Unit 42: Commissioning Electrical Installations in Building Services Engineering

NQF Level 3: **BTEC National**

Guided learning hours: 60

Unit abstract

By law, in accordance with the Electricity at Work Regulations 1989, precautions must be taken against the risk of death or personal injury at work arising out of activities involving the use of electricity. Neglecting faulty electrical systems could result in injuries to employees, lost income and fines for organisations that are found to be in breach of statutory responsibilities.

In some instances insurance claims may be invalidated and there is a move towards the imposition of custodial sentences for directors of companies found to be in breach of their obligations.

Inspection, testing and commissioning have an increasingly critical role to play. All new installations must be inspected and tested before connection to the mains electrical supply to ensure that they are safe and that they meet current requirements. All existing installations must be periodically inspected and tested.

In the first part of the unit the purpose of inspection, testing and commissioning and the factors to be considered are addressed. Learners will then be introduced to inspection and testing process, including safe isolation, identification and selection of instruments, methods of testing, and certification and reporting. The need for compliance with test specification limit values, together with the actions to be taken in the event of unsatisfactory test results, are explored.

Learning outcomes

On completion of this unit a learner should:

1 Know the requirements for inspection, testing and commissioning

2 Understand the inspection process for electrical installations

3 Be able to carry out testing and commissioning operations

4 Understand the certification and reporting process.

Unit content

1 **Know the requirements for inspection, testing and commissioning**

New installation: initial verification; complying with regulations; meeting the specification; safe to use

Factors to be considered: safety precautions; assessment of safe working practice; permit to work; isolation, purpose and usage of systems and equipment; identification of circuits; equipment; test procedures; test instruments; correct methods; relevant data; accurate labelling; recording; contact with relevant parties; customers; clients

Purpose and conditions for periodic inspection: change of use of buildings; alterations; additions to electrical systems; damage

Sources of information to facilitate inspection and testing: BS: 7671; contract specification; distribution and wiring diagrams; manufacturers' instructions; relevant statutory legislation

2 **Understand the inspection process for electrical installations**

Visual inspection prior to commissioning: main intake/switchboard connections; powers circuits; lighting circuits; conduit; trunking, traywork; components

3 **Be able to carry out testing and commissioning operations**

Instruments: multimeter; wattmeter; tong tester; earth-loop impedance tester; low-ohm continuity tester; insulation resistance tester; residual current device and prospective short circuit current tester; approved voltage indicator; proving unit; verifying test instruments; regular calibration; use of documentary evidence

Test methods: sequence of tests; precautions to be taken; continuity; insulation resistance; polarity; earth fault loop impedance; earth electrode resistance; operation of residual current devices; functional testing; test values; reasons for unsatisfactory results; action to be taken

4 **Understand the certification and reporting process**

Certification: person/s responsible for the design; testing and construction; electrical installation certificate; schedule of inspection; schedule of test results; minor works certificate; periodic inspection report

Reporting: dealing with report forms; documentation; operation and maintenance manual

Grading grid

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all of the learning outcomes for the unit. The criteria for a pass grade describes the level of achievement required to pass this unit.

Grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 describe the requirements of BS: 7671 in relation to inspection and testing electrical installations and identify the purpose and conditions for periodic inspection	M1 accurately interpret BS: 7671 in relation to inspection and testing electrical installations	D1 reliably evaluate a range of electrical systems for compliance with relevant legislation and regulations
P2 identify relevant sources of information to facilitate inspection and testing and identify items associated with visual inspection prior to commissioning	M2 make valid and appropriate decisions relating to the inspection, testing and commissioning requirements of domestic, small commercial and industrial buildings	D2 analyse and justify the testing and commissioning techniques, equipment and results for a range of electrical systems.
P3 identify instruments suitable for testing and commissioning, explain how to carry out tests as per BS: 7671 and understand the need to comply with test values and the actions to be taken in the event of unsatisfactory results	M3 produce comprehensive reports for inspection, testing and commissioning procedures	
P4 describe the certification process for a completed installation and the procedures for dealing with report forms and documentation.	M4 produce clear and accurate answers to the calculations required to verify compliance with BS: 7671.	

Essential guidance for tutors

Delivery

Tutors delivering this unit have opportunities to use a wide range of techniques. Lectures, discussions, seminar presentations, site visits, supervised practicals, research using the internet and/or library resources and the use of personal and/or industrial experience are all suitable. Delivery should stimulate, motivate, educate and enthuse learners. Visiting expert speakers could add to the relevance of the subject.

