Diploma	0844 576 0028
DiDA and other qualifications	0844 576 0031

Calls may be recorded for training purposes.

Useful publications

Related information and publications include:

- *Centre Handbook for Edexcel QCF NVQs and Competence-based Qualifications* published annually
- functional skills publications – specifications, tutor support materials and question papers
- *Regulatory Arrangements for the Qualification and Credit Framework* (published by Ofqual, August 2008)
- the current Edexcel publications catalogue and update catalogue.

Edexcel publications concerning the Quality Assurance System and the internal and standards verification of vocationally related programmes can be found on the Edexcel website.

NB: Some of our publications are priced. There is also a charge for postage and packing. Please check the cost when you order.

How to obtain National Occupational Standards

To obtain the National Occupational Standards go to www.ukstandards.org.uk or www.semta.org.uk.

Professional development and training

Edexcel supports UK and international customers with training related to NVQ and BTEC qualifications. This support is available through a choice of training options offered in our published training directory or through customised training at your centre.

The support we offer focuses on a range of issues including:

- planning for the delivery of a new programme
- planning for assessment and grading
- developing effective assignments
- building your team and teamwork skills
- developing student-centred learning and teaching approaches
- building functional skills into your programme
- building effective and efficient quality assurance systems.

The national programme of training we offer can be viewed on our website (www.edexcel.com/training). You can request customised training through the website or by contacting one of our advisers in the Training from Edexcel team via Customer Services to discuss your training needs.

The training we provide:

- is active
- is designed to be supportive and thought provoking
- builds on best practice
- may be suitable for those seeking evidence for their continuing professional development.

Annexe A: Progression pathways

The Edexcel qualification framework for the engineering sector

Level	General qualifications	Diplomas	BTEC vocationally-related qualifications	BTEC specialist qualification/ professional	NVQ/competence
8					
7					
6					We have too many qualifications to list in this space. Please go to www.edexcel.com for further information.

Level	General qualifications	Diplomas	BTEC vocationally-related qualifications	BTEC specialist qualification/ professional	NVQ/competence
5			Edexcel BTEC Level 5 HND Diploma in Manufacturing Engineering Edexcel BTEC Level 5 HND Diploma in Mechanical Engineering Edexcel BTEC Level 5 HND Diploma in Operations Engineering Edexcel BTEC Level 5 HND Diploma in Electrical/Electronic Engineering Edexcel BTEC Level 5 HND Diploma in General Engineering Edexcel BTEC Level 5 HND Diploma in Automotive Engineering Edexcel BTEC Level 5 HND Diploma in Aeronautical Engineering		We have too many qualifications to list in this space. Please go to www.edexcel.com for further information.

Level	General qualifications	Diplomas	BTEC vocationally-related qualifications	BTEC specialist qualification/ professional	NVQ/competence
4			Edexcel BTEC Level 4 HNC Diploma in Manufacturing Engineering Edexcel BTEC Level 4 HNC Diploma in Mechanical Engineering Edexcel BTEC Level 4 HNC Diploma in Operations Engineering Edexcel BTEC Level 4 HNC Diploma in Electrical/Electronic Engineering Edexcel BTEC Level 4 HNC Diploma in General Engineering Edexcel BTEC Level 4 HNC Diploma in Automotive Engineering Edexcel BTEC Level 4 HNC Diploma in Aeronautical Engineering		We have too many qualifications to list in this space. Please go to www.edexcel.com for further information.

Level	General qualifications	Diplomas	BTEC vocationally-related qualifications	BTEC specialist qualification/ professional	NVQ/competence
3		Edexcel Level 3 Diploma in Engineering	Edexcel BTEC Level 3 Certificate, Subsidiary Diploma, Diploma and Extended Diploma in Engineering Edexcel BTEC Level 3 Diploma and Extended Diploma in Mechanical Engineering Edexcel BTEC Level 3 Diploma and Extended Diploma in Manufacturing Engineering Edexcel BTEC Level 3 Diploma and Extended Diploma in Operations and Maintenance Engineering Edexcel BTEC Level 3 Diploma and Extended Diploma in Electrical/Electronic Engineering Edexcel BTEC Level 3 Diploma and Extended Diploma in Aeronautical Engineering		We have too many qualifications to list in this space. Please go to www.edexcel.com for further information.

