

# **City & Guilds Level 3 Electrotechnical Qualification (Installation) or (Maintenance) (5357-03)**

**November 2022 Version 2.5**

**Qualification Handbook**

## Qualification at a glance

<b>Subject area</b>	Electrical (Installation) and (Maintenance)
<b>City &amp; Guilds number</b>	5357-03
<b>Age group approved</b>	16-18, 19+
<b>Entry requirements</b>	There are no formal entry requirements for this qualification. However, it is expected that apprenticeship candidates have a Level 2 in English and Maths or are working towards achieving this by the end of their apprenticeship.
<b>Assessment</b>	Portfolio of evidence, Assignments, MC online tests
<b>Approvals</b>	Fast track from 2357
<b>Support materials</b>	Centre handbook, Candidate logbook, Training manual, Sample assessments
<b>Registration and certification</b>	Consult the Walled Garden/Online Catalogue for last dates

Title and level	City & Guilds number	Ofqual number	GLH	TQT
City & Guilds Level 3 Electrotechnical Qualification	5357-03	601/6299/5	743	1040

Version and date	Change detail	Section
V1.0 08 June 2015	Initial version	All
V1.1 01 July 2015	Change to 012 test spec	Assessment
V1.4 15 July 2015	Removed 0844 contact numbers	Useful contacts
V1.5 13 Aug 2015	Changed units	Course structure
V1.6 09 Oct 2015	Unit 104 to assignment Added Assessor requirements Added 004 test spec	Course structure Assessment
	Updated assessment types	Logbook
V1.7 06 Jan 2016	Updated test spec information for unit 004 and 505. Updated Notes for Guidance on unit 102	Assessment Assessment
V1.8 5 <sup>th</sup> Feb 2016	Minor wording change	Units
V1.9 June 2016	Assessment information unit 103	Units
V1.10 July 2016	Updated range information in learning outcome 4 of unit 101 City & Guilds group statement updated Phone numbers removed	Units Useful contacts Useful contacts
V1.11 Nov 2016	Assessment information unit 101	Assessment Units
V1.12 Nov 2016	Moderation procedures removed	Assessment
V1.13 June 2017	Note attached to confirm resit for unit 003 (303) is Pass/Fail only	Test Specification Page 17
V1.14 Sept 2017	Total GLH and TQT added	Qualification at a glance
V1.15 Oct 2017	Permitted materials added for unit 004. Test duration for unit 012 amended to 80 minutes. Test duration for unit 014 amended to 60 minutes. Range added to LO4 unit 101/001	Assessment Units
V1.16 March 2018	Clarification provided that 103 resits are capped to Pass grade	Test Specifications

Version and date	Change detail	Section
V2.0 July 2018	Addition of unit 018	Assessment Units
	Additional guidance added around related qualifications 2382 and 2391	Appendix 1
V2.1 Dec 2018	AM2 to AM2S	Throughout
V2.2 July 2020	Qualification grading information added	Introduction
	Clarification around relationship to AM2S and apprenticeship frameworks	Introduction and Assessment
	Unit 005 replaced with 505	Units
	Text relating to regulatory arrangements and adjustments updated with City & Guilds standard text	Appendix 2
V2.3 Aug 2021	Correction of unit number (107 to 104) and title	Unit 113 – Supporting Information
V2.4 May 2022	Addition of unit 022 to rules of combination, structure tables, test specs and units.	Structure, Assessment, Units
	Details of how to claim certification for 18 <sup>th</sup> Edition Wiring Regulations updated to include new Amendment 2 (2022) assessment.	Appendix 1
	Formatting, hyperlinks and template updated where applicable	Throughout
V2.5 November 2022	City & Guilds added to qualification titles	Throughout
	Assessment direct observation requirement amendments	Unit 102 – Supporting information
	Contents page numbering corrected	Contents page

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# 1 Introduction

This document tells you what you need to do to deliver the qualification:

Area	Description
Who is the qualification for?	This qualification meets the needs of learners in England, Wales and Northern Ireland who want to work as electricians, installing systems and equipment in buildings, structures and the environment, within the Electrotechnical industry. It is a mandatory requirement of the Electrotechnical apprenticeship frameworks in England and Northern Ireland.
What does the qualification cover?	The qualification allows the candidate to develop the knowledge, skills and competency required for an Installation and Maintenance Electrician in the Electrotechnical sector.
What opportunities for progression are there?	The Electrotechnical qualification will enable candidates to progress within employment.
Who did we develop the qualification with?	The qualification has been developed in conjunction with a wider employer group who set the apprenticeship standard from which the qualification was derived.
Is it part of an apprenticeship framework or initiative?	England and Northern Ireland Apprenticeship frameworks for Installation Electricians and Maintenance Electricians.

## Grading

This qualification is graded as pass/fail.

## Structure

To achieve City & Guilds Level 3 Electrotechnical Qualification (installation) learners must achieve all the mandatory units, including either 016, 018 or 022 along with optional unit **109 Apply Design and Installation Practices and Procedures**

To achieve City & Guilds Level 3 Electrotechnical Qualification (maintenance) learners must achieve all the mandatory units, including either 016, 018 or 022, along with optional unit **110 Apply Practices and Procedures for Maintenance**

## City & Guilds Level 3 Electrotechnical Qualification

UAN	City & Guilds unit number	Unit title	Assessment Method	GLH
<b>Mandatory</b>				
J/507/0649	101	Understand Health, Safety and Environmental Considerations	Assignment	65
	001		e-volve MC test	
A/507/0650	102	Apply Health, Safety and Environmental Considerations	Portfolio	10
F/507/0651	103	Electrical Scientific Principles and Technologies	Assignment	115
	003		e-volve MC test	
J/507/0652	104	Understand Design and Installation Practices and Procedures	Assignment	170
	004		e-volve MC test	
L/507/0653	105	Understand how to Plan and Oversee Electrical Work Activities	Assignment	40
	505		e-volve MC test	
R/507/0654	106	Organise and Oversee the Electrical Work Environment	Portfolio	12
Y/507/0655	107	Understand Terminations and Connections of Conductors	Assignment	93
D/507/0656	108	Terminate and Connect Conductors	Portfolio	12
H/507/0660	112	Understand Inspection, Testing and Commissioning	Assignment	78
	012		e-volve MC test	
K/507/0661	113	Inspect, Test and Commission Electrical Systems	Portfolio	16
M/507/0662	114	Understand Fault Diagnosis and Rectification	Assignment	32
	014		e-volve MC test	
T/507/0663	115	Apply Fault Diagnosis and Rectification	Portfolio	10
<b>Optional (1 from)</b>				
M/507/0659	016	Understand the Requirements for Electrical Installations BS 7671: 2008 (2015)	e-volve MC test	70
	018	Understand the Requirements for Electrical Installations BS 7671:2018	e-volve MC test	70
	022	Understand the Requirements for Electrical Installations BS 7671:2018 (2022)	e-volve MC test	70
<b>Specialist unit (1 from)</b>				
H/507/0657	109	Apply Design and Installation Practices and Procedures	Portfolio	20
K/507/0658	110	Apply Practices and Procedures for Maintenance	Portfolio	20



## 2 Centre requirements

### Approval

If your Centre is approved to offer the qualification 2357 you have automatic approval for 5357.

To offer this qualification, new centres will need to gain both centre and qualification approval. Please refer to the document Quality Assurance Standards: Centre Approval Process for further information.

Centre staff should familiarise themselves with the structure, content and assessment requirements of the qualifications before designing a course programme.

### Resource requirements

#### Centre staffing

Staff delivering these qualifications must be able to demonstrate that they meet the following occupational expertise requirements. They should:

- be occupationally competent or technically knowledgeable in the area[s] for which they are delivering training and/or have experience of providing training. This knowledge must be to the same level as the training being delivered
- have recent relevant experience in the specific area they will be assessing
- have credible experience of providing training.

See also page 16 for details from the assessment strategy on the role of supervisors and managers in the assessment process.

Centre staff may undertake more than one role, eg tutor and assessor or internal verifier, but cannot internally verify their own assessments.

### Learner entry requirements

City & Guilds does not set entry requirements for this qualification. However, centres must ensure that candidates have the potential and opportunity to gain the qualification successfully. It is also expected that apprenticeship candidates have Level 2 English and Maths by the end of their apprenticeship programme.

#### Age restrictions

City & Guilds cannot accept any registrations for candidates under 16 as this qualification is not approved for under 16s.

## 3 Delivering the qualification

### Initial assessment and induction

An initial assessment of each candidate should be made before the start of their programme to identify:

- if the candidate has any specific training needs,
- support and guidance they may need when working towards their qualifications,
- any units they have already completed, which is relevant to the qualifications,
- the appropriate type and level of qualification.

We recommend that centres provide an induction programme so the candidate fully understands the requirements of the qualification, their responsibilities as a candidate, and the responsibilities of the centre. This information can be recorded on a learning contract.

### Support materials

The following resources are available for this qualification:

Description	How to access
Fast track approval form	<a href="http://www.cityandguilds.com">www.cityandguilds.com</a>
Candidate logbook	<a href="http://www.cityandguilds.com">www.cityandguilds.com</a>
SmartScreen	<a href="http://www.smartscreen.co.uk">www.smartscreen.co.uk</a>
Sample Assessments	<a href="http://www.cityandguilds.com">www.cityandguilds.com</a>
Assessment packs	<a href="http://www.cityandguilds.com">www.cityandguilds.com</a>
Assessor guidance	<a href="http://www.cityandguilds.com">www.cityandguilds.com</a>
FAQ's	<a href="http://www.cityandguilds.com">www.cityandguilds.com</a>

### Recording documents

Candidates and centres may decide to use a paper-based or electronic method of recording evidence.

City & Guilds endorses several ePortfolio systems, including our own, **Learning Assistant**, an easy-to-use and secure tool to support and evidence learners' progress towards achieving qualifications. Further details are available at: [www.cityandguilds.com/e-portfolios](http://www.cityandguilds.com/e-portfolios).

City & Guilds has developed a logbook specifically designed to meet the needs of candidates and assessors for these qualifications. This can be found on [www.cityandguilds.com](http://www.cityandguilds.com), navigate to **Building Services Industry, Electrical Installations, 2357**.

Although it is expected that new centres will use these forms, centres may devise or customise alternative forms, which must be approved for use by the EQA before they are used.

## 4 Assessment

### Requirements of Assessors, Internal Quality Assurers, External Quality Assurers and Delivery Personnel.

#### 1.1 Assessors

Assessors must be working towards or have achieved a relevant recognised assessor qualification such as a Level 3 Certificate in Assessing Vocational Achievement and continue to practice to that standard. Assessors who hold earlier qualifications (D32 or D33 or TQFE/TQSE) should have CPD evidence to the most current standards.

They must be occupationally competent electricians. Evidence which supports this is by the assessor holding a relevant electrotechnical NVQ L3\* and/or having registration with the JIB as 'Approved Electrician' status or Eng-Tech status via the IET.

\*Assessors who qualified before NVQs were developed should provide evidence of how they are occupationally competent (such as through a CV together with any relevant references).

Assessors must be able to demonstrate evidence of being up to date with the electrical industry. This can be evidenced for example by either accessing trade publications, undertaking updates to wiring regulations or other course of learning, attending networking events relevant to this qualification and/or attending industry events. They must also satisfy any other Awarding Organisation requirements.

#### 1.2 Internal Quality Assurers

Internal quality assurers must have a minimum of occupational experience evidenced by having a building services engineering related qualification or proven sector competence/experience plus access to relevant 'occupational expertise' to enable them to conduct their role as an **internal quality assurer**. This evidence and access to 'occupational expertise' is quality assured by the Awarding Organisation.

They must be working towards or have achieved a relevant recognised internal quality assurance qualification such as the Level 4 Award in the Internal Quality Assurance of Assessment Processes and Practice and continue to practice to that standard. Assessors who hold earlier qualifications (D34 or V1) should have CPD evidence to the most current standards.

They must be able to demonstrate evidence of being up to date with building services engineering industry. This can be evidenced for example by either accessing trade publications, undertaking courses of learning, attending networking events relevant to this qualification and/or attending industry events.

### 1.3 External Quality Assurers (from the Awarding Organisation)

External quality assurers must be accountable to the Awarding Organisation. They must be working towards or have achieved the L4 Certificate in Leading the External Quality Assurance of Assessment Processes and Practice and continue to practice to that standard.

They must:

- be fully conversant with the assessment process,
- have no connections with the assessment centre, in order to maintain objectivity
- have sufficient and relevant technical/occupational understanding in the qualification(s)/unit(s) being verified
- be fully conversant with the standards and performance criteria in the units to be assessed
- be able to provide centres with advice and guidance on assessment and internal quality assurance procedures.

External Quality Assurers must be occupationally competent electricians. Evidence which supports this is by holding a relevant electrotechnical NVQ L3\* and/or having registration with the JIB as 'Approved Electrician' status or Eng-Tech status via the IET.

\* External Quality Assurers who qualified before NVQs were developed should provide evidence of how they are occupationally competent (such as through a CV together with any relevant references).

External Quality Assurers be able to demonstrate evidence of being up to date with the electrical industry. This can be evidenced for example by either accessing trade publications, undertaking updates to wiring regulations or other course of learning, attending networking events relevant to this qualification and/or attending industry events.

### 1.4 Expert Witnesses

Where “**Expert Witnesses**” are used in the assessment process identified above they must be; Sector competent individuals who can attest to the learner's performance in the workplace,

It is not necessary for expert witnesses to hold an assessor qualification, as a qualified assessor they must assess the performance evidence provided by an expert witness. Evidence from expert witnesses must meet the tests of validity, reliability, authenticity and sufficiency.

Expert witnesses will need to demonstrate: -

1. They have relevant current knowledge of industry working practices and techniques
2. That they have no conflict of interest in the outcome of their evidence

## 1.5 Markers - Technically competent

Where centre-based assessments are marked by a person who does not come into the assessor category as 1.1 above, the marker must have auditable technical competence in the subject. As an example, for a scientific based assessment the person may have auditable competency in that subject area but not necessarily electrotechnical installation or maintenance.

## 1.6 Teachers/Instructors

Teachers/instructors involved with the delivery of the knowledge units must demonstrate an understanding of the topics/technical content in this qualification. As a minimum they must have achieved a relevant technical qualification to at least level 3 which covers the key topics in this qualification.

Examples of evidence for this are: City & Guilds Level 2 plus Level 3 Certificates in Electrical Installation Part One and Part Two or EAL L3 Diploma in Electrotechnical Services. Other electrical engineering qualifications such as OND, or HNC/D etc. An example of **not** meeting this requirement is by only holding a L2 VRQ or a L3 Award – as clearly this person has not demonstrated technical/academic ability to the level of the qualification being delivered.

Teachers/instructors of practical work should in addition to the above be technically skilled for their instruction. This can be evidenced for example through a CV, JIB grading at an appropriate grade, membership of an institution eg EngTech, MEIT.

All teachers/instructors must hold (or be working toward) a recognised teaching qualification (to a minimum of L3 standard) such as: Level 3 Award in Preparing to Teach in the Lifelong Learning Sector (PTLLS)

Teachers/ Instructors must be able to demonstrate evidence of being up to date with the electrical industry. This can be evidenced for example by either accessing trade publications, undertaking updates to wiring regulations or other courses of learning, attending networking events relevant to this qualification and/or attending industry events.

## Summary of assessment methods

The qualification is assessed through a variety of assessment methods. The knowledge units include:

- Online tests
- written paper
- projects or assignments
- practical observations

These units will be assessed at the candidate's training provider and centres should refer to assessor guidance for rules on test conditions. The performance units will be evidenced through a workplace evidence record which will form part of the candidates' portfolio. The performance units should be assessed through naturally occurring opportunities whilst in the workplace. The workplace evidence record allows candidates to demonstrate the practical skills and associated knowledge required of an electrical apprentice.

Candidates must:

- successfully complete all assessments for each mandatory unit
- successfully complete all assessments for chosen optional unit.

