Level 3 Advanced Technical Diploma in Electrical Installation (450) (8202-30)

June 2019 Version 1.2

Guide to the examination

Version and Date	Change Detail	Section
June 2019 V1.1	Amendments to Total Marks for exam	2. Content assessed by the exam
	Update to Command verb grid	3. Guidance
June 2019 V1.2	Amendment to number of resit opportunities	1. Details of the exam

Who is this document for?

This document has been produced for centres who offer **City & Guilds Level 3 Advanced Technical Diploma in Electrical Installation (450).** It gives all of the essential details of the qualification's external assessment (exam) arrangements and has been produced to support the preparation of candidates to take the exam/s.

The document comprises of four sections:

1. **Details of the exam**. This section gives details of the structure, length and timing of the exam.
2. **Content assessed by the exam.** This section gives a summary of the content that will be covered in each exam and information of how marks are allocated to the content.
3. **Guidance.** This section gives guidance on the language of the exam, the types of questions included and examples of these, and links to further resources to support teaching and exam preparation.
4. **Further information.** This section lists other sources of information about this qualification and City & Guilds Technical Qualifications.

1. Details of the exam

External assessment

City & Guilds Technical qualifications have been developed to meet national policy changes designed to raise the rigour and robustness of vocational qualifications. These changes are being made to ensure our qualifications can meet the needs of employers and Higher Education. One of these changes is for the qualifications to have an increased emphasis on external assessment. This is why you will see an external exam in each of our Technical qualifications.

An external assessment is an assessment that is set and/or marked by the awarding organisation (ie externally). All City and Guilds Technical qualifications include an externally set and marked exam. This must be taken at the same time by all candidates who are registered on a particular qualification. We produce an exam timetable each year. This specifies the date and time of the exam so you can plan your delivery, revision and room bookings/PC allocation in plenty of time.

The purpose of this exam is to provide assurance that all candidates achieving the qualification have gained sufficient knowledge and understanding from their programme of study and that they can independently recall and draw their knowledge and understanding together in an integrated way. Whilst this may not be new to you, it is essential that your learners are well prepared and that they have time to revise, reflect and prepare for these exams. We have produced a Teaching, Learning, and Assessment guide that is you should refer to alongside the present document *(Teaching, Learning and Assessment Guide).* If a learner does not pass the exam at their first attempt, there is only one opportunity to resit the exam, so preparation is essential.

Exam requirements of this qualification

- **Electrical Installation** – Theory Exam (2 hours 30 minutes)

The exam is graded and a candidate must achieve at least a Pass grade in order to be awarded the qualification. (In addition to the exam, a synoptic assignment must also be completed and passed). You can find full details of the synoptic assignment in the *Qualification Handbook* and the *Synoptic Assessment Guide – p*lease see the link to the qualification page at the end of this document.

When does the exam take place?

The exam is offered on two fixed dates in April and June. The exact dates will be published at the start of the academic year in the *Assessments and Exam Timetable* *http://www.cityandguilds.com/delivering-our-qualifications/exams-and-admin*.

At the start of the programme of study, in order to effectively plan teaching and exam preparation, centres should know when the exam will be taking place and allocate teaching time accordingly. Section 2 of this document gives a summary of the content that needs to be covered in order to prepare learners for the exam and full details of this are given in the Qualification Handbook.

Form of exam

The exam for this qualification can be taken on paper only (8202-531).

Can candidates resit the exam?

Candidates who have failed an exam or wish to retake it in an attempt to improve their grade, can do so **twice**. The third and final retake opportunity applies to Level 3 only. The best result will count towards the final qualification. If the candidate fails the exam three times then they will fail the qualification.

How the exam is structured

Each exam has a total of 75 marks and is made up of:

- approximately 18-20 short answer questions
- 1 extended response question.

Short answer questions are used to confirm **breadth of knowledge and understanding**.

The extended response question is to allow candidates to demonstrate **higher level and integrated understanding** through written discussion, analysis and evaluation. This question also ensures the exam can differentiate between those learners who are 'just able' and those who are higher achieving.

More details about and examples of question types are given in Section 3 of this document.

Assessment Objectives

The exams are based on the following set of assessment objectives (AOs). These are designed to allow the candidate's responses to be assessed across the following three categories of performance:

- **Recollection** of knowledge.
- **Understanding** of concepts, theories and processes.
- **Integrated application** of knowledge and understanding.