Level	General qualifications	Diplomas	BTEC vocationally-related qualifications	BTEC specialist qualification/ professional	NVQ/competence
2	GCSE Engineering GCSE Manufacturing	Edexcel Level 2 Diploma in Engineering	Edexcel BTEC Level 2 Certificate, Extended Certificate and Diploma in Engineering		We have too many qualifications to list in this space. Please go to www.edexcel.com for further information.
1		Edexcel Level 1 Diploma in Engineering	Edexcel BTEC Level 1 Award, Certificate and Diploma in Engineering		We have too many qualifications to list in this space. Please go to www.edexcel.com for further information.
Entry					

Annexe B: Quality assurance

Key principles of quality assurance

- A centre delivering Edexcel qualifications must be an Edexcel recognised centre and must have approval for qualifications that it is offering.
- The centre agrees, as part of gaining recognition, to abide by specific terms and conditions relating to the effective delivery and quality assurance of assessment. The centre must abide by these conditions throughout the period of delivery.
- Edexcel makes available to approved centres a range of materials and opportunities to exemplify the processes required for effective assessment and provide examples of effective standards. Approved centres must use the guidance on assessment to ensure that staff who are delivering Edexcel qualifications are applying consistent standards.
- An approved centre must follow agreed protocols for: standardisation of assessors; planning, monitoring and recording of assessment processes; internal verification and recording of internal verification processes and dealing with special circumstances, appeals and malpractice.

Quality assurance processes

The approach to quality assured assessment is made through a partnership between a recognised centre and Edexcel. Edexcel is committed to ensuring that it follows best practice and employs appropriate technology to support quality assurance processes where practicable. The specific arrangements for working with centres will vary. Edexcel seeks to ensure that the quality assurance processes it uses do not inflict undue bureaucratic processes on centres, and works to support them in providing robust quality assurance processes.

The learning outcomes and assessment criteria in each unit within this specification set out the standard to be achieved by each learner in order to gain each qualification. Edexcel operates a quality assurance process, designed to ensure that these standards are maintained by all assessors and verifiers.

For the purposes of quality assurance, all individual qualifications and units are considered as a whole. Centres offering these qualifications must be committed to ensuring the quality of the units and qualifications they offer, through effective standardisation of assessors and internal verification of assessor decisions. Centre quality assurance and assessment processes are monitored by Edexcel.

The Edexcel quality assurance processes will involve:

- gaining centre recognition and qualification approval if a centre is not currently approved to offer Edexcel qualifications
- annual visits to centres by Edexcel for quality review and development of overarching processes and quality standards. Quality review and development visits will be conducted by an Edexcel quality development reviewer
- annual visits by occupationally competent and qualified Edexcel Standards Verifiers for sampling of internal verification and assessor decisions for the occupational sector
- the provision of support, advice and guidance towards the achievement of National Occupational Standards.

Centres are required to declare their commitment to ensuring quality and appropriate opportunities for learners that lead to valid and accurate assessment outcomes. In addition, centres will commit to undertaking defined training and online standardisation activities.

Annexe C: Centre certification and registration

Edexcel Standards Verifiers will provide support, advice and guidance to centres to achieve Direct Claims Status (DCS). Edexcel will maintain the integrity of Edexcel QCF NVQs through ensuring that the awarding of these qualifications is secure. Where there are quality issues identified in the delivery of programmes, Edexcel will exercise the right to:

- direct centres to take action
- limit or suspend certification
- suspend registration.

The approach of Edexcel in such circumstances is to work with the centre to overcome the problems identified. If additional training is required, Edexcel will aim to secure the appropriate expertise to provide this.

What are the access arrangements and special considerations for the qualification in this specification?

Centres are required to recruit learners to Edexcel qualifications with integrity.

Appropriate steps should be taken to assess each applicant's potential and a professional judgement should be made about their ability to successfully complete the programme of study and achieve the qualification. This assessment will need to take account of the support available to the learner within the centre during their programme of study and any specific support that might be necessary to allow the learner to access the assessment for the qualification. Centres should consult Edexcel's policy on learners with particular requirements.

Edexcel's policy on access arrangements and special considerations for Edexcel qualifications aims to enhance access to the qualifications for learners with disabilities and other difficulties (as defined by the 1995 Disability Discrimination Act and the amendments to the Act) without compromising the assessment of skills, knowledge, understanding or competence. Please refer to *Access Arrangements and Special Considerations for BTEC and Edexcel NVQ Qualifications* for further details (www.edexcel.com).

Annexe D: Assessment Strategy

See Semta website www.semta.org.uk for details of assessment strategy.

Annexe E: Additional requirement for qualifications that use the term 'NVQ' in a QCF qualification title

Please go to www.ofqual.gov.uk to access the document *'Operating rules for using the term 'NVQ' in a QCF qualification title'*.

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For more information on Edexcel and BTEC qualifications please
visit our website: www.edexcel.com

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