## Assessment Types

Assessment type	Assessment method	Where to obtain assessment materials
Assignments	Centrally set and centre marked assignments open or closed book (to be stated). These do not require invigilation but must be the work of the candidate, marked by technically competent staff and quality assured by the centre and City & Guilds.	Assessment packs can be accessed from <a href="http://www.cityandguilds.com">www.cityandguilds.com</a>
Projects	Externally set and internally marked, open book research and scenario-based assignments. These do not require invigilation but must be the work of the candidate, marked by technically competent staff, quality assured by the centre and City & Guilds.	
e-volve	City & Guilds online e-volve multiple choice test. The test covers all of the knowledge in the unit. These tests are externally set and externally marked.	Examinations provided on e-volve.
Question Paper	Externally set and internally marked open or closed book (to be stated) controlled assessment carried out under controlled invigilated conditions. Marked by technically competent staff and quality assured by the centre and City & Guilds	Assessment packs can be accessed from <a href="http://www.cityandguilds.com">www.cityandguilds.com</a>
Practical observation	Demonstration of knowledge under assessment conditions open or closed book (to be stated). Observed and controlled by a qualified assessor and quality assured by the centre and the Awarding Organisation	Assessment packs can be accessed from <a href="http://www.cityandguilds.com">www.cityandguilds.com</a>
Workplace evidence logbook	<p>This assessment designed to capture all evidence in the workplace that meets the performance units of this qualification.</p> <p>Evidence that is sourced from the real working environment for performance units must be naturally occurring and assessed on a minimum of two occasions.</p>	The workplace evidence logbook can be accessed from <a href="http://www.cityandguilds.com">www.cityandguilds.com</a>

## Time constraints

The following must be applied to the assessment of this qualification:

- Centre staff should guide learners to ensure excessive evidence gathering is avoided.
- All assignments/tasks must be completed and assessed within the learner's period of registration. Centres should advise learners of any internal timescales for the completion and marking of individual assignments.

## Important note - AM2S

This handbook contains all the assessment information needed to pass all the units within this qualification. However, for the candidate to achieve the **apprenticeship in England or Northern Ireland**, they also need to successfully complete the AM2S synoptic competence-based assessment. No assessment in this qualification will contribute to the overall grade of the apprenticeship in England or Northern Ireland which is determined solely by the AM2S.

The AM2S is a robust, timed (16.5 hours typically over 2 and a half days) practical and theory (40 multiple-choice questions) assessment in sections, requiring candidates to perform a set of common tasks and procedures that a full scope electrical operative might face when working in commercial or industrial premises as well as dwellings. It assesses candidates on installation, inspection and testing and fault-finding; their work must comply with BS 7671, be in line with relevant Health and Safety legislation and conform to current industry practices and procedures.

The AM2S will be graded pass/merit/distinction and weighting of practical to theory of 70%/30%.

## Assessment strategy

A common assessment strategy has been produced jointly by awarding organisations to ensure the consistency of the assessments offered across awarding organisations.

For unit 101 candidates who successfully complete both the assignment (101) and the evolve test (001) and are a registered apprentice with the JIB they will be exempt from having to do the ECS Health and Safety Assessment. Providers will be able to apply for ECS cards on behalf of all of their Trailblazer apprentice.

## Test specifications

These boundaries may be subject to slight variation to ensure fairness should any variations in the difficulty of the test be identified.

The way the knowledge is covered by each test is laid out in the tables below:

<b>001 Understand Health, Safety and Environmental Considerations</b>		
<b>Outcome</b>	<b>Number of questions</b>	<b>%</b>
1 Understand how relevant legislation applies in the work place	4	16
2 Understand the procedures for dealing with Environmental and Health and Safety situations in the work environment	6	24
3 Understand the procedures for establishing a safe working environment	7	28
4 Understand the requirements for identifying and dealing with hazards in the work environment	8	32
<b>Total</b>	<b>25</b>	<b>100</b>

**Assessment method:** Evolve online MC

**Duration:** 40 mins

**Grade boundaries:** Pass is approximately 60 %

**Permitted material:** Closed book

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## 003 Electrical Scientific Principles and Technologies

Outcome	Number of questions	%
1 Understand mathematical principles which are appropriate to electrical installation, maintenance and design work	2	5
2 Understand standard units of measurement used in electrical installation, maintenance and design work	5	13
3 Understand basic mechanics and the relationship between force, work, energy and power	7	18
4 Understand the relationship between resistance, resistivity, voltage, current and power	15	37
5 Understand the fundamental principles which underpin the relationship between magnetism and electricity	7	17
6 Understand the types, applications and limitations of electronic components in electrotechnical systems and equipment	4	10
<b>Total</b>	<b>40</b>	<b>100</b>

**Assessment methods:** e-volve online MC test

**Duration:** 90 mins

**Grade boundaries for this test will approximately be:**

Pass: 50 %

Merit: 65 %

Distinction: 80 %

**Resit e-volve (unit 303);** Pass only: 50%

**Permitted material:** Closed book

Non-programmable calculator

## 103 Electrical Scientific Principles and Technologies

Outcome	Number of questions	%
7 Understand electrical supply systems	6	23
8 Understand how different electrical properties can affect electrical circuits, systems and equipment	8	31
9 Understand the operating principles and applications of DC machines and AC motors	4	15
10 Understand the operating principles of electrical components	3	11
11 Understand the principles and applications of electrical lighting systems	3	11
12 Understand the principles and applications of electrical heating	2	8
<b>Total</b>	<b>26</b>	<b>100</b>

**Assessment methods:** Short answer question paper

**Duration:** 120 mins

**Grade** boundaries for the first sitting of this test will approximately be:

Pass: 50 %

Merit: 65 %

Distinction: 80 %

Grade boundaries for resits of this test will approximately be:

Pass: 50%

Please note: The resits for this assessment are capped to a Pass grade only. When re-sitting candidates can no longer achieve merit or distinction.

**Permitted material:** Closed book

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## 004 Understand Design and Installation Practices and Procedures

Outcome	Number of questions	%
1 Understand how to prepare for the installation of wiring systems.	5	17
2 Understand the applications of wiring systems	9	30
3 Understand the practices and procedures for carrying out electrical work	8	26
6 Understand protection against overcurrent	5	17
7 Understand electrical systems and circuits	3	10
<b>Total</b>	<b>30</b>	<b>100</b>

**Assessment methods:** e-volve online MC test/written task

**Duration:** 70 mins

**Grade boundaries:** Pass is approximately 70%

**Permitted material:** BS 7671; IET On-site Guide  
Non-programmable calculator

## 505 Understand how to plan and oversee electrical work activities

Outcome	Number of questions	%
1 Understand the requirements for liaising with others when organising and overseeing work activities	10	63
3 Understand the requirements for organising the provision and storage of resources that are required for work activities	6	37
<b>Total</b>	<b>16</b>	<b>100</b>

**Assessment methods:** e-volve online MC test/written task – closed book

**Duration:** 40 mins

**Grade boundaries:** Pass is approximately 60%

Note: Learning outcome 2 will be assessed through an assignment

**Permitted material:** Closed book

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## 012 Understand Inspection, Testing and Commissioning Outcomes 1-7

Outcome	Number of questions	%
1 Understand the requirements for completing the safe isolation of electrical circuits and installations	6	17
2 Understand the requirements for initial verification of electrical installations	2	6
3 Understand the requirements for completing the inspection of electrical installations prior to their being placed into service	Assessed by assignment	
4 Understand the requirements for the safe testing and commissioning of electrical installations	8	23
5 Understand the requirements for testing before circuits are energised	7	20
6 Understand the requirements for testing energised installation	10	28
7 Understand the requirements for the completion of electrical installation certificates and associated documentation	2	6
<b>Total</b>	<b>35</b>	<b>100</b>

**Assessment methods:** e-volve online MC test

**Duration:** 80 minutes

**Grade boundaries:** Pass is approximately 60%

Note: Learning outcomes 8-11 will be assessed through a practical observation

**Permitted material:** Closed book

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## 014 Understand Fault Diagnosis and Rectification.

Outcome	Number of questions	%
1 Understand the Health and Safety requirements relevant to fault diagnosis	3	10
2 Understand the importance of reporting and communication in fault diagnosis	2	7
3 Understand the nature and characteristics of electrical faults	6	20
4 Understand the fault diagnosis procedure	10	33
5 Understand the procedures and techniques for correcting electrical faults	9	30
<b>Total</b>	<b>30</b>	<b>100</b>

**Assessment methods:** e-volve MC test

**Duration:** 60 mins

**Grade boundaries:** Pass is approximately 60%

Note: learning outcome 6 will be assessed through a practical observation

**Permitted material:** Closed book

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## 016 Understand the Requirements of Electrical Installations BS7671: June 2008 (2015)

Outcome	Number of questions	%
1 Know the scope, object and fundamental principles of BS7671	4	7
2 Understand the definitions used within BS 7671	2	3
3 Understand how to assess the general characteristics of electrical installations	6	10
4 Understand requirements of protection for safety for electrical installations	15	25
5 Understand the requirements for selection and erection of equipment for electrical installations	14	23
6 Understand the requirements of inspection and testing of electrical installations	4	7
7 Understand the requirements of special installations or locations as identified in BS 7671	10	17
8 Understand the information contained within the appendices of BS 7671	5	8
<b>Total</b>	<b>60</b>	<b>100</b>

**Assessment methods:** e-volve online MC test

**Duration:** 120 mins

**Grading:** Pass/Fail

**Pass Mark:** The pass mark for this examination is set at approx. 60%

**Permitted material:** BS 7671 (17<sup>th</sup> Edition 3<sup>rd</sup> Amendment)

Non-programmable calculator

## 018 Understand the Requirements of Electrical Installations BS7671:2018

Outcome	Number of questions	%
1. Understand the scope, object and fundamental principles of BS7671.	4	7%
2. Understand the definitions used within BS7671.	2	3%
3. Understand how to assess the general characteristics of electrical installations	6	10%
4. Understand requirements of protection for safety for electrical installations	15	25%
5. Understand the requirements for selection and erection of equipment for electrical installations	14	23%
6. Understand the requirements of inspection and testing of electrical installations	4	7%
7. Understand the requirements of special installations or locations as identified in BS 7671.	10	17%
8. Understand the information contained within the appendices of BS7671.	5	8%
<b>Total</b>	<b>60</b>	<b>100</b>

**Assessment methods:** e-volve online MC test

**Duration:** 120 mins

**Grading:** Pass/Fail

**Pass Mark:** The pass mark for this examination is set at approx. 60%

**Permitted material:** IET Wiring Regulations 18th Edition: BS 7671:2018 Requirements for Electrical Installations  
Non-programmable calculator



## 022 Understand the Requirements of Electrical Installations BS7671:2018 (2022)

Outcome	Number of questions	%
1. Understand the scope, object and fundamental principles of BS7671.	4	7%
2. Understand the definitions used within BS7671.	2	3%
3. Understand how to assess the general characteristics of electrical installations.	6	10%
4. Understand requirements of protection for safety for electrical installations.	15	25%
5. Understand the requirements for selection and erection of equipment for electrical installations.	14	23%
6. Understand the requirements of inspection and testing of electrical installations.	4	7%
7. Understand the requirements of special installations or locations as identified in BS 7671.	7	12%
8. Understand the information contained within Part 8 and the appendices of BS7671.	8	13%
<b>Total</b>	<b>60</b>	<b>100</b>

**Assessment methods:** e-volve online MC test

**Duration:** 120 mins

**Grading:** Pass/Fail

**Pass Mark:** The pass mark for this examination is set at approx. 60%

**Permitted material:** IET Wiring Regulations 18th Edition: BS 7671:2018 (2022) Requirements for Electrical Installations  
Non-programmable calculator

### Recognition of prior learning (RPL)

The City & Guilds policy on RPL can be found at: <http://www.cityandguilds.com/Provide-Training/Centre-Support/Centre-Document-Library/Policies-and-Procedures/Quality-Assurance-Documents>

Recognition of prior learning means using a person's previous experience or qualifications which have already been achieved to contribute to a new qualification.

## **Moderation and standardisation of assessment**

### **Internal standardisation of marking**

The centre is required to standardise the assessment across different assessors, to ensure that all work at the centre has been marked to the same standard. If two or more tutors are involved in marking assessments, one supervisor/tutor must be designated as responsible for internal standardisation.

Common pieces of work must be marked by all markers on a trial basis and differences between outcomes discussed at an internal training session in which all tutors involved must participate.

The supervisor/tutor responsible for standardising the marking must ensure that the training includes the use of reference and archive materials such as work from a previous year.

### **Supervision and authentication of internally assessed work**

The Head of Centre is responsible for ensuring that internally assessed work is conducted in accordance with City & Guilds instructions and JCQ instructions.

City & Guilds requires:

- learners to sign the record form to confirm that the work submitted is their own
- tutors to confirm on the record form that the work assessed is solely that of the learner concerned and was conducted under the conditions laid down in the handbook and assessment pack
- the supervisor/tutor responsible for internal standardisation also to sign the Centre Declaration Sheet (CDS) to confirm that internal standardisation has taken place and that the work presented is that of the learners named. If only one teacher has undertaken the marking, that person must sign this form.

The completed record form must be attached to each learner's work and the Centre Declaration Sheet must be sent to the moderator. Failure to sign either or both the record form and the CDS may delay the processing of the learners' results.

The supervisor/tutor should be sufficiently aware of the learner's standard and level of work to appreciate if the work submitted is beyond the ability of the learner and further confirmation of authenticity is required.

If it is believed that a learner has received assistance within bounds of what is acceptable in the guidelines for the internally assessed assessment, the supervisor/tutor should carry out marking which represents the learner's unaided achievement. The authentication statement should be signed and information given on the relevant form.

If the supervisor/tutor is unable to sign the authentication statement for a particular learner, then the learner's work cannot be accepted for assessment.

## Retaining evidence

The centre must retain the work of all learners for each assessment, with record forms attached, under secure conditions, from the time it is assessed, to allow for the possibility of an enquiry about results. The work may be returned to learners after the deadline for enquiries about results. If an enquiry about a result has been made, the work must remain under secure conditions in case it is required by City & Guilds.

## Malpractice

Please refer to the City & Guilds guidance notes *Managing cases of suspected malpractice in examinations and assessments*. This document sets out the procedures to be followed in identifying and reporting malpractice by learners and/or centre staff and the actions which City & Guilds may subsequently take. The document includes examples of learner and centre malpractice and explains the responsibilities of centre staff to report actual or suspected malpractice. Centres can access this document on the City & Guilds website.

Examples of learner malpractice are detailed below (note that this is not an exhaustive list):

- falsification of assessment evidence or results documentation
- plagiarism of any nature
- collusion with others
- copying from another candidate (including the use of ICT to aid copying), or allowing work to be copied
- deliberate destruction of another's work
- false declaration of authenticity in relation to the contents of a portfolio or coursework
- impersonation.

These actions constitute malpractice, for which a penalty (eg disqualification from the examination) will be applied.

Where suspected malpractice in internally assessed work is identified by a centre after the learner has signed the declaration of authentication, the Head of Centre must submit full details of the case to City & Guilds at the earliest opportunity. Please refer to the form in the document *Managing cases of suspected malpractice in examinations and assessments*. Alternatively, please complete the form, JCQ/M1. Copies of this form can be found on the JCQ website: <http://www.jcq.org.uk>

Malpractice in internally assessed work discovered prior to the learner signing the declaration of authentication need not be reported to City & Guilds but should be dealt with in accordance with the centre's internal procedures. City & Guilds would expect centres to treat such cases very seriously. Details of any work which is not the learner's own must be recorded on the cover sheet or other appropriate place.

## Factors affecting individual learners

If work is lost, City & Guilds should be notified immediately of the date of the loss, how it occurred, and who was responsible for the loss. Centres should use the JCQ form, JCQ/LCW, to inform City & Guilds Candidate Support of the circumstances.

Learners who move from one centre to another during the course may require individual attention. Possible courses of action depend on the stage at which the move takes place. If the move occurs early in the course, the new centre should take responsibility for assessment. If it occurs late in the course it may be possible to arrange for the moderator to assess the work through the 'Educated Elsewhere' procedure. Centres should contact City & Guilds at the earliest possible stage for advice about appropriate arrangements in individual cases.