It is assumed that learners embarking on this unit will be working with, or have experience of, electrical installations within building services. Tutors will need to encourage learners with little knowledge of the IEE Wiring Regulations to undertake a considerable amount of self-study. Individual tutorial support will be a key factor.

This unit can be delivered as a stand-alone package but could also be integrated with other electrical services units to produce a more holistic approach to building services.

Group activities are permissible, but tutors will need to ensure that individual learners are provided with equal experiential and assessment opportunities.

Health, safety and welfare issues are paramount and should be strictly reinforced through close supervision of all workshops and activity areas, and risk assessments must be undertaken prior to practical activities. Centres are advised to read the *Delivery approach* section on page 24, and *Annexe G: Provision and Use of Work Equipment Regulations 1998 (PUWER)*.

Assessment

Evidence for this unit may be gathered from a variety of sources, including well-planned investigative assignments, case studies or reports of practical assignments.

There are many suitable forms of assessment that could be employed, and tutors are encouraged to consider and adopt these where appropriate. Some examples of possible assessment approaches are suggested below. However, these are not intended to be prescriptive or restrictive and are provided as an illustration of the alternative forms of assessment evidence that would be acceptable. General guidance on the design of suitable assignments is available on page 19 of this specification.

Some criteria can be assessed directly by the tutor during practical activities. If this format is used then suitable evidence would be observation records or witness statements. Guidance on their use is provided on the Edexcel website.

Much of the evidence for the assessment criteria can be achieved through realistic project work based on electrical installations for real buildings. Learners should complete design calculations or proposals for the various aspects of learning in formal, written or computer-produced reports and drawings with, where appropriate, a verbal presentation.

It is recommended that written tests and assignments are used to gather evidence not covered by the project work. Where tests and assignments are used, they will be relevant and sufficient to justify the grades awarded. The volume of evidence required for each assessment should take into account the overall number of assessment criteria being contemplated within this unit and the design of the overall teaching programme.

To achieve a pass grade learners must meet the four pass criteria listed in the grading grid.

For P1, learners must describe the requirements of BS: 7671 in relation to inspection and testing electrical installations and identify the purpose and conditions for periodic inspection.

For P2, learners must identify relevant sources of information to facilitate inspection and testing and identify items associated with visual inspection prior to commissioning. P2 could be viewed as an extension to P1. This could include the use of drawings, plans, specifications, and equipment schedules.

For P3, learners must identify instruments suitable for testing and commissioning, explain how to carry out tests as per BS: 7671 and understand the need to comply with test values and the actions to be taken in the event of unsatisfactory results. Learners should also understand the actions to be taken in the event of unsatisfactory results.

For P4, learners must describe the certification process for a completed installation and the procedures for dealing with report forms and documentation.

To achieve a merit grade learners must meet all of the pass grade criteria **and** the four merit grade criteria.

For M1, learners must accurately interpret BS: 7671 in relation to inspection and testing electrical installations.

For M2, learners must make valid and appropriate decisions relating to the inspection, testing and commissioning requirements of domestic, small commercial and industrial buildings.

For M3, learners must produce comprehensive reports for inspection, testing and commissioning procedures. This should include the use of installation certificates, schedule of items inspected and schedule of test results.

For M4, learners must produce clear and accurate answers to the calculations required to verify compliance with BS: 7671. This should include checking for compliance with voltage drop, shock protection and thermal constraints.

To achieve a distinction grade learners must meet all of the pass and merit grade criteria **and** the two distinction grade criteria.

For D1, learners must reliably evaluate a range of electrical systems for compliance with relevant legislation and regulations. This can be demonstrated as a development progression from M3 and M4, with learners justifying results and drawing conclusions in relation to compliance with both statutory and non-statutory legislation. Learners should show how a proposed electrical design meets the needs of the building, client and end user in terms of protection from electrical fire, shock and burns.

For D2, learners must analyse and justify the testing and commissioning techniques, equipment and results for a range of electrical systems. In justifying the techniques the learner must explain clearly why they used particular methods and what alternative methods could be used.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

The learning outcomes in this unit are closely linked with, for example, *Unit 39: Electrical Principles in Building Services Engineering, Unit 40: Electrical Installation Standards and Components in Building Services Engineering* and *Unit 41: Electrical Installation Design in Building Services Engineering,* together with similar units at Higher National and degree level.

This unit may have links to the Edexcel Level 3 Technical and Professional NVQs for Construction and the Built Environment. Updated information on this, and a summary mapping of the unit to the CIC Occupational Standards, is available from Edexcel. See *Annexe D: National Occupational Standards/mapping with NVQs*.