## 5 Administration

### Quality assurance

#### Quality assurance of assessments

Centres must use the provided documentation, unless otherwise agreed, to ensure that all of the appropriate information is available for moderation processes. Centres may devise additional documentation/forms to support those provided by City & Guilds. If a learner's work is selected for external moderation, samples of work must be made available.

#### Internal quality assurance

Registered centres must have effective quality assurance systems to ensure optimum delivery and assessment of qualifications. Quality assurance includes initial centre registration by City & Guilds and the centre's own internal procedures for monitoring quality. Centres are responsible for internal quality assurance and City & Guilds is responsible for external quality assurance.

Standards and rigorous quality assurance are maintained by the use of:

- internal quality assurance
- City & Guilds external moderation.

In order to carry out the quality assurance role, Internal Quality Assurers must have appropriate teaching and vocational knowledge and expertise. For more information on the requirements, refer to Section 2 of this handbook.

To meet the quality assurance criteria for this qualification, the centre must ensure that the following procedures are followed:

- the setting of the internally set and marked assessment against the specification
- suitable training of staff involved in the assessment of the qualification to ensure they understand the process of marking and standardisation
- completion by the person responsible for internal standardisation of the Centre Declaration Sheet to confirm that internal standardisation has taken place
- the completion by learners and supervisors/assessors of the record form for each learner's work.

#### External quality assurance

External quality assurance is provided by the two-stage moderation system described in Section 6. External moderation of internally assessed work is carried out to ensure that assessment is valid and reliable, and that there is good assessment practice in centres and that standards are maintained.

City & Guilds requires the Head of Centre to

- facilitate any inspection of the Centre which is undertaken on behalf of City & Guilds make secure arrangements to receive, check and keep examination material secure at all times, maintain the security of City & Guilds confidential material from receipt to the time when it is no longer confidential and keep scripts secure from the time they are collected from the candidates to their dispatch to City & Guilds.

## 6 Units

## Unit 101/001

## Understand Health, Safety and Environmental Considerations

<b>UAN:</b>	J/507/0649
<b>Level:</b>	Level 3
<b>GLH:</b>	65
<b>Endorsement by a sector or regulatory body:</b>	This unit is endorsed by the electrotechnical apprenticeship employer group
<b>Aim:</b>	This unit will provide learners with an understanding of the relevant Health and Safety legislation, practices and procedures when installing and maintaining electrical systems and equipment. The knowledge covered in this unit underpins the practical application of Health and Safety legislation, practices and procedures.
<b>Assessment type</b>	On-screen (001) multiple-choice assessment (closed book) and practical tasks (101)

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### Learning outcome:

The learner will:

1. Understand how relevant legislation applies in the workplace

### Assessment criteria

The learner can:

1. identify **roles** and responsibilities with regard to current **relevant Health and Safety legislation**
2. identify roles and responsibilities with regard to current relevant **environmental legislation**

---

### Range

#### Roles:

- Employers
- Employees
- Organisations
- Clients.

#### Relevant Health and Safety legislation:

- The Health and Safety at Work Act
- The Electricity at Work Regulations
- The Management of Health and Safety at Work Regulations
- Workplace (Health and Safety and Welfare) Regulations
- Control of Substances Hazardous to Health (COSHH) Regulations

- Working at Height Regulations
- Personal Protective Equipment at Work Regulations
- Manual Handling Operations Regulations
- Provision and Use of Work Equipment Regulations
- Control of Asbestos at Work Regulations.

**Relevant Environmental legislation:**

- Control of Asbestos at Work Regulations
- Environmental Protection Act
- The Hazardous Waste Regulations
- Pollution Prevention and Control Act
- Control of Pollution Act
- The Control of Noise at Work Regulations
- The Waste Electrical and Electronic Equipment Regulations.

**Learning outcome**

**2. Understand the procedures for dealing with Environmental and Health and Safety situations in the work environment**

**Assessment criteria**

1. state the procedures that should be followed in the case of accidents which involve injury, including requirements for the treatment of electric shock/electrical burns
2. specify **appropriate procedures** which should be followed when emergency situations occur in the workplace
3. state the actions to be taken in situations which exceed their level of responsibility for Health and Safety in the workplace
4. specify **appropriate responsible persons** to whom Health and Safety and welfare related matters should be reported.
5. describe the **ways in which the environment may be affected by work activities**
6. specify the current **requirements and good working practices** for processing waste on site
7. explain why it is important to report any hazards to the environment that arise from work procedures

**Range**

**Appropriate procedures:**

- Procedures for summoning emergency services
- Information that emergency services require
- Alarm and evacuation procedures
- Designated escape routes
- Fire fighting procedures
- Application of first aid
- RIDDOR reporting procedure.

**Appropriate responsible persons:**

- Employer
- Employees
- Customer/client

- Safety officers
- Health & Safety executive/inspectors
- Trades union representative.
- Environmental health officers

**Effect of work activities:**

- Land contamination
- Air pollution
- Pollution of water courses.

**Requirements and good working practices:**

- Recycling
- Hazardous waste
- Landfill.

**Learning outcome**

3. **Be able to demonstrate and understand the procedures for establishing a safe working environment**

**Assessment criteria**

1. state the procedure for producing risk assessments and method statements in accordance with their level of responsibility
2. describe the procedures that should be taken to remove or minimise risks before deciding PPE is needed
3. state the purpose of PPE
4. specify the appropriate protective clothing and equipment that is required for identified work tasks
5. state the first aid facilities that must be available in the work area in accordance with Health and Safety regulations
6. explain why it is important not to misuse first aid equipment/supplies and to replace first aid supplies once used
7. describe and demonstrate safe practices and **procedures** for the use of **equipment and materials** in the working environment
8. specify and demonstrate the procedures for ensuring electrical systems are safe to work on
9. state the **implications** of:
  - a. carrying out safe isolation procedures
  - b. not carrying out safe isolation procedures.

**Range**

**Procedures:**

- Responsible persons
- Competent persons
- Safe isolation procedures
- Permits to work
- Selection and checking correct power tools, hand tools or portable electrical equipment.



### Equipment and materials:

- Access equipment (PASMA requirements)
- Portable power tools (eg cartridge gun, drills, grinders)
- Tools and materials storage facilities
- Dangerous substances (eg cutting compounds and adhesives)
- Ladders
- Use of mobile scaffold towers
- Use of signs and guarding.

### Implications:

- Self
  - Others
  - Building systems.
- 

## Learning outcome

### 4. Understand the requirements for identifying and dealing with hazards in the work environment

#### Assessment criteria

1. identify warning signs for the seven main groups of hazardous substance, as defined by The Chemical (Hazard Information and Packaging for Supply) Regulations (CHIP)
  2. define what is meant by the term hazard in relation to Health and Safety legislation in the workplace
  3. identify **specific hazards** associated with the installation and maintenance of electrical systems and equipment
  4. describe **situations** which can constitute a hazard in the workplace
  5. explain practices and procedures for addressing **hazards in the work place** (inferred through practical)
  6. identify the correct type of fire extinguisher for a particular type of fire
  7. explain situations **where asbestos may be encountered**
  8. specify the procedures for dealing with the suspected presence of asbestos in the workplace
- 

## Range

### Specific hazards:

- Electric shock (direct and indirect contact)
- Burns
- Fires
- Explosions.

### Situations:

- Temporary electrical supplies
  - Trailing leads/cables
  - Slippery or uneven surfaces
  - Presence of dust and fumes
  - Handling and transporting equipment or materials
  - Contaminants and irritants
-

- Fire
- Working at height
- Hazardous malfunctions of equipment
- Improper use, maintenance and storage of tools and equipment.

**Hazards in the workplace:**

- Temporary electrical supplies
- Trailing leads/cables
- Slippery or uneven surfaces
- Presence of dust and fumes
- Handling and transporting equipment or materials
- Contaminants and irritants
- Fire
- Working at height
- Hazardous malfunctions of equipment
- Improper use and storage of tools and equipment
- Bacteria: Weil's disease
- Use of signs to warn of hazards.

**Where asbestos may be encountered:**

- In decorative finishes (aertex, plaster, floor tiles)
- In accessories (flash guards and matting in fuse carriers and on distribution board covers)
- In insulation storage compartments, vessels and pipework.

# **Unit 101/001 Understand Health, Safety and Environmental Considerations**

## Notes for guidance

In the delivery of this unit emphasis shall be made to the learner on the necessity to keep up to date with the latest standards, technologies and practices which relate to and affect the topics covered in this unit. This is then in keeping with good engineering practice.

For unit 101 candidates who successfully complete both the assignment (101) and the evolve test (001) and are a registered apprentice with the JIB they will be exempt from having to do the ECS Health and Safety Assessment. Providers will be able to apply for ECS cards on behalf of all of their Trailblazer apprentices

## Unit 102

## Apply Health, Safety and Environmental Considerations

<b>UAN:</b>	A/507/0650
<b>Level:</b>	Level 3
<b>GLH:</b>	10
<b>Endorsement by a sector or regulatory body:</b>	This unit is endorsed by the electrotechnical apprenticeship employer group
<b>Aim:</b>	This unit is designed to enable learners to develop the skills and apply the relevant knowledge associated with Health and Safety legislation, practices and procedures when installing and maintaining electrical systems and equipment.

**Assessment type** Portfolio of evidence

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### Learning outcome:

1. Be able to apply relevant Health and Safety legislation in the workplace

### Assessment criteria

1. identify which workplace Health and Safety procedures are relevant to the working environment and comply with their duties and obligations as defined by current legislation and organisational procedures
2. produce a risk assessment and method statement in accordance with organisational procedures for a given work activity
3. work within the requirements of:
  - a. risk assessments
  - b. method statements
  - c. safe systems of work.

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### Learning outcome

2. Be able to assess the work environment for hazards and identify remedial actions in accordance with Health and Safety legislation

### Assessment criteria

1. identify unsafe situations and conditions and take remedial actions
2. assess the work environment and revise work practices accordingly to take into account hazards which could cause harm, including the handling of potentially hazardous:
  - a. materials
  - b. tools
  - c. equipment.

3. identify any hazards which may present a high risk and report their presence to relevant persons who have overall responsibility for Health and Safety in the workplace
4. apply measures to control Health and Safety hazards
5. select and use correct personal protective equipment

---

### Learning outcome

#### 3. Be able to apply methods and procedures to ensure work on site is in accordance with Health and Safety legislation

#### Assessment criteria

1. demonstrate a level of personal conduct and behaviour within the workplace, to ensure that the Health and Safety of themselves and others is not endangered
2. apply procedures to ensure the safe use, maintenance and storage of tools, plant and equipment as stipulated in:
  - a. workplace policies (company and site)
  - b. supplier information
  - c. manufacturer's instructions.
3. comply with information, warning, mandatory instruction and prohibition notices
4. apply procedures to ensure the safety of the work location through the correct use of guards barriers and notices
5. use **access equipment** correctly

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### Range

#### Access equipment:

Assess two from the following:

- ladder
- tower scaffold or mewp
- stepladder
- platform.

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### Learning outcome

#### 4. Be able to work in accordance with environmental legislation for electrical services

#### Assessment criteria

1. demonstrate appropriate procedures for the safe handling, storage and disposal of hazardous materials and products, in accordance with one of the following:
  - Environmental Protection Act
  - the Hazardous Waste Regulations
  - Pollution Prevention and Control Act
  - Control of Pollution Act
  - the Control of Noise at Work Regulations
  - Environment Act.

## Unit 102

# Apply Health, Safety and Environmental Considerations

## Supporting Information

### Notes for guidance

Prior to undertaking this unit a learner must provide auditable evidence that they have the relevant knowledge and understanding as detailed in the unit:

- Unit 101 – Understand Health, Safety and Environmental considerations for electrical systems

### Evidence requirements

Learning Outcomes 1 to 5:

Auditable evidence sourced from a real working environment must be provided to illustrate that, the learner has demonstrated on two separate occasions they can apply Health and Safety legislation and working practices when Installing and Maintaining Electrical Systems and Equipment in accordance with approved industry practices, statutory and non-statutory regulations and the assessment criteria for each of the learning outcomes.

In this unit the learner is subject to direct observation on at least **two** separate occasions in the workplace by a qualified assessor. Reflective accounts will not be accepted as evidence for this unit. Any outstanding performance criteria that are not met through the direct observation must be supplemented by alternate evidence provided by the employer.

As a minimum, **one** of the two direct observations must be a physical, face to face, site visit with an assessor, the second direct observation may be live streamed online assessment with an assessor. On both occasions this should be fully documented and made available for quality assurance.

## Unit 103/003

## Electrical Scientific Principles and Technologies

<b>UAN:</b>	F/507/0651
<b>Level:</b>	Level 3
<b>GLH:</b>	115
<b>Endorsement by a sector or regulatory body:</b>	This unit is endorsed by the electrotechnical apprenticeship employer group
<b>Aim:</b>	This unit is designed to enable learners to understand the relationship between electrical scientific principles and the competencies required of a qualified electrical operative. Its content is the knowledge needed by a learner to underpin the application of skills in the installation and maintenance of electrical systems and equipment.
<b>Assessment type</b>	On-screen multiple-choice assessment (003) or (303 for resit), centre marked written question paper and practical activity (103)

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### Learning outcome:

1. Understand mathematical principles which are appropriate to electrical installation, maintenance and design work

### Assessment criteria

1. identify and apply appropriate **mathematical principles** which are relevant to electrical work tasks

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### Range

#### Mathematical principles:

- Fractions and percentages
- Algebra
- Indices
- Transposition
- Triangles and trigonometry
- Statistics.

## Learning outcome

2. Understand standard units of measurement used in electrical installation, maintenance and design work

## Assessment criteria

1. identify and use internationally recognised base and derived **(SI) units of measurement**
  2. identify and determine values of base and derived SI units which apply specifically to **electrical quantities**
  3. identify appropriate electrical instruments for the measurement of different **electrical quantities**
- 

## Range

### (SI) Units of measurement for:

- Length
- Area
- Volume
- Mass
- Density
- Time
- Temperature
- Velocity.

### Electrical quantities (SI units):

- Resistance
- Resistivity
- Power
- Frequency
- Current
- Voltage
- Energy
- Impedance
- Inductance and inductive reactance
- Capacitance and capacitive reactance
- Power factor.

### Electrical quantities (measurement):

- Resistance
  - Power
  - Current
  - Voltage
  - Energy.
- 

## Learning outcome

3. Understand basic mechanics and the relationship between force, work, energy and power



### Assessment criteria

1. specify what is meant by mass and weight
  2. explain the principles of basic mechanics as they apply to **levers**, gears and pulleys
  3. describe the main principles of the following and their inter-relationships:
    - a. force
    - b. work
    - c. energy (kinetic and potential)
    - d. power
    - e. efficiency.
  4. calculate values of mechanical energy, power and efficiency
- 

### Range

#### Levers:

- class I
  - class II
  - class III
- 

### Learning outcome

4. **Understand the relationship between resistance, resistivity, voltage, current and power**

### Assessment criteria

1. describe the basic principles of electron theory
  2. identify and distinguish between materials which are good conductors and insulators
  3. describe what is meant by resistance and resistivity in relation to electrical circuits
  4. explain the relationship between current, voltage and resistance in parallel and series D.C. circuits
  5. calculate the values of current, voltage and resistance in parallel and series D.C. circuits
  6. calculate values of power in parallel and series D.C. circuits
  7. state what is meant by the term voltage drop in relation to electrical circuits
  8. describe the chemical and thermal effects of electric currents
- 

### Learning outcome

5. **Understand the fundamental principles which underpin the relationship between magnetism and electricity**

### Assessment criteria

1. describe the effects of magnetism in terms of attraction and repulsion
  2. state the difference between magnetic flux and flux density
  3. describe the magnetic effects of electrical currents in terms of:
    - a. production of a magnetic field
    - b. force on a current-carrying conductor in a magnetic field
    - c. electromagnetism
    - d. electromotive force.
  4. describe the basic principles of generating an A.C. supply in terms of:
    - a. a single-loop generator
    - b. sine-wave
-

- c. frequency
  - d. EMF
  - e. magnetic flux.
5. identify the **characteristics of sine-waves**
- 

### Range

#### Characteristics of a sine-wave:

- Root Mean Square (RMS) value
  - Average value
  - Peak to peak value
  - Periodic time
  - Frequency
  - Amplitude.
- 

### Learning outcome

6. **Understand the types, applications and limitations of electronic components in electrical systems and equipment**

### Assessment criteria

1. describe the function and application of electronic components that are used in **electrical systems**
  2. state the basic operating principles of **electronic components and devices**
- 

### Range

#### Electrical systems:

- Security alarms
- Telephones
- Dimmer switches
- Heating/boiler controls
- Motor control
- Wireless control systems.

#### Electronic components and devices:

- Capacitors
  - Resistors
  - Rectifiers
  - Diodes
  - Zener
  - LED
  - photo
  - Thermistors
  - Diacs
  - Triacs
  - Transistors
  - Thyristors
  - Invertors.
-

---

## Learning outcome

### 7. Understand electrical supply systems

#### Assessment criteria

1. describe how electricity is generated and transmitted for domestic and industrial/commercial consumption
2. specify the **features and characteristics** of a generation and transmission system
3. state the basic operating principles of **other sources** of electricity
4. describe the main characteristics of:
  - a. single phase electrical supplies
  - b. three phase electrical supplies
  - c. three phase and neutral supplies
  - d. sub-station transformers.
5. identify types of transformers
6. describe the **operating principles, applications and limitations** of transformers
7. determine by calculation and measurement:
  - a. primary and secondary voltages
  - b. primary and secondary current
  - c. kVA rating of a transformer.

---

#### Range

##### Features and characteristics:

- Power Stations
- Fossil fuels
- Hydro
- Nuclear
- Super-grid and standard grid system
- Transformers
- Transmission voltages
- Distribution voltages
- Sub-stations
- Above and below ground distribution.

##### Other sources:

- Batteries, cells or UPS systems
- Solar power (thermal and photovoltaic)
- Wind energy
- Wave energy
- Micro hydro
- Combined Heat and Power (CHP) including micro CHP.

##### Operating principles, applications and limitations:

- Iron loss
- Copper loss
- Relationship between current and voltage
- Primary and secondary windings

- Step up and step down transformers.
- 

### Learning outcome

#### 8. Understand how different electrical properties can affect electrical circuits, systems and equipment

##### Assessment criteria

1. explain the relationship between resistance, inductance, capacitance and impedance
  2. determine **electrical quantities** in alternating current circuits
  3. explain the relationship between kW, kVAr, kVA and power factor
  4. calculate power factor
  5. explain what is meant by power factor correction
  6. specify methods of power factor correction
  7. determine the neutral current in a three-phase and neutral supply and why systems should be balanced
  8. calculate values of voltage and current in star and delta connected systems
- 

### Range

#### Electrical quantities:

- Resistance
  - Inductance
  - Inductive reactance
  - Capacitance
  - Capacitive reactance
  - Impedance.
- 

### Learning outcome

#### 9. Understand the operating principles and applications of DC machines and AC motors

##### Assessment criteria

1. state the basic types, applications and describe the operating principles of **DC machines**
  2. describe the operating principles of **AC motors**
  3. state the basic types, applications and limitations of **AC motors**
  4. describe the basic operating principles, limitations and applications of **motor control**
- 

### Range

#### DC machines:

- Series
- Shunt
- Compound.

#### AC motors:

- single phase AC motors (induction, capacitor start, split phase, universal, synchronous)
- three phase AC motors (induction; wound-rotor).

#### Motor control:

- Direct-on-line
-

- Star-Delta
  - Rotor-resistance
  - Soft-start
  - Variable frequency.
- 

### Learning outcome

#### 10. Understand the operating principles of electrical components

##### Assessment criteria

1. specify the main types and operating principles of **electrical components**
- 

### Range

#### Electrical components:

- Contactors
  - Relays
  - Solenoids
  - Over-current protection devices:
    - Fuses (HRC, cartridge and re-wireable)
    - Circuit-breakers
    - RCBOs.
  - RCDs.
- 

### Learning outcome

#### 11. Understand the principles and applications of electrical lighting systems

##### Assessment criteria

1. explain the basic principles of illumination and state the applications of:
    - a. inverse square law
    - b. cosine law
    - c. lumen method.
  2. explain the operating principles, types, limitations and applications of **luminaires**
- 

### Range

#### Luminaires:

- General Lighting Service (GLS):
    - Tungsten
    - Halogen.
  - Discharge lighting:
    - Low and high pressure mercury vapour
    - Low and high pressure sodium vapour
    - Metal halide.
  - Energy saving (such as compact fluorescent lamps)
  - LED.
- 

### Learning outcome

#### 12. Understand the principles and applications of electrical heating

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## Assessment criteria

1. explain the basic principles of electrical space heating and electrical water heating
2. explain the operating principles, types, limitations and applications of **electrical space and water heating appliances and components**

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## Range

### Electrical space and water heating appliances and components:

- Convection cycle
- Conduction
- Radiation
- Immersion heaters
- Storage heaters
- Convector heaters
- Under floor heating
- Controls, timers and programmers for heating systems.

## **Unit 103/003**

# **Electrical Scientific Principles and Technologies**

## Supporting Information

Notes for guidance

Practical support learning activity

Given the safety-critical nature of this topic it is a requirement that learners will have their knowledge consolidated by the use of 'Practical Support Learning' activity in simulated conditions as appropriate.

In the delivery of this unit an emphasis shall be made to the learner on the necessity to keep up to date with the latest standards, technologies and practices which relate to and affect the topics covered in this unit. This is then in keeping with good engineering practice.

## Unit 104/004

## Understand Design and Installation Practices and Procedures

<b>UAN:</b>	J/507/0652
<b>Level:</b>	Level 3
<b>GLH:</b>	170
<b>Endorsement by a sector or regulatory body:</b>	This unit is endorsed by the electrotechnical apprenticeship employer group
<b>Aim:</b>	<p>This unit is designed to enable the learner to develop the skills required, and apply the associated knowledge, in order that they are able to demonstrate the competence required to design, prepare and install wiring systems and associated equipment in buildings, structures and the environment in accordance with approved industry practices, statutory and non-statutory regulations:</p> <ul style="list-style-type: none"><li>• The Electricity at Work Regulations (1989)</li><li>• The current edition of BS7671</li><li>• Health &amp; Safety Act (1974)</li><li>• Building Regulations (2000)</li></ul>
<b>Assessment type</b>	Assignment (104) and e-volve MC test (004)

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### Learning outcome:

#### 1. Understand how to prepare for the installation of wiring systems

### Assessment criteria

1. identify **relevant sources of information** which will inform electrical work
2. describe the **actions required** to ensure that electrical work sites are correctly prepared in terms of Health and Safety considerations
3. state why it is important to check for any pre-existing damage to **customer/client property** prior to commencement of any work activity
4. explain how to check for any pre-existing damage to **customer/client property**:
  - a. Equipment and components
  - b. Building décor and floor finishes.
5. state the actions that should be taken if pre-existing damage to customer/client property is identified
6. specify methods for protecting the fabric and structure of the property before and during electrical work

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### Range

#### Relevant sources of information:

- Statutory documents
- Codes of Practice



- British Standards
- Site drawings
- Installation specifications – Wiring diagrams; Fitting and Fixing dimensions/drawings; Technical data
- Manufacturer's instructions.

#### **Actions required:**

- Provision for safe access and egress
- Checking immediate work location for potential hazards as appropriate to property, personnel and livestock
- Know the requirements for the completion of a risk assessment
- Confirm that appropriate risk assessments and method statements have been produced.

#### **Customer/client property:**

- Building wall/floor fabric.

### **Learning outcome**

#### **2. Understand the applications of wiring systems**

#### **Assessment criteria**

1. explain the constructional features, applications, advantages and limitations of **electrical cables**
2. explain the **characteristics** of **containment, support and wiring systems** used in electrical installations
3. determine the size of conduit and trunking as appropriate to the size and number of cables
4. describe the **factors** which affect the selection of **wiring systems, associated equipment and enclosures.**
5. Assess and select suitable wiring systems and equipment appropriate to the situation and use

### **Range**

#### **Electrical cables:**

- Single and multicore thermosetting insulated cables including flexible cables
- Single and multicore thermoplastic (PVC) and thermosetting insulated cables and flexible cables
- PVC/PVC flat profile cable
- MICC (with and without PVC sheath)
- SWA cables
- Armoured/braided flexible cables and cords
- Data cables
- Fibre optic cable
- Fire resistant cable.

#### **Characteristics:**

- Constructional features
- Applications
- Advantages
- Limitations.

### **Containment, support and wiring systems:**

- Conduit (PVC and Metallic)
- Trunking (PVC and Metallic)
- Cable Tray
- Cable Basket
- Ladder systems
- Ducting
- Modular wiring systems
- Busbar systems and Powertrack.

### **Factors:**

- Building
- Utilisation
- Environment
- Cost.

### **Wiring systems and equipment:**

- Lighting systems
- Power systems (final circuits)
- Distribution systems (sub mains)
- Environmental control/building management systems
- Emergency management systems
- Security systems – Fire Alarm/Prevention; Unlawful Entry; Emergency Lighting
- Closed Circuit TV, communication and data transmission systems
- Escape routes.

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## **Learning outcome**

### **3. Understand the practices and procedures for carrying out electrical work**

#### **Assessment criteria**

1. state the procedures for selecting and safely using appropriate hand tools, power tools and adhesives for electrical work
2. state the procedures for selecting and safely using equipment for measuring and marking out for wiring systems, equipment and enclosures
3. state the criteria for selecting and safely using tools and equipment for fixing and installing wiring systems, associated equipment and enclosures
4. state the **criteria** for selecting and safely using fixing devices for wiring systems, associated equipment and enclosures
5. assess and specify the installation methods and procedures to ensure that in accordance with the installation specification and statutory and non-statutory regulations:
  - a. wiring systems, enclosures, cables and components are securely fixed and installed
  - b. a wiring system's mechanical integrity is maintained
  - c. no damage to the wiring system or its components has occurred
6. specify methods and techniques for restoring the building fabric

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## Range

### Criteria:

- Load bearing capacity
- Fabric of structure
- Environmental considerations
- Aesthetic considerations.

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## Learning outcome

### 4. Understand the characteristics and applications of supply systems and consumer's equipment

#### Assessment criteria

1. explain the characteristics and applications of **earthing arrangements**
2. explain the characteristics and applications of **supply systems**
3. specify the arrangements for electrical installations and systems with regard to provision for
  - a. Isolation and switching
  - b. Overcurrent protection
  - c. Earth fault protection.

---

## Range

### Earthing arrangements:

- TN-S
- TNC-S
- TN-C
- TT
- IT systems.

### Supply systems:

- Single phase
- Three phase
- Three phase and neutral.

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## Learning outcome

### 5. Understand earthing and protection

#### Assessment criteria

1. explain the purpose of earthing and protective conductors
2. identify extraneous and exposed conductive parts
3. describe the requirements and measures for protection against electric shock
4. state the maximum disconnection time for different types of circuit
5. explain the earth fault loop path and earth fault loop impedance
6. specify requirements and applications of functional earthing
7. select suitably sized protective conductors in accordance with BS 7671

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### Learning outcome:

#### 6. Understand protection against overcurrent

##### Assessment criteria

1. identify types of and reasons for **overcurrent**
  2. explain the operating principles, applications and limitations of **protective devices**
  3. identify fault current capacities of devices
  4. outline the need for discrimination between protective devices
- 

### Range

#### Overcurrent:

- Short circuits
- Earth Faults
- Overloads.

#### Protective devices:

- Fuses
  - CBs
  - RCDs/RCBOs, circuit overload and short-circuit protection
  - (BS3036, re-wireable, BS1361/2 cartridges, BS88 HBC).
- 

### Learning outcome:

#### 7. Understand electrical systems and circuits

##### Assessment criteria

1. describe the characteristics of standard **electrical circuits**
  2. outline the key characteristics of particular **electrical systems and circuits** and the applications of these circuits and systems
- 

### Range

#### Electrical circuits:

- Lighting circuits
- Socket outlet circuits
- Supplies to fixed equipment.

#### Electrical systems and circuits:

- Distribution systems (sub mains)
  - Environmental control/building energy management systems
  - Emergency Lighting
  - Security systems – Fire Alarm/Prevention; Unlawful Entry; Emergency Lighting
  - UPS
  - Closed Circuit TV, communication and data transmission systems
  - Machine control
  - Heating control.
-

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## Learning outcome:

### 8. Understand the electrical design procedure

#### Assessment criteria

1. state the purpose of diversity factors
2. select suitable current using equipment giving consideration to energy efficiency and relevant codes of practice for sustainability
3. determine the maximum demand (of an installation) after the application of diversity
4. determine the design current
5. select a suitably rated protective device
6. establish the installation method reference
7. determine appropriate rating factors
8. determine the minimum cross-sectional area of live conductors taking into consideration current carrying capacity and voltage drop
9. establish if the voltage drop is acceptable
10. verify if the disconnection times have been achieved
11. evaluate thermal constraints
12. interpret the requirements of **sources of information** in the design of an installation

---

#### Range

##### Sources of information:

- BS 7671
- Guidance notes
- Other relevant standards.

# **Unit 104/004 Understand Design and Installation Practices and Procedures**

## Supporting Information

### Notes for guidance

In the delivery of this unit an emphasis shall be made to the learner on the necessity to keep up to date with the latest standards, technologies and practices which relate to and affect the topics covered in this unit. This is then in keeping with good engineering practice.

## Unit 105/505

## Understand How to Plan and Oversee Electrical Work Activities

<b>UAN:</b>	L/507/0653
<b>Level:</b>	Level 3
<b>GLH:</b>	40
<b>Endorsement by a sector or regulatory body:</b>	This unit is endorsed by the electrotechnical apprenticeship employer group
<b>Aim:</b>	This unit is designed to enable learners to understand the practices and procedures used when planning electrical installation and maintenance work activities. Its content is the knowledge needed by a learner to underpin the application of skills for overseeing and organising the work environment.
<b>Assessment type</b>	Online multiple choice (505) (closed book) and project (105) (open book)

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### Learning outcome

1. Understand the requirements for liaising with others when organising and overseeing work activities

### Assessment criteria

1. describe techniques for the communication with **others** for the purpose of:
  - a. motivation
  - b. instruction
  - c. monitoring
  - d. co-operation and teamwork
2. describe **methods** of determining the competence of operatives for whom they are responsible
3. specify procedures for re-scheduling work to co-ordinate with changing conditions in the workplace and to coincide with other trades
4. specify **organisational procedures** for completing the documentation that is required during work operations

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### Range

#### Others:

- Customers
- Clients
- Site managers
- Major Contractors (where appropriate)
- Sub-contractors (where appropriate)

- Other services
- The public
- Employer.

Note: With reference to the above range this includes candidates to perform to their highest standard and to work within the conduct expected of an employee in the industry. Such standards are of high importance when co-operating with employer and/or customer during work activities.

#### Methods:

- Checking competency cards (eg. CSCS cards, JIB cards)
- Checking technical qualifications
- Written references from previous employers
- Informal monitoring of performance on site
- Competent Person Scheme Registration.

#### Organisational Procedures:

- Variation order
- Day worksheets
- Timesheets
- Site diary
- Requisitions
- Delivery note.

## Learning outcome

### 2. Understand the requirements for organising and overseeing work programmes

#### Assessment criteria

1. describe how to plan and implement:
  - a. work allocations
  - b. duties of operative for whom they are responsible
  - c. coordination with other services and personnel.
2. state the procedures for carrying out work activities that will:
  - a. maintain the safety of the work environment
  - b. maintain cost effectiveness
  - c. ensure compliance with the programmes of work.
3. identify the **industry standards** that are relevant to activities carried out during the installation of electrical systems and equipment, including the **current editions**
4. evaluate within the scope of the work programme and operations the responsibilities of themselves and others
5. identify the **procedures** for dealing with changes to an original contract specification
6. identify installations that require specialist advice or guidance:
  - a. Hazardous installations
  - b. Installations outside the scope of BS 7671.
7. explain how the work completion time is estimated taking into account **influential factors**
8. state the possible consequences of not:
  - a. completing work within the estimated time
  - b. meeting the requirements of the programme of work
  - c. using the specified materials
  - d. installing materials and equipment as specified.