There are also links with Summit Skills N-SVQ Level 3: Building Services Engineering Technology and Project Management, in particular, Unit SST/NOS 5: Monitor Commissioning and Testing Procedures for Building Services Engineering Projects and Unit SST/NOS 7: Provide Technical and Functional Information to Relevant People. Summit Skills N-SVQ Level 4: Building Services Engineering Technology and Project Management, in particular, Unit SSTE/NOS 11: Commission Building Services Engineering Products After Installation.

This unit presents opportunities to demonstrate key skills in application of number, communication and problem solving. Opportunities for satisfying requirements for Wider Curriculum Mapping are summarised in *Annex F: Wider curriculum mapping*.

Essential resources

Learners will need access to a range of publications, reference data, manufacturers' products/information, approved test instruments and computer facilities. Centres should work closely with major building services contractors in order to provide realism and relevance to the project work.

Indicative reading for learners

Textbooks

Construction Industry Training Board — Construction Skills — IEE Regulations Study Notes: *BS 7671 — Requirements for Electrical Installation, 16th Edition* (CITB, 2005) ISBN 1857510453

Cook P — *Commentary on IEE Wiring Regulations (BS 7671:2001): Requirements for Electrical Installations Amendment No.1 2002, 16th Edition* (Institution of Engineering and Technology, 2002) ISBN 0852962371

IEE — *Inspection and Testing, 4th Edition* (IET, 2001) ISBN 0852969910

Institution of Electrical Engineers — *Requirements for Electrical Installations: IEE Wiring Regulations, 16th Edition* (IEE, 2001) ISBN 0863413730

Miller H and Puckering R — *Electrical Installation Practice, 4th Edition* (Blackwell Science, 1993) ISBN 0632025425

Whitfield J — *The Electrician's Guide to the 16th Edition of the IEE Wiring Regulations, 8th Edition* (EPA Press, 2005) ISBN 0953788547

Key skills

Achievement of key skills is not a requirement of this qualification but it is encouraged. Suggestions of opportunities for the generation of Level 3 key skill evidence are given here. Tutors should check that learners have produced all the evidence required by part B of the key skills specifications when assessing this evidence. Learners may need to develop additional evidence elsewhere to fully meet the requirements of the key skills specifications.

Application of number Level 3	
When learners are:	**They should be able to develop the following key skills evidence:**
• producing clear and accurate answers to the calculations required to verify compliance with BS: 7671.	N3.1 Plan an activity and get relevant information from relevant sources. N3.2 Use this information to carry out multi-stage calculations to do with: a amounts or sizes b scales or proportion c handling statistics d using formulae. N3.3 Interpret the results of your calculations, present your findings and justify your methods.
Communication Level 3	
When learners are:	**They should be able to develop the following key skills evidence:**
• describing the requirements of BS: 7671 in relation to inspection and testing electrical installations and identifying the purpose and conditions for periodic inspection.	C3.1a Take part in a group discussion. C3.1b Make a formal presentation of at least eight minutes using an image or other support material. C3.2 Read and synthesise information from at least **two** documents about the same subject. Each document must be a minimum of 1000 words long. C3.3 Write **two** different types of documents, each one giving different information about complex subjects. One document must be at least 1000 words long.

Information and communication technology Level 3	
When learners are:	**They should be able to develop the following key skills evidence:**
• describing the certification process for a completed installation and the procedures for dealing with report forms and documentation.	ICT3.1 Search for information, using different sources, and multiple search criteria in at least one case. ICT3.2 Enter and develop the information and derive new information. ICT3.3 Present combined information such as text with image, text with number, image with number.
Improving own learning and performance Level 3	
When learners are:	**They should be able to develop the following key skills evidence:**
• producing comprehensive reports for inspection, testing and commissioning procedures.	LP3.1 Set targets using information from appropriate people and plan how these will be met. LP3.2 Take responsibility for your learning, using your plan to help meet targets and improve your performance. LP3.3 Review progress and establish evidence of your achievements.
Problem solving Level 3	
When learners are:	**They should be able to develop the following key skills evidence:**
• identify instruments suitable for testing and commissioning, explain how to carry out tests as per BS: 7671 and understand the need to comply with test values and the actions to be taken in the event of unsatisfactory results.	PS3.1 Explore a problem and identify different ways of tackling it. PS3.2 Plan and implement at least one way of solving the problem. PS3.3 Check if the problem has been solved and review your approach to problem solving.

Working with others Level 3	
When learners are:	**They should be able to develop the following key skills evidence:**
• producing comprehensive reports for inspection, testing and commissioning procedures.	WO3.1 Plan work with others. WO3.2 Seek to develop co-operation and check progress towards your agreed objectives. WO3.3 Review work with others and agree ways of improving collaborative work in the future.