## 9. specify and evaluate methods of producing and illustrating **work programmes**

---

### Range

#### Current editions of industry standards:

- Management of Health and Safety regulations
- Health & Safety at Work Act
- Electricity at Work regulations
- Construction design and management
- BS 7671 requirements for electrical installations
- BS EN graphical symbols
- Employment Rights Act
- Data Protection Act
- Equality Act
- Human Rights Act.

#### Procedures:

- Variation order
- Day work sheets
- Implications to work programme.

#### Influential factors:

- The deployment and availability of suitable personnel
- The delivery and availability of equipment, components and material
- Weather conditions
- Work to be completed by other services
- Specification variations.

#### Work programmes:

- Bar charts
- Spread sheets
- Critical Path Analysis.

---

### Learning outcome

#### 3. Understand the requirements for organising the provision and storage of resources that are required for work activities

#### Assessment criteria

1. interpret the installation specification and work programme to identify **resource** requirements
2. interpret the material schedule to confirm that materials available are:
  - a. the right type
  - b. fit for purpose
  - c. in the correct quantity
  - d. suitable for work to be completed cost efficiently.
3. specify the storage and transportation requirements for all materials required in the work location
4. specify procedures to ensure the safe and effective storage of materials, tools and equipment in the work location

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## Range

### Resource:

- Materials
- Components
- Plant
- Vehicles
- Equipment
- Labour
- Tools
- Measuring and test instruments.

## Unit 106

## Organise and Oversee the Electrical Work Environment

<b>UAN:</b>	R/507/0654
<b>Level:</b>	Level 3
<b>GLH:</b>	12
<b>Endorsement by a sector or regulatory body:</b>	This unit is endorsed by the electrotechnical apprenticeship employer group
<b>Aim:</b>	This unit is designed to enable learners to develop the skills required, and apply the associated knowledge, so that they can demonstrate that they can implement practices and procedures for overseeing and organising the work environment for the installation of electrical systems and equipment.
<b>Assessment type</b>	Portfolio of evidence

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### Learning outcome:

1. Be able to provide relevant people with technical and functional information for work on electrical systems and equipment

### Assessment criteria

1. liaise with relevant people to evaluate the information they require to ensure that systems, equipment or components can be operated safely and effectively
2. identify appropriate technical and functional information that is required for the work activity
3. provide information in a timely, courteous, suitable and professional manner in accordance with organisational procedures and engineering standards

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### Learning outcome

2. Be able to oversee Health and Safety during work on electrical systems and equipment

### Assessment criteria

1. produce, or revise generic, risk assessments and method statements, to cover their own work and others working the area (colleagues and other operatives) in accordance with their level of responsibility
2. implement suitable procedures to confirm that work is being completed in accordance with Health and Safety legislation and industry standards

---

### Learning outcome

#### 3. Be able to co-ordinate liaison with other relevant persons during work activities

##### Assessment criteria

1. select effective procedures to ensure co-ordination with other workers/contractors, including steps to resolve issues which are outside the scope of their job role
2. evaluate and apply communication techniques that are clear, accurate and appropriate to the situation.
3. demonstrate working effectively with colleagues to enhance performance

(Such as: undertaking work to the one's best ability, being a good employee/worker. Co-operating with the employer and/or customer during work activities).

---

### Learning outcome

#### 4. Be able to organise and oversee work activities and operations

##### Assessment criteria

1. organise operatives by allocating duties and responsibilities to make the best use of their competence and skill
2. monitor the work of operatives to ensure it is in accordance with:
  - a. industry working practices
  - b. programme of work
  - c. Health and Safety requirements
  - d. cost effectiveness
  - e. Environmental considerations.
3. evaluate and apply appropriate procedures to correct issues that arise during work activities

---

### Learning outcome

#### 5. Be able to organise a programme for working on electrical systems and equipment

##### Assessment criteria

1. produce a simple programme of work from the work specification, including requirements for the following:
  - a. estimate of the amount of time required for completion of the work
  - b. liaison with other trades where necessary.
2. communicate with others clearly and concisely
3. assess situations when it is necessary to liaise with other relevant parties to resolve issues.

---

### Learning outcome

#### 6. Be able to organise the resource requirements for work on electrical systems and equipment

## Assessment criteria

1. organise provision of **resources**
  2. confirm that materials available are:
    - a. the right type
    - b. fit for purpose
    - c. in the correct quantity
    - d. suitable for work to be completed cost efficiently.
  3. ensure that resources are undamaged at the point of delivery
  4. demonstrate effective measures which ensure the safe and effective storage of materials, tools and equipment in the work location
- 

## Range

### Resources:

- Materials
- fixings
- Plant
- Labour
- Tools.

## Unit 106

# Organise and Oversee the Electrical Work Environment

## Supporting Information

### Notes for guidance

Prior to undertaking this unit a learner must provide auditable evidence that they have the relevant knowledge and understanding as detailed in the unit:

- Unit 105 Understand the organising and overseeing of the electrical work environment (buildings and structures).

### Evidence requirements

Learning Outcomes 1 to 6 - Auditable evidence sourced from a real working environment must be provided to illustrate that, the learner has demonstrated on two separate occasions they can implement practices and procedures for overseeing and organising the work environment for the installation of electrical systems and equipment in accordance with the assessment criteria for each of the learning outcomes.

In the delivery of this unit an emphasis shall be made to the learner on the necessity to keep up to date with the latest standards, technologies and practices which relate to and affect the topics covered in this unit. This is then in keeping with good engineering practice.

## Unit 107

# Understand Terminations and Connections of Conductors

<b>UAN:</b>	Y/507/0655
<b>Level:</b>	Level 3
<b>GLH:</b>	93
<b>Endorsement by a sector or regulatory body:</b>	This unit is endorsed by the electrotechnical apprenticeship employer group
<b>Aim:</b>	This unit is designed to enable learners to understand and interpret the principles, practices and legislation associated with the termination and connection of conductors and cables in electrical systems. Its content is the knowledge needed by a learner to underpin the application of skills for terminating and connecting conductors and cables in electrical systems in accordance with statutory and non-statutory regulations/requirements.
<b>Assessment type</b>	Practical assessment with supplementary oral or written questioning. (107)

### Learning outcome:

1. Understand the regulatory requirements and procedures for terminating and connecting conductors and cables in electrical wiring systems and equipment

### Assessment criteria

1. identify and interpret appropriate **sources of relevant information** for the termination and connection of conductors and cables in electrical wiring systems and equipment
2. describe methods and procedures appropriate to the installation environment to ensure the safe and effective termination and connection of conductors and cables in electrical **wiring systems and equipment.**

### Range

#### Sources of relevant information:

- Statutory documents
- Codes of practice
- British standards
- BS 7671
- Manufacturers' instructions
- Installation specifications.

#### Wiring systems and equipment:

- Single and multicore thermosetting insulated cables including flexible cables
- Single and multicore thermoplastic (PVC) insulated cables including flexible cables
- PVC/PVC flat profile cable

- MICC (with and without PVC sheath)
  - SWA cables (XLPE, PVC)
  - Armoured/braided flexible cables
  - Data cables
  - Fibre optic cable
  - Fire performance cable.
- 

### Learning outcome

#### 2. Understand the procedures and applications of different methods of terminating, connecting and supporting conductors and cables in electrical wiring systems and equipment

#### Assessment criteria

1. explain the advantages, limitations and applications of the following connection methods:
    - a. screw
    - b. crimped
    - c. soldered
    - d. non-screw compression
    - e. insulation displacement.
  2. describe the procedures for verifying that terminations and connections are electrically and mechanically sound
  3. explain the consequences of terminations not being electrically and mechanically sound in terms of:
    - a. high resistance joints
    - b. corrosion and erosion.
  4. interpret and apply the techniques and methods for the **safe** and effective termination and connection of:
    - a. flexible cables
    - b. single and multicore thermoplastic (PVC) and thermosetting insulated cables
    - c. PVC/PVC flat profile cable
    - d. MICC
    - e. SWA cables
    - f. Galvanised steel wire braid
    - g. data cables
    - h. fire performance cable.
  5. apply techniques and methods for **effective support** of cables
- 

### Range

#### Safe:

- Selection and use of tools
- PPE
- Risk assessment
- Reporting of unsafe situations
- Adherence to relevant statutory and non-statutory regulations.

#### Effective support:

- PVC conduit
  - Metal conduit
  - Metal trunking
  - Metal tray.
-



## **Unit 107**

# **Understand Terminations and Connections of Conductors**

## Supporting Information

Notes for guidance

Practical support learning activity

Given the safety-critical nature of this topic it is a requirement that learners will have their knowledge consolidated by the use of 'Practical Support Learning' activity in simulated conditions. Assessment criteria 4.5 is supported by learning outcomes from unit 104; Understanding design and installation practices and procedures.

In the delivery of this unit an emphasis shall be made to the learner on the necessity to keep up to date with the latest standards, technologies and practices which relate to and affect the topics covered in this unit. This is then in keeping with good engineering practice.

<b>UAN:</b>	D/507/0656
<b>Level:</b>	Level 3
<b>GLH:</b>	12
<b>Endorsement by a sector or regulatory body:</b>	This unit is endorsed by the electrotechnical apprenticeship employer group
<b>Aim:</b>	<p>This unit is designed to enable the learner to develop the skills required, and apply the associated knowledge, in order that they are able to demonstrate the competence required to terminate and connect conductors and cables in electrical systems in accordance with approved industry practices, statutory and non-statutory regulations:</p> <ul style="list-style-type: none"> <li>• The Electricity at Work Regulations (1989)</li> <li>• The current edition of BS7671</li> <li>• Health &amp; Safety Act (1974)</li> <li>• Building Regulations (2000)</li> </ul>
<b>Assessment type</b>	Portfolio of evidence

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### Learning outcome:

#### 1. Prepare to terminate and connect cables and conductors

##### Assessment criteria

1. evaluate and apply appropriate procedures to include:
  - a. selecting appropriate tools/equipment to enable termination and connection
  - b. adopting appropriate PPE
  - c. following a safe system of work (eg. risk assessment, method statement, permit to work procedure).
2. assess and confirm it is safe to complete termination and connection in terms of:
  - a. Checking for presence of supply/carrying out safe isolation
  - b. Mechanical soundness of the electrical equipment to be connected to
  - c. Checking for unsafe situations.

---

### Learning outcome

#### 2. Terminate and connect conductors and cables

##### Assessment criteria

1. terminate and connect cables and conductors in accordance with manufacturers instructions, BS 7671, and any relevant drawing or specification

Assess four from the following:

- a. Single core (singles)
- b. Multicore insulated
- c. PVC - PVC flat profile cable
- d. MICC
- e. Fire performance
- f. SWA cable
- g. GSWB galvanised steel wire braid
- h. Data.

2. connect to electrical equipment in accordance with manufacturers instructions, BS 7671, and any relevant drawing or specification

Assess five from the following:

- a. Isolators /switches
- b. Socket outlets
- c. Distribution-boards / consumer control units
- d. Luminaires
- e. Electric motors / motor control equipment
- f. Overcurrent protective devices
- g. Earthing terminals
- h. Control panels
- i. Data socket outlets or data connections
- j. Fire detection/alarm components
- k. Other appropriate equipment (such as: heating system components).

3. terminate and connect conductors, using appropriate methods

Assess two from the following:

- a. Screwing
- b. Crimping
- c. Soldering
- d. Non-screw compression
- e. Insulation displacement.

4. ensure that terminations and connections are electrically and mechanically sound (Eg. by simple inspecting and testing terminations)
5. ensure cables have appropriate identification in accordance with BS 7671

## Unit 109

# Apply Design and Installation Practices and Procedures

<b>UAN:</b>	H/507/0657
<b>Level:</b>	Level 3
<b>GLH:</b>	20
<b>Endorsement by a sector or regulatory body:</b>	This unit is endorsed by the electrotechnical apprenticeship employer group
<b>Aim:</b>	<p>This unit is designed to enable the learner to develop the skills required, and apply the associated knowledge, in order that they are able to demonstrate the competence required to plan, prepare and install wiring systems and associated equipment in buildings, structures and the environment in accordance with approved industry practices, statutory and non-statutory regulations:</p> <ul style="list-style-type: none"><li>• The Electricity at Work Regulations (1989)</li><li>• The current edition of BS7671</li><li>• Health &amp; Safety Act (1974)</li><li>• Building Regulations (2000)</li></ul>
<b>Assessment type</b>	Portfolio of evidence

### Learning outcome:

#### 1. Prepare to install wiring systems, enclosures and associated equipment

#### Assessment criteria

1. assess and apply appropriate procedures to include:
  - a. Adopting appropriate PPE
  - b. Following a safe system of work (eg. working in accordance with a risk assessment and method statement)
  - c. Selecting appropriate tools/equipment for the installation work.
2. prepare to install wiring systems, enclosures and associated equipment, to include:
  - a. Confirm secure site storage facilities for tools, equipment, materials and components
  - b. Select materials (equipment and components) in accordance with the installation specification
  - c. Report any pre-work damage/defects to existing equipment or building features, to the relevant person (Such as: customer/client, site/line manager)
  - d. Confirm site readiness for installation work to begin
  - e. Confirm authorisation for the installation work to start.
3. use documentation to confirm that materials and equipment is of the correct quantity and is free from damage
4. ensure the planned locations for the wiring system and associated equipment are compatible with other building services (eg. gas, water or other electrical services)
5. check the planned locations for the wiring system in terms of:
  - a. Cosmetic appearance
  - b. External influences.

---

## Learning outcome

### 2. Interpret appropriate information for the installation of wiring systems, enclosures and associated equipment

#### Assessment criteria

1. use sources of information to enable the installation of wiring systems, enclosures and associated equipment to be carried out including:
  - a. Specifications
  - b. Work schedules/programmes
  - c. Manufacturer instructions
  - d. Layout Drawings
  - e. Other appropriate source of information (eg. BS 7671, other plans or diagrams, 'approved documents', building regulations)

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## Learning outcome

### 3. Install wiring systems, and equipment in accordance with current relevant statutory and non-statutory regulations

#### Assessment criteria

1. use appropriate measuring and marking out techniques which are appropriate to the wiring system, wiring enclosure and/or associated equipment that is being installed
2. install cables in accordance with BS 7671, the installation specification and programme of work: Assess four from:
  - a. Single core (singles)
  - b. Multicore insulated
  - c. PVC - PVC flat profile cable
  - d. MICC
  - e. Fire performance
  - f. SWA cable
  - g. GSWB galvanised steel wire braid
  - h. Data.
3. install the following in accordance with the wiring regulations, the installation specification and agreed planned programme of work: Assess four from:
  - a. PVC Conduit
  - b. Metallic Conduit
  - c. PVC Trunking
  - d. Metallic Trunking)
  - e. Cable Tray
  - f. Cable Basket
  - g. Ladder systems
  - h. Ducting
  - i. Modular wiring systems
  - j. Busbar systems or Powertrack.
4. install the following types of electrical equipment and accessories, in accordance with, BS 7671, the installation specification, manufacturers' instructions and the programme of work: Assess four from the following:
  - a. Isolators /switches
  - b. Socket-outlets

- c. Distribution-boards / consumer control units
  - d. Overcurrent protective devices
  - e. Luminaires
  - f. Data socket outlets
  - g. Other appropriate equipment (eg. heating system components, control equipment.
5. communicate with others professionally and appropriately to aid the effective installation of the wiring system/equipment
  6. dispose of waste materials in accordance with site procedures and statutory requirements
- 

### **Learning outcome**

#### **4. Confirm the quality of the completed work**

#### **Assessment criteria**

1. ensure the installed wiring system/s and enclosure/s meet specified requirements including that they:
  - a. Are the correct type and fit for purpose
  - b. Are installed in accordance with BS 7671
  - c. Meet the installation specification/other relevant plans/instructions
  - d. Are installed in accordance with any relevant manufacturer instructions.

## Unit 110

## Apply Practices and Procedures for Maintenance

<b>UAN:</b>	K/507/0658
<b>Level:</b>	Level 3
<b>GLH:</b>	20
<b>Endorsement by a sector or regulatory body:</b>	This unit is endorsed by the electrotechnical apprenticeship employer group
<b>Aim:</b>	<p>This unit is designed to enable the learner to develop the skills required, and apply the associated knowledge, in order that they are able to demonstrate the competence required to maintain electrical systems and equipment in accordance with approved industry practices, statutory and non-statutory regulations:</p> <ul style="list-style-type: none"><li>• The Electricity at Work Regulations (1989)</li><li>• The current edition of BS 7671 Wiring Regulations</li><li>• Health &amp; Safety Act (1974)</li><li>• Building Regulations (2000)</li></ul>
<b>Assessment type</b>	Portfolio of evidence

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### Learning outcome:

#### 1. Prepare to carry out electrical maintenance

### Assessment criteria

1. produce a maintenance work plan following best practice procedures to include:
  - a. analysing the requirements of task, (based on technical and engineering principles and know-how)
  - b. planned shut downs/isolations
  - c. Health and Safety precautions (eg. provision for release of stored and latent energy)
  - d. permits to work
  - e. organising tools, equipment and spare parts
  - f. liaison with/co-ordination of work with other persons will be necessary
  - g. time/cost effectiveness
  - h. A method statement (to include the appropriate best practice techniques/procedures/methods to undertake the maintenance activity).
2. use appropriate methods to communicate the plan/or key aspects of the planned work to relevant people such as: other workers, colleagues and clients
3. perform maintenance duties effectively as part of a team (such as: with the employer, other workers etc.)
4. assess and apply appropriate preparation procedures to include:
  - a. Adopting appropriate PPE

- b. Obtaining authorisation to carry out the maintenance work (such as a permit to work)
  - c. Notifying relevant personnel of the maintenance work (other trades, users of equipment etc.)
  - d. Following risk assessments.
5. select appropriate tools and equipment for the maintenance work:
    - a. Hand tools/power tools:
      - i. Access equipment
      - ii. Calibrated test instruments together with leads to GS 38 (as appropriate).
      - iii. Positioning/lifting/jacking equipment
      - iv. Trolleys/hand operated jacks.
    - b. Following a safe system of work (eg. working in accordance with a risk assessment and method statement)
    - c. Secure the work areas (fences, barriers, screens and warning signs).
  6. ensure relevant shutdown procedures are followed and safe isolation has been carried out (eg. electrical systems/pressurised systems (hydraulic/compressed air/water, gas))
  7. assess and confirm secure storage facilities for tools, equipment, materials and components
  8. confirm that all appropriate job information is available for use
 

Assess 5 from:

    - a. Maintenance schedules/specifications
    - b. Maintenance programmes
    - c. drawings/diagrams
    - d. Regulatory documents (eg. current version of BS 7671)
    - e. Method statements
    - f. servicing records
    - g. Manufacturer's instructions
    - h. Certificates of competency
    - i. Permits to work
    - j. Other relevant information.
  9. verify that proposed materials/equipment/components are in accordance with:
    - a. Industry requirements (best practice)
    - b. The type of installation, its use, and the environment in which it is installed.
  10. ensure permission for the proposed work has been given (eg. from the client)

## **Learning outcome**

### **2. Carry out electrical maintenance**

#### **Assessment criteria**

1. interpret the maintenance schedule/specification to accurately identify and locate electrical systems and equipment that is to be worked upon
2. use appropriate tools, equipment and materials for maintenance work
3. apply best practice work procedures which are appropriate for the type of maintenance activity being undertaken (planned preventative, breakdown, monitored)
4. apply best practice work procedures which are in accordance with:
  - a. Manufacturer's instructions
  - b. Industry approved practices
  - c. Maintenance schedules and specifications.



5. complete documented maintenance procedures on electrical circuits/systems:  
Assess five from the following:
  - a. Distribution systems
  - b. Low voltage circuits
  - c. Extra low voltage circuits
  - d. Lighting systems
  - e. Heating and ventilating systems
  - f. Air conditioning and refrigeration systems
  - g. Drive systems
  - h. Security systems
  - i. Earthing systems
  - j. Data communication/networking systems
  - k. Other circuit/system.
6. complete documented maintenance procedures on electrical equipment:  
Assess five from the following:
  - a. Electrical plant, components and accessories
  - b. Motors
  - c. motor control equipment
  - d. Switchgear/distribution panels
  - e. Control systems/components
  - f. Contactors
  - g. Power transmission mechanisms
  - h. Luminaires/lamps
  - i. Other relevant equipment.
7. monitor the effectiveness of the maintenance activity against current industry best practice and technical principles
8. evaluate and apply the appropriate inspections, tests/checks to verify the maintenance work has been carried out in accordance with requirements
9. complete maintenance work in a professional manner - assess one:
  - a. Within the timescale agreed by the person ordering the work
  - b. Advising the relevant person/s about any anticipated delays or about any further repairs that need to be carried out.
10. complete maintenance records accurately and submit them to the relevant person/s
11. evaluate the effectiveness of the maintenance activity against current industry best practice and technical principles
12. make formal recommendations for the improvement of maintenance activities to the supervisor.

## Unit 112/012

## Understand Inspection, Testing and Commissioning

<b>UAN:</b>	H/507/0660
<b>Level:</b>	Level 3
<b>GLH:</b>	78
<b>Endorsement by a sector or regulatory body:</b>	This unit is endorsed by the electrotechnical apprenticeship employer group
<b>Aim:</b>	This unit is designed to enable learners to understand principles, practices and legislation for the initial verification of electrical installations with statutory and non-statutory regulations and requirements. Its content is the knowledge needed by a learner to underpin the application of skills for the inspection, testing, commissioning and certification of electrical installations.
<b>Assessment type</b>	On-line multiple choice test (012) and an assignment comprising of practical and theory written tasks

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### Learning outcome:

1. Understand the requirements for completing the safe isolation of electrical circuits and installations

### Assessment criteria

1. state the **requirements** of the Electricity at Work Regulations for the safe inspection of electrical systems and equipment
2. specify the appropriate **procedure** for completing safe isolation
3. state the **reasons** for carrying out safe isolation
4. state the **implications** of carrying out safe isolation
5. state the **implications** of not carrying out safe isolation
6. identify the **Health and Safety requirements** which apply when inspecting, testing and commissioning electrical installations and circuits

---

### Range

#### Requirements:

In terms of:

- those carrying out the work
- those using the premises during the inspection.

#### Procedure:

Carrying out safe working practices:

- Identification of circuit(s) to be isolated
- Identifying suitable points of isolation

- Selecting correct test and proving instruments in accordance with relevant industry guidance and standards
- Suitable testing methods
- Selecting locking devices for securing isolation
- Warning notices
- Appropriate sequence for isolating circuits.

**Reasons:**

In relation to:

- The inspector
- Other personnel
- Customers/clients
- Public
- Building systems.

**Implications:**

In relation to:

- The inspector
- Other personnel
- Customers/clients
- Public
- Building systems (removal of supply).

**Health and Safety requirements:**

- Working in accordance with risk assessments / permits to work / method statements
- Safe use of tools and equipment
- Safe and correct use of measuring instruments
- Provision and use of PPE
- Reporting of unsafe situations.

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**Learning outcome****2. Understand the requirements for initial verification of electrical installations****Assessment criteria**

1. state the purpose of the Initial Verification of electrical installations
2. state the requirements of the initial verification
3. identify the **relevant documents** associated with the inspection, testing and commissioning of an electrical installation
4. specify the information that is required by the inspector to conduct the initial verification of an electrical installation

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**Range****Relevant documents:**

- Electricity at Work Regulations
- BS 7671
- IET Guidance Note 3
- HSE Guidance.

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## Learning outcome

### 3. Understand the requirements for completing the inspection of electrical installations prior to their being placed into service

#### Assessment criteria

1. select appropriate items to be checked during the inspection process
2. identify human senses appropriate for initial verification
3. state how the senses can be used during the inspection process
4. specify the **requirements for the inspection** of electrical installations
5. specify the requirements for the inspection to include:
  - a. special installations and locations as identified in Part 7 of BS 7671
  - b. IP Classification of equipment.

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## Range

### Requirements for the inspection:

- Earthing conductors
- Earth electrodes
- Circuit protective conductors
- Main and supplementary protective bonding conductors
- Devices for isolation and switching
- Type and rating of overcurrent protective devices
- Type and rating of RCDs and RCBOs
- Barriers and Enclosures
- Containment systems (Steel and Plastic)
- Cables
- Conductors and terminations
- Electrical accessories.

---

## Learning outcome

### 4. Understand the requirements for the safe testing and commissioning of electrical installations

#### Assessment criteria

1. state the tests to be carried out on an electrical installation in accordance with the BS 7671 and IET Guidance Note 3
2. identify the appropriate instrument for each test to be carried out in terms of:
  - a. The instrument is fit for purpose
  - b. Identifying the correct scale or setting.
3. specify the requirements for the safe use of instruments to be used for testing and commissioning, to include:
  - a. Checks required to prove that test instruments are safe and functioning correctly
  - b. The requirements for test leads and probes must comply with HSE Guidance GS38
  - c. The need for instruments to be regularly checked and calibrated.
4. explain why it is necessary for test results to comply with standard values
5. state the actions to be taken in the event of unsatisfactory results being obtained
6. explain why testing is carried out in the sequence specified in BS 7671 and IET Guidance Note 3

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## Learning outcome

### 5. Understand the requirements for testing before circuits are energised

#### Assessment criteria

1. state why it is necessary to verify continuity to include:
  - a. Protective bonding conductors
  - b. Circuit protective conductors
  - c. Ring final circuit conductors.
2. state the methods for verifying continuity to include:
  - a. Protective conductors
  - b. Ring final circuit conductors.
3. explain **factors that affect conductor resistance values**
4. specify the **procedures** for completing insulation resistance testing
5. state the effects on insulation resistance values that the following can have:
  - a. cables connected in parallel
  - b. variations in cable length.
6. explain why it is necessary to verify polarity
7. state the procedures for verifying polarity

---

## Range

### Factors that affect conductor resistance values:

- Cables connected in parallel
- Variations in cable length
- Variations in conductor cross sectional area.

### Procedures:

- Precautions to be taken before conducting insulation resistance tests
- Methods of testing insulation resistance
- The required test voltages and minimum insulation resistance values for circuits operating at various voltages
- Identifying typical voltage sensitive devices
- Particular requirements for testing where there are voltage sensitive devices and/or surge protection devices installed.

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## Learning outcome

### 6. Understand the requirements for testing energised installations

#### Assessment criteria

1. state the procedures for confirming polarity of the incoming supply
2. specify the methods for measuring earth electrode resistance to include:
  - a. installations forming part of a TT system
  - b. generators and transformers.
3. describe **common earth fault loop paths**
4. state the **methods for verifying protection** by automatic disconnection of supply
5. identify the requirements for the measurement of prospective fault current
6. specify the methods for **determining** prospective **fault current**
7. verify the suitability of protective devices for prospective fault currents
8. specify the methods for testing the correct operation of residual current devices
9. state the reasons for verifying phase sequence
10. state the methods used to verify phase sequence

11. state the need for functional testing
  12. identify items which require functional testing
  13. state the appropriate **procedures for dealing with clients** during the commissioning and certification process
- 

## Range

### Common earth fault loop paths:

- TT
- TN-S
- TN-C-S.

### Methods for verifying protection:

- The measurement of the external earth fault loop impedance ( $Z_e$ ) and the system earth fault loop
- Impedance ( $Z_s$ )
- Establishing  $Z_e$  by enquiry
- Calculation of the value of  $Z_s$  from given information
- Comparing measured  $Z_s$  values with the maximum tabulated figures as specified in BS 7671 including the application of the correction factor.

### Requirements for determining fault current:

- Single phase installations
- Three phase installations.

### Procedures for dealing with clients:

- Ensuring the safety of others during the work activities
  - Keeping clients informed during the process
  - Labelling electrical circuits, systems and equipment that are still to be commissioned
  - Providing clients with all the appropriate documentation upon work completion.
- 

## Learning outcome

### 7. Understand the requirements for the completion of electrical installation certificates and associated documentation

#### Assessment criteria

1. explain the purpose of certification and associated **documentation**
  2. state the information that must be contained on initial verification **documentation**
  3. describe the certification process for a completed installation
  4. identify the responsibilities of different relevant personnel in relation to the completion of the certification process
  5. explain the requirements for the recording and retention of completed initial verification documentation in accordance with the BS 7671
- 

## Range

### Documentation:

- An Electrical Installation Certificate
  - A Minor Electrical Installation Works Certificate
  - Schedule of Inspections
  - Schedule of Test results.
-

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### Learning outcome

#### 8. Be able to confirm safety of system and equipment prior to completion of inspection, testing and commissioning

#### Assessment criteria

1. carry out safe isolation procedures in accordance with regulatory requirements
2. comply with the Health and Safety requirements of themselves and others within the work location during the initial verifications process
3. check the safety of electrical systems prior to the commencement of inspection, testing and commissioning

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### Learning outcome

#### 9. Be able to carry out inspection of electrical installations prior to them being placed into service

#### Assessment criteria

1. identify a safe system of work appropriate to the work activity
2. carry out an initial inspection of an electrical installation in accordance with the requirements of BS 7671 and IET Guidance Note 3
3. complete a Schedule of Inspections in accordance with BS 7671 and IET Guidance Note 3 based on engineering evaluation of the installation to be verified

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### Learning outcome

#### 10. Be able to test electrical installations prior to them being placed into service

#### Assessment criteria

1. select the test instruments and their accessories for tests to include:
  - a. continuity
  - b. insulation resistance
  - c. polarity
  - d. earth electrode resistance
  - e. earth fault loop impedance
  - f. prospective fault current
  - g. RCD operation
  - h. phase sequence
  - i. functional testing.
2. evaluate the appropriate tests suitable for the installation to be verified
3. carry out tests in accordance with BS 7671, IET On-site Guide and Guidance notes 3 to include:
  - a. continuity including:
    - i. main protective bonding conductors
    - ii. circuit protective conductors
    - iii. Ring Final Circuits.
  - b. insulation resistance
  - c. polarity
  - d. external earth fault loop impedance ( $Z_e$ )

- e. system earth fault loop impedance ( $Z_s$ )
  - f. prospective fault current
  - g. RCD operation including additional protection
  - h. phase sequence
  - i. functional testing.
4. confirm compliance by evaluating and verifying test results
  5. complete appropriate documentation in accordance with the BS 7671 and IET Guidance Note 3 including:
    - a. Electrical Installation Certificate
    - b. Schedule of Inspections
    - c. Schedule of Test results.

---

## **Learning outcome**

### **11. Be able to commission electrical systems and equipment**

#### **Assessment criteria**

1. clarify the commissioning procedures with relevant persons
2. carry out the commissioning of circuits, accessories and equipment to confirm functionality



## Unit 113

# Inspect, Test and Commission Electrical Systems

<b>UAN:</b>	K/507/0661
<b>Level:</b>	Level 3
<b>GLH:</b>	16
<b>Endorsement by a sector or regulatory body:</b>	This unit is endorsed by the electrotechnical apprenticeship employer group
<b>Aim:</b>	<p>This unit is designed to enable the learner to develop the skills required, and apply the associated knowledge, in order that they are able to demonstrate the competence required to inspect, test, commission and certify electrical systems and equipment in buildings, structures and the environment in accordance with approved industry practices, statutory and non-statutory regulations:</p> <ul style="list-style-type: none"><li>• The Electricity at Work Regulations (1989)</li><li>• The current edition of BS7671</li><li>• Health &amp; Safety Act (1974)</li><li>• Building Regulations (2000)</li></ul>
<b>Assessment type</b>	Portfolio of evidence

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### Learning outcome:

1. **Be able to confirm safety of the system and equipment prior to completion of inspection, testing and commissioning in accordance with statutory and non-statutory regulations**

### Assessment criteria

1. carry out safe isolation procedures in accordance with regulatory requirements for electrical installations
2. ensure the Health and Safety of themselves and others within the work location during inspection, testing and commissioning
3. check the safety of electrical systems prior to the commencement of inspection, testing and commissioning

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### Learning outcome

2. **Be able to inspect electrical systems and equipment**

### Assessment criteria

1. assess whether the safe system of work is appropriate to the work activity

2. carry out a visual inspection in accordance with the requirements of the installation specification, BS 7671 and IET Guidance Note 3
  3. complete a schedule of inspections in accordance with the BS 7671 and IET Guidance Note 3 making technical decisions.
- 

### Learning outcome

#### 3. Be able to test and commission electrical systems and equipment

#### Assessment criteria

1. select the correct test instruments and their accessories for tests
  2. carry out **tests** in accordance with the installation specification and BS 7671 and manufacturer's instructions
  3. analyse and verify test results reporting all findings to **relevant persons**, as appropriate
  4. complete in accordance with BS 7671 and IET Guidance Note 3:
    - a. Electrical installation certificates:
      - i. Schedules of inspections
      - ii. Schedules of test results
    - b. Minor electrical installation works certificates
  5. complete the handover of electrical systems and equipment to relevant persons including the provision of accurate and completed documentation regarding the completed inspection, testing, commissioning and customer satisfaction.
  6. demonstrate to the customer/client that the operation of the circuits, equipment and components are in accordance with the installation specification and customer/client requirements
- 

#### Range

##### Tests:

- Continuity
- Insulation resistance
- Polarity
- Earth fault loop impedance/earth electrode
- Prospective fault current
- RCD operation
- Functional testing

##### Relevant persons:

- Representatives of other services/colleagues
  - Customers/clients
-

## Unit 113

# Inspect, Test and Commission Electrical Systems

## Supporting Information

### Notes for guidance

Prior to undertaking this unit a learner must provide auditable evidence that they have the relevant knowledge and understanding as detailed in the units:

- 112 Understand inspection, testing and commissioning
- 104 Understand design and installation practices and procedures.

### Evidence requirements

#### Learning Outcome 1:

- Authorised confirmation that the learner has had involvement and experience in safe-isolation procedures as relevant on two separate occasions.
- Auditable evidence must be provided that the learner has demonstrated that they have competently undertaken a risk assessment on two separate occasions.

Learning Outcomes 2 to 3 – Auditable evidence sourced from a real working environment must be provided to illustrate that, the learner has demonstrated on two separate occasions they can apply the principles and follow the procedures for the inspecting, testing, commissioning and certifying of electrical systems and equipment in buildings, structures and the environment in accordance with approved industry practices, statutory and non-statutory regulations and the assessment criteria for each of the learning outcomes.

In the delivery of this unit an emphasis shall be made to the learner on the necessity to keep up to date with the latest standards, technologies and practices which relate to and affect the topics covered in this unit. This is then in keeping with good engineering practice.

## Unit 114/014

## Understand Fault Diagnosis and Rectification

<b>UAN:</b>	M/507/0662
<b>Level:</b>	Level 3
<b>GLH:</b>	32
<b>Endorsement by a sector or regulatory body:</b>	This unit is endorsed by the electrotechnical apprenticeship employer group
<b>Aim:</b>	This unit is designed to enable learners to understand principles, practices and legislation associated with diagnosing and correcting electrical faults in electrical systems and equipment in buildings, structures and the environment in accordance with statutory and non-statutory regulations and requirements. Its content is the knowledge needed by a learner to underpin the application of skills used for fault diagnosis and correction in electrical systems and equipment in buildings, structures and the environment.
<b>Assessment type</b>	Assignment (114) and e-volve MC test (014)

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### Learning outcome:

#### 1. Understand the Health and Safety requirements relevant to fault diagnosis

### Assessment criteria

1. state the dangers of electricity in relation to fault diagnosis work
2. identify the **Health and Safety requirements** relevant to diagnosing and correcting electrical faults in electrical systems and equipment
3. specify **safe working procedures** that should be adopted for completion of fault diagnosis and correction work.

---

### Range

#### Health and Safety requirements

- Working in accordance with risk assessments / permits to work/method statements
- Safe use of tools and equipment
- Safe and correct use of measuring instruments
- Provision and use of PPE
- Reporting of unsafe situations

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#### Safe working procedures

- Effective communication with others. I.e. people on the premises, customers etc.

- Use of barriers
  - Positioning of notices
  - Safe isolation
  - Use of equipment to GS 38
- 

### Learning outcome

#### 2. Understand the importance of reporting and communication in fault diagnosis

##### Assessment criteria

1. describe the documentation relevant to fault diagnosis
  2. state the **implications** of the fault diagnosis for customers and clients.
  3. explain the **communication requirements** relevant to fault diagnosis
- 

### Range

#### Implications

- Loss of circuits
- Equipment

#### Communication requirements

- Informing relevant persons about information on electrical fault diagnosis and correction work
  - Why it is important to provide relevant persons with information on fault diagnosis and correction work clearly, courteously and accurately
  - Explain why relevant people need to be kept informed during completion of fault correction work:
    - Other workers/colleagues
    - Customers/clients
    - Representatives of other services
- 

### Learning outcome

#### 3. Understand the nature and characteristics of electrical faults

##### Assessment criteria

1. identify types, causes and consequences of **electrical faults**
  2. describe typical types of faults and their likely **locations in wiring systems** and equipment.
- 

### Range

#### Electrical faults

- Loss of supply
  - Low voltage/voltage drop
  - Component/equipment malfunction/failure
  - Operation of overload or fault current devices
  - Arcing - loose connection
  - High resistance - loose connection
  - Transient voltages - lightning strike
  - Excess current - overload
-

- Insulation failure - deterioration, mechanical damage
  - Short-circuit
  - Open Circuit
  - Earth fault
- Signal faults.

#### **Locations in wiring systems**

- Wiring Systems
- Terminations and connections
- Equipment/accessories (switches, luminaires, switchgear and control equipment)
- Instrumentation/metering.

### **Learning outcome**

#### **4. Understand the fault diagnosis procedure**

##### **Assessment criteria**

1. state precautions that must be taken when carrying out fault diagnosis with regard to **particular locations, equipment and circumstances**
2. explain the **logical stages** of fault diagnosis.
3. select the appropriate **test instrument/s** for fault diagnosis work
4. describe how **test instruments** are confirmed to be fit for purpose and functioning correctly
5. specify an appropriate and logical procedures for carrying out fault diagnosis **tests**
6. analyse and determine if **test** results are acceptable

### **Range**

#### **Particular locations, equipment and circumstances:**

- Lone working
- Hazardous areas
- Fibre-optic cabling
- Electro-static discharge (friction, induction, separation)
- Electronic devices (damage by over voltage)
- IT equipment (eg. shutdown, damage)
- High frequency or capacitive circuits
- Presence of batteries (eg. lead acid cells, connecting cells)
- Additional sources of energy
- Time controlled devices.

#### **Logical stages:**

- Identification of symptoms
- Collection and analysis of data
- Use of sources/types of information such as BS 7671, Certificates/Reports, Installation Specifications, drawings/diagrams, manufacturer's information and operating instructions
- Maintenance records
- Experience (personal and of others) i.e. speaking to operators/customers to determine nature/characteristics of the fault
- Checking and testing (eg. supply, protective devices)
- Interpreting results/information
- Fault correction
- Functional testing
- Restoration

All live test equipment in accordance with HSE guidance document GS 38.

**Test instrument/s:**

- Voltage indicator
- Low resistance ohm meter
- Insulation resistance testers
- EFLI and PFC tester
- RCD tester
- Tong tester/clamp on ammeter
- Phase sequence tester
- Dead testing
- Live testing.

**Tests:**

- Continuity
- Insulation resistance
- Polarity
- Earth fault loop impedance
- RCD operation
- Current and voltage measurement
- Phase sequence
- Functional testing/checking.

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**Learning outcome**

**5. Understand the procedures and techniques for correcting electrical faults**

**Assessment criteria**

1. identify **factors** which can affect repair or replacement of equipment
2. specify the procedures for **verifying** that the fault has been corrected suitable for the situation using technical analysis.
3. state the methods to ensure the safe disposal of any waste and that the work area is left in a safe and clean condition

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**Range**

**Factors:**

- Cost
- Availability of replacement parts, resources and staff
- Down time (planning)
- Legal and personal responsibility (eg. contracts, warranties, relevant personnel)
- Access to systems and equipment
- Provision of emergency or stand by supplies
- Client demand (continuous supply, out of hours working).

**Verifying:**

- Functional testing/checking
- Continuity
- Insulation resistance
- Polarity
- Earth fault loop impedance

- RCD operation
  - Current and voltage measurement/ checking presence of supply
  - Phase sequencing.
- 

## Learning outcome

### 6. Perform fault diagnosis

#### Assessment criteria

1. follow safe working procedures
  2. evaluate and apply appropriate fault diagnosis **methods** and techniques
  3. diagnose electrical faults using engineering decision and evaluation of symptoms and findings
  4. recommend the appropriate action/s to correct the fault
- 

#### Range

##### Methods:

- Logical stages of fault diagnosis
- Identification of symptoms
- Collection and analysis of data
- Use of sources/types of information - circuit schedule etc.
- installation specifications, drawings/diagrams,
- Determining nature/characteristics of the fault with discussion with 'customer' (lecturer)
- Checking and testing
- Interpreting results/information
- Functional testing.



## Unit 115

## Apply Fault Diagnosis and Rectification

<b>UAN:</b>	T/507/0663
<b>Level:</b>	Level 3
<b>GLH:</b>	10
<b>Endorsement by a sector or regulatory body:</b>	This unit is endorsed by the electrotechnical apprenticeship employer group
<b>Aim:</b>	<p>This unit is designed to enable the learner to develop the skills required, and apply the associated knowledge, in order that they are able to demonstrate the competence required to diagnose and correct electrical faults in electrical systems and equipment in buildings, structures and the environment in accordance with approved industry practices, statutory and non-statutory regulations:</p> <ul style="list-style-type: none"><li>• The Electricity at Work Regulations (1989)</li><li>• The current edition of BS7671</li><li>• Health &amp; Safety Act (1974)</li><li>• Building Regulations (2000)</li></ul>
<b>Assessment type</b>	Portfolio of evidence

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### Learning outcome

#### 1. Prepare to carry out fault diagnosis

##### Assessment criteria

1. check it is safe to carry out fault diagnosis
2. inform the relevant personnel of the fault diagnosis work (such as personnel on the premises, users of electrical equipment)
3. carry out the safe isolation procedure
4. evaluate and apply appropriate methods to ensure the safety of themselves and others when diagnosing and correcting electrical faults

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### Learning outcome

#### 2. Carry out fault diagnosis

##### Assessment criteria

1. communicate effectively with relevant personnel (eg. customer, premises manager) to ascertain the nature of the fault.
2. select and interpret appropriate documents (eg. layout drawings, schematic diagrams etc) which relate to the electrical systems and equipment being worked upon

3. assess and communicate potential disruption that may be a consequence of fault diagnosis and correction work to relevant people, such as:
  - a. Other workers/colleagues
  - b. Customers/clients.
4. carry out relevant inspections of electrical equipment analysing findings
5. confirm test instruments are fit for purpose, functioning correctly and are correctly calibrated
6. perform suitable diagnostic tests, based on engineering decision, to identify electrical faults

Assess three from the following:

- a. Loss of supply
  - b. Overload
  - c. Short-circuit
  - d. Earth fault
  - e. Incorrect phase rotation
  - f. High resistance joints/loose terminations
  - g. Component, accessory or equipment faults
  - h. Open circuit
  - i. Signal faults.
7. use appropriate methods for locating faults including:
    - a. Using a logical approach
    - b. Using safe working practices
    - c. Interpretation of test readings.
  8. use appropriate instruments correctly to carry out fault diagnosis

Assess three of the following:

- a. Voltage indicator
- b. Low resistance ohm meter
- c. Insulation resistance tester
- d. EFLI and PFC tester
- e. RCD tester
- f. Ammeter
- g. Phase rotation tester
- h. Other appropriate instrument.

---

## **Learning outcome**

### **3. Carry out fault rectification**

#### **Assessment criteria**

1. assess the appropriate repairs, removals and replacements and their implications with relevant people including: One of the following:
  - a. Other workers/colleagues
  - b. Customers/clients.
2. perform fault correction procedures correctly and safely using appropriate tools, equipment and material
3. assess and verify that replacement components and associated equipment maintain:
  - a. Ease of access to enable future maintenance

- b. compliance with relevant regulations
  - c. compliance with manufacturer's instructions/ organisational procedures.
4. apply appropriate procedures to ensure electrical equipment and components are left safe, in accordance with industry regulations, if the fault cannot be corrected immediately based on technical assessment.
  5. establish and perform an appropriate inspection and testing procedure to confirm that circuits/equipment/components are functioning correctly after completion of fault correction work
  6. record test results and other appropriate information regarding the fault correction work clearly and accurately and report it to relevant people.

Assess one of the following:

- a. Other workers/colleagues
- b. Customers/clients
- c. Representatives of other services.

## Unit 016

# Understand the Requirements for Electrical Installations BS 7671: 2008 (2015)

<b>UAN:</b>	M/507/0659
<b>Level:</b>	Level 3
<b>GLH:</b>	70
<b>Endorsement by a sector or regulatory body:</b>	This unit is endorsed by the electrotechnical apprenticeship employer group
<b>Aim:</b>	This unit gives the learner an understanding of the full content of BS6761, and how this applies to electrical installations within its scope.
<b>Assessment type</b>	On-screen multiple-choice assessment (016) (open book)

---

### Learning outcome:

1. Understand the scope, object and fundamental principles of BS 7671.

### Assessment criteria

1. identify the scope of BS 7671
2. identify the object of BS 7671
3. identify the fundamental principles of BS 7671

---

### Learning outcome:

2. Understand the definitions used within BS 7671

### Assessment criteria

1. interpret the definitions used within BS 7671
2. relate the definitions to the regulations and appendices of BS 7671

---

### Learning outcome:

3. Understand how to assess the general characteristics of electrical installations.

### Assessment criteria

1. interpret the requirements of assessing the general characteristics of electrical installations within the scope of BS 7671

---

### Learning outcome:

4. Understand requirements of protection for safety for electrical installations.

### Assessment criteria

1. identify the requirements of protection for safety within the scope of BS 7671
  2. interpret how this applies to electrical installations within the scope of BS 7671 to include:
    - a. Protection against electric shock
    - b. Protection against thermal effects
    - c. Protection against overcurrent
    - d. Protection against voltage disturbances and electromagnetic disturbances.
- 

### Learning outcome:

5. **Understand the requirements for selection and erection of equipment for electrical installations**

### Assessment criteria

1. identify the requirements for selecting and erecting equipment, within the scope of BS 7671
  2. interpret how this applies to electrical installations within the scope of BS 7671 to include:
    - a. Common rules
    - b. Selection and erection of wiring systems
    - c. Protection, isolation, switching, control and
    - d. Monitoring
    - e. Earthing arrangements and protective conductors
    - f. Other equipment
    - g. Safety services.
- 

### Learning outcome:

6. **Understand the requirements of Inspection and testing of electrical installations**

### Assessment criteria

1. identify the requirements for inspection and testing
  2. interpret how this applies to electrical installations
- 

### Learning outcome:

7. **Understand the requirements of special installations or locations as identified in BS 7671**

### Assessment criteria

1. identify the requirements for special installations and locations
  2. interpret how these effect the general requirements of the regulations
- 

### Learning outcome:

8. **Understand the requirements for selection and erection of equipment for electrical installations.**

### Assessment criteria

1. identify the information in the appendices of BS 7671
  2. specify how the information contained in the appendices is used to support electrical installation activities.
-

## **Unit 016**

# **Understand the Requirements for Electrical Installations BS 7671: 2008 (2015)**

## **Supporting Information**

### Notes for guidance

In delivery of this unit an emphasis shall be made to the learner on the necessity to keep up to date with the latest standards, technologies and practices which relate to and affect the topics covered in this unit. This is in then in keeping with good engineering practice.

## Unit 018

## Understand the Requirements for Electrical Installations BS 7671:2018

<b>Level:</b>	Level 3
<b>GLH:</b>	70
<b>Endorsement by a sector or regulatory body:</b>	This unit is endorsed by the electrotechnical apprenticeship employer group
<b>Aim:</b>	This unit gives the learner an understanding of the full content of BS6761, and how this applies to electrical installations within its scope.
<b>Assessment type</b>	On-screen multiple-choice assessment (018) (open book)

---

### Learning outcome

The learner will:

- 1 Understand the scope, object and fundamental principles of BS7671.

### Assessment criteria

---

The learner can:

- 1.1 identify the scope of BS7671
- 1.2 identify the object of BS7671
- 1.3 identify the fundamental principles of BS7671.

---

### Learning outcome

The learner will:

- 2 Understand the definitions used within BS7671.

### Assessment criteria

The learner can:

- 2.1 interpret the definitions used within BS7671
- 2.2 relate the definitions to the regulations and appendices of BS7671.

---

## Learning outcome

The learner will:

- 3 Understand how to assess the general characteristics of electrical installations.

## Assessment criteria

The learner can:

- 3.1 interpret the requirements of assessing the general characteristics of electrical installations within the scope of BS767 including;
- Chapter 31 Purpose, supplies and structure
  - Chapter 32 Classification of external influences
  - Chapter 33 Compatibility
  - Chapter 34 Maintainability.
  - Chapter 35 Safety services Chapter
  - Chapter 36 Continuity of service

---

## Learning outcome

The learner will:

- 4 Understand requirements of protection for safety for electrical installations.

## Assessment criteria

The learner can:

- 4.1 identify the requirements of protection for safety within the scope of BS7671 including;
- Chapter 41 Electric shock
  - Chapter 42 Thermal effects
  - Chapter 43 Overcurrent
  - Chapter 44 Voltage disturbances and EMI
  - Chapter 46 Isolation and switching
- 4.2 interpret how this applies to electrical installations within the scope of BS7671 to include:
- Protection against electric shock
  - Protection against thermal effects
  - Protection against overcurrent
  - Protection against voltage disturbances and electromagnetic disturbances
  - Isolation and switching



---

## Learning outcome

The learner will:

- 5 Understand the requirements for selection and erection of equipment for electrical installations.

## Assessment criteria

The learner can:

5.1 identify the requirements for selecting and erecting equipment and interpret how this applies to wiring systems

5.2 interpret how this applies to electrical installations within the scope of BS7671 to include:

- Common rules
- Wiring systems
- Protection, isolation, switching, control and monitoring
- Earthing arrangements and protective conductors
- Other equipment
- Safety services

---

## Learning outcome

The learner will:

- 6 Understand the requirements of inspection and testing of electrical installations.

## Assessment criteria

The learner can:

6.1 identify the requirements for inspection and testing

6.2 interpret how this applies to electrical installations including;

- Chapter 64 Initial verification
- Chapter 65 Periodic inspection and testing

---

## Learning outcome

The learner will:

- 7 Understand the requirements of Special installations or locations as identified in BS 7671

## Assessment criteria

The learner can:

- 7.1 identify the requirements for special installations including;
- Section 700 General
  - Section 701 Locations containing a bath or shower
  - Section 702 Swimming pools and other basins
  - Section 703 Rooms and cabins containing sauna heaters
  - Section 704 Construction and demolition site installations
  - Section 705 Agricultural and horticultural premises
  - Section 706 Conducting locations with restricted movement
  - Section 708 Electrical installations in caravan / camping parks and similar locations
  - Section 709 Marinas and similar locations
  - Section 710 Medical locations
  - Section 711 Exhibitions, shows and stands
  - Section 712 Solar photovoltaic (PV) power supply systems
  - Section 714 Outdoor lighting installations
  - Section 715 Extra-low voltage lighting installations
  - Section 717 Mobile or transportable units
  - Section 721 Electrical installations in caravans and motor caravans
  - Section 722 Electric vehicle charging installations
  - Section 729 Operating and maintenance gangways
  - Section 730 Onshore units of electrical connections for inland navigation vessels
  - Section 740 Temporary electrical installations for structures, amusement devices and booths at fairgrounds, amusement parks and circuses
  - Section 753 Heating cables and embedded heating systems
- 7.2 interpret how these effect the general requirements of the regulations.

---

## Learning outcome

The learner will:

- 8 Understand the information contained within the appendices of BS7671.

## Assessment criteria

The learner can:

- 8.1 identify the information in the appendices of BS7671.
- 8.2 specify how the information contained in the appendices is used to support electrical installation activities.

## Unit 022

# Understand the Requirements of Electrical Installations BS 7671:2018 (2022)

<b>Level:</b>	Level 3
<b>GLH:</b>	70
<b>Endorsement by a sector or regulatory body:</b>	This unit is endorsed by the electrotechnical apprenticeship employer group
<b>Aim:</b>	This unit gives the learner an understanding of the full content of BS6761, and how this applies to electrical installations within its scope.
<b>Assessment type</b>	On-screen multiple-choice assessment (022) (open book)

---

### Learning outcome

The learner will:

- 1 Understand the scope, object and fundamental principles of BS7671.

### Assessment criteria

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The learner can:

- 1.1 identify the scope of BS7671
- 1.2 identify the object of BS7671
- 1.3 identify the fundamental principles of BS7671.

---

### Learning outcome

The learner will:

- 2 Understand the definitions used within BS7671.

### Assessment criteria

The learner can:

- 2.1 interpret the definitions used within BS7671
- 2.2 relate the definitions to the regulations and appendices of BS7671.

---

## Learning outcome

The learner will:

- 3 Understand how to assess the general characteristics of electrical installations.

## Assessment criteria

The learner can:

- 3.1 interpret the requirements of assessing the general characteristics of electrical installations within the scope of BS767 including;
- Chapter 31 Purpose, supplies and structure
  - Chapter 32 Classification of external influences
  - Chapter 33 Compatibility
  - Chapter 34 Maintainability
  - Chapter 35 Safety services
  - Chapter 36 Continuity of service.

---

## Learning outcome

The learner will:

- 4 Understand requirements of protection for safety for electrical installations.

## Assessment criteria

The learner can:

- 4.1 identify the requirements of protection for safety within the scope of BS7671 including;
- Chapter 41 Electric shock
  - Chapter 42 Thermal effects
  - Chapter 43 Overcurrent
  - Chapter 44 Voltage disturbances and EMI
  - Chapter 46 Isolation and switching.
- 4.2 interpret how this applies to electrical installations within the scope of BS7671 to include:
- Protection against electric shock
  - Protection against thermal effects
  - Protection against overcurrent
  - Protection against voltage disturbances and electromagnetic disturbances
  - Isolation and switching.

---

## Learning outcome

The learner will:

- 5 Understand the requirements for selection and erection of equipment for electrical installations.

## Assessment criteria

The learner can:

- 5.1 identify the requirements for selecting and erecting equipment and interpret how this applies to wiring systems
- 5.2 interpret how this applies to electrical installations within the scope of BS7671 to include:
  - Common rules
  - Wiring systems
  - Protection, isolation, switching, control and monitoring
  - Earthing arrangements and protective conductors
  - Other equipment
  - Safety services

---

## Learning outcome

The learner will:

- 6 Understand the requirements of inspection and testing of electrical installations.

## Assessment criteria

The learner can:

- 6.1 identify the requirements for inspection and testing
- 6.2 interpret how this applies to electrical installations including;
  - Chapter 64 Initial verification
  - Chapter 65 Periodic inspection and testing

---

## Learning outcome

The learner will:

7 Understand the requirements of special installations or locations as identified in BS 7671

## Assessment criteria

The learner can:

- 7.1 identify the requirements for special installations including;
- Section 700 General
  - Section 701 Locations containing a bath or shower
  - Section 702 Swimming pools and other basins
  - Section 703 Rooms and cabins containing sauna heaters
  - Section 704 Construction and demolition site installations
  - Section 705 Agricultural and horticultural premises
  - Section 706 Conducting locations with restricted movement
  - Section 708 Electrical installations in caravan / camping parks and similar locations
  - Section 709 Marinas and similar locations
  - Section 710 Medical locations
  - Section 711 Exhibitions, shows and stands
  - Section 712 Solar photovoltaic (PV) power supply systems
  - Section 714 Outdoor lighting installations
  - Section 715 Extra-low voltage lighting installations
  - Section 717 Mobile or transportable units
  - Section 721 Electrical installations in caravans and motor caravans
  - Section 722 Electric vehicle charging installations
  - Section 729 Operating and maintenance gangways
  - Section 730 Onshore units of electrical connections for inland navigation vessels
  - Section 740 Temporary electrical installations for structures, amusement devices and booths at fairgrounds, amusement parks and circuses
  - Section 753 Heating cables and embedded heating systems
- 7.2 interpret how these affect the general requirements of the regulations.

---

## Learning outcome

The learner will:

8 Understand the information contained within Part 8 and the appendices of BS7671.

## Assessment criteria

The learner can:

- 8.1 identify the information contained in Part 8 of BS7671
- 8.2 identify the information in the appendices of BS 7671
- 8.3 specify how the information contained in the appendices is used to support electrical installation activities.

# Appendix 1 Relationships to other qualifications

## Links to other qualifications

This qualification has connections to the following within the electrical suite offered by City & Guilds:

- 2382
- 2391

Upon achievement of the 5357-03 or 5357-93 (unit route) candidates are able to apply for additional certification.

## 2382 Requirements for Electrical Installations

To gain certification for **Level 3 Award in the Requirements for Electrical Installations BS 7671:2018**:

- Candidates must have achieved the assessment 5357-018 and have been certificated against 5357-03/93. Centres can then register candidates onto the 2382-78 and claim the certification module 2382-919 which will generate this certificate.

To gain certification for **Level 3 Award in the Requirements for Electrical Installations BS 7671:2018 (2022)**:

- Candidates must have achieved the assessment 5357-022 and have been certificated against 5357-03/93. Centres can then register candidates onto the 2382-82 and claim the certification module 2382-923 which will generate this certificate.

## 2391 Electrical Inspection and Testing

To gain certification for Level 3 Award in Initial Verification of Electrical Installations, candidates must have achieved the assessments 5357-112, 5357-012 and have been certificated against 5357-03/93.

Centres can then register candidates onto 2391-71 and claim the certification module 2391-902 which will generate this certificate.

## Appendix 2 Sources of general information

The following documents contain essential information for centres delivering City & Guilds qualifications. They should be referred to in conjunction with this handbook. To download the documents and to find other useful documents, go to the **Centre Document Library** on **www.cityandguilds.com** or click on the links below:

### **Quality Assurance Standards: Centre Handbook**

This document is for all approved centres and provides guidance to support their delivery of our qualifications. It includes information on

- Centre quality assurance criteria and monitoring activities
- Administration and assessment systems
- Centre-facing support teams at City & Guilds / ILM
- Centre quality assurance roles and responsibilities.

The Centre Handbook should be used to ensure compliance with the terms and conditions of the Centre Contract.

### **Quality Assurance Standards: Centre Assessment**

This document sets out the minimum common quality assurance requirements for our regulated and non-regulated qualifications that feature centre assessed components. Specific guidance will also be included in relevant qualification handbooks and/or assessment documentation.

It incorporates our expectations for centre internal quality assurance and the external quality assurance methods we use to ensure that assessment standards are met and upheld. It also details the range of sanctions that may be put in place when centres do not comply with our requirements, or actions that will be taken to align centre marking/assessment to required standards. Additionally, it provides detailed guidance on the secure and valid administration of centre-assessments.

### **Access arrangements - When and how applications need to be made to City & Guilds**

provides full details of the arrangements that may be made to facilitate access to assessments and qualifications for candidates who are eligible for adjustments in assessment.

This **Centre Document Library** also contains useful information on such things as:

- Conducting examinations
- Registering learners
- Appeals and malpractice

## Useful contacts

Please visit the Contact Us section of the City & Guilds website, **Contact us**



## Appendix 3      Electrotechnical Apprenticeship Standard

### 1. Occupation

Installation Electrician  
Maintenance Electrician

### 2. Duration

It is unlikely that a candidate coming to this apprenticeship without previous relevant experience would complete the apprenticeship in less than 42 months, and a typical completion time is likely to be 48 months. This may reduce if an apprentice is part-qualified or has relevant experience on entry.

### 3. Occupational profile

Electricians install, maintain and repair electrical systems in industrial, commercial and domestic environments. Electricians might work in both indoor and outdoor settings. Electrical equipment and systems may include switchboards, motors, cables, fuses, thermal relays, fault current protection switches, heating, lighting, air conditioning and metering equipment as well as crime and fire alarm systems and renewable energy technologies. They are able to work on their own proficiently and work without immediate supervision in the most efficient and economical manner. They may contribute to the design of electrical systems. They are able to set out jobs from drawings and specifications and requisition the necessary installation materials.

Electrical safety is an important area of Electricians' work. On completion of their work the electrical systems must be safe to use. They must adhere to safe working practices without endangering themselves or others.

*Installation Electricians* work on the installation, testing, commissioning and maintenance of low voltage (less than 1000v) electrical and electronic devices and appliances

*Maintenance Electricians* work on the maintenance of electrical and electronic installations including automated production systems. Duties include the supervision of the equipment, its maintenance and necessary repairs.

### 4. Entry requirements

Individual employers will identify any relevant entry requirements in terms of previous qualifications, trainability tests, or other criteria. Most candidates will have English and mathematics at level 2 on entry.

### 5. Knowledge and Skills

Electricians will use engineering knowledge and understanding to apply their technical and practical skills. They will contribute to the design, development, manufacture, construction, commissioning, operation or maintenance of products, equipment, processes, systems or services. Electricians must:

- Understand and apply the principles, practices and legislation for the termination and connection of conductors, cables and cords in electrical systems

- Understand and apply the practices and procedures for the preparation and installation of wiring systems and electrotechnical equipment in buildings, structures and the environment
- Understand and apply the principles, practices and legislation for the inspection, testing, commissioning and certification of electrotechnical systems and equipment in buildings, structures and the environment
- Understand and apply the principles, practices and legislation for diagnosing and correcting electrical faults in electrotechnical systems and equipment in buildings, structures and the environment
- Understand and apply the electrical principles associated with the design, building, installation and maintenance of electrical equipment and systems
- Oversee and organise the work environment

In addition,

Installation Electricians must:

- Understand and apply the principles of planning and selection for the installation of electrotechnical equipment and systems in buildings, structures and the environment

Maintenance Electricians must:

- Understand and apply the practices and procedures for planning and preparing to maintain electrotechnical systems and equipment

In all of these activities, Electricians must understand and apply Health and Safety and environmental regulations, guidance notes and relevant codes of practice; and the requirements of the current edition of the Wiring Regulations.

## **6. Behaviours**

Electricians will be expected to:

- Work reliably and effectively without close supervision
- Accept responsibility for the work of themselves and others
- Accept allocate and supervise technical and other tasks
- Use oral, written and electronic methods for the communication of technical and other information
- Work effectively with colleagues, other trades, clients, suppliers and the public
- Undertake work in a way that contributes to sustainable development
- Maintain and enhance competence in own area
- Exercise responsibilities in an ethical manner.

## **7. Qualifications**

Candidates will be required to achieve the Level 3 Electrotechnical Qualification, (Installation) or (Maintenance) and the final assessment, AM2S.

Apprentices without level 2 English and mathematics will need to achieve this level prior to completion of their apprenticeship.

## **8. Link to professional registration**

By the end of the apprenticeship the candidate will have satisfied the requirements for registration as Eng Tech by the Engineering Council.

**9. Level**

This is a Level 3 apprenticeship

**10. Review**

This standard will be reviewed in three years

July 2015

## About City & Guilds

As the UK's leading vocational education organisation, City & Guilds is leading the talent revolution by inspiring people to unlock their potential and develop their skills. We offer over 500 qualifications across 28 industries through 8500 centres worldwide and award around two million certificates every year. City & Guilds is recognised and respected by employers across the world as a sign of quality and exceptional training.

## City & Guilds Group

The City & Guilds Group is a leader in global skills development. Our purpose is to help people, organisations and economies develop their skills for growth. We work with education providers, employers and governments in over 100 countries across the world to help people, businesses and economies grow by shaping skills systems and supporting skills development.

The Group is made up of City & Guilds, ILM, Kineo, The Oxford Group, Gen2, and Intertrain. Together we set the standard for professional and technical education and corporate learning and development around the world.

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