In full, the assessment objectives covered by the exam for this qualification are:

Assessment objective ***The candidate..***	**Mark allocation (approx %)**
AO1 **Recalls knowledge** from across the breadth of the qualification	36%
AO2 **Demonstrates understanding** of concepts, theories and processes from a range of learning outcomes.	44%
AO4 **Applies knowledge, understanding and skills** from across the breadth of the qualification in an integrated and holistic way to achieve specified purposes.	20%

Booking and taking the exam

All assessments for City & Guilds Technical Exams must be booked through Walled Garden. There is a deadline for booking exams, synoptic assessments and any other centre marked assessments, please refer to the time line to check these dates.

The exam must be taken under the supervision of an invigilator who is responsible for ensuring that it is conducted under controlled conditions. Full details of the conditions under which the exam must be taken can be found in the Joint Council for Qualifications (JCQ) document, *Instructions for Conducting Examinations (ICE)*.

Special consideration

Candidates who are unable to sit the exam owing to temporary injury, illness or other indisposition at the scheduled time may qualify for special consideration. This is a post-examination adjustment that can, in certain circumstances, be made to a candidate's final grade. The Joint Council for Qualifications' guide to the special consideration process can be found at www.jcq.org.uk .

To make a request for special consideration, please contact: policy@cityandguilds.com

Access arrangements

Access arrangements are arrangements that allow candidates with particular requirements, disabilities or temporary illness to take assessments, where appropriate, using their normal way of working. The Joint Council for Qualifications document, *Access Arrangements and Reasonable Adjustments* gives full details and can be downloaded here.

For further information and to apply for access arrangements please see:

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

Applying for access arrangements on the Walled Garden

2. Content assessed by the exam

Electrical Installation

The exam assesses:

- **Unit 301: Planning and overseeing electrical work activities**
- **Unit 302: Principles of electrical science**
- **Unit 303: Design and installation practices and procedures**
- **Unit 304: Principles of inspection, testing and commissioning electrical systems**
- **Unit 306: Electrical system fault diagnosis and rectification**
- **Unit 307: Requirements for electrical installations**

Each exam assesses a sample of the content of these units. This means that a single exam will **not** cover 100% of the unit content. The full range of content will be assessed over a number of examination series. Details of the coverage of a particular exam paper will **not** be released in advance of the exam itself. Centres should **not** make assumptions about what will be assessed by a particular exam based on what has been covered on previous occasions. In order to be fully prepared for the exam, learners **must** be ready to answer questions on **any** of the content outlined below.

The table below provides an overview of how the qualification's Learning Outcomes are covered by each exam and the number of **marks** available per Learning Outcome (ie **not** the number of *questions* per Learning Outcome). In preparing candidates for the exam, we recommend that centres take note of the number of marks allocated to Learning Outcomes and to assign teaching and preparation time accordingly.

In preparing candidates for the exam, centres should refer to the Qualification Handbook which gives full details of each Learning Outcome.

The following is a summary of only that qualification content which is assessed by the exam and **not** a summary of the full content of the qualification.

Unit	Learning outcome	Topics	Number of marks per section
301 Planning and overseeing electrical work activities	L01 Understand the requirements for liaising with others when organising and overseeing work activities	1.1: Communication techniques 1.2: Determining competence 1.3: Rescheduling work 1.4: Documentation for work operations	3

	LO2 Understand the requirements for organising and overseeing work programmes	2.1: Planning work programmes 2.2: Carrying out work activities 2.3: Industry standards 2.4: Estimating work times 2.5: Consequences of problems	
	LO3 Understand the requirements for organising the provision and storage of resources required for work activities	3.1: Installation specifications and work programmes 3.2: Interpreting material schedules 3.3: Storage and transportation requirements 3.4: Safe and effective storage	
302 Principles of electrical science	LO1 Understand electrical supply systems	1.1: Electricity generation and transmission 1.2: Other sources of electricity 1.3: Electrical supplies 1.4: Transformers 1.5: Calculating and measuring electricity	21
	LO2 Understand how electrical properties affect electrical circuits, systems and equipment	2.1: Electrical relationships 2.2: Alternating current circuits 2.3: Power factor 2.4: Calculating voltage and current	
	LO3 Understand the operating principles and applications of D.C. machines, A.C. motors and electrical components	3.1: D.C. machines 3.2: A.C. motors 3.3: Motor control 3.4: Electrical components	
	LO4 Understand the principles and applications of electrical lighting systems	4.1: Principles of illumination 4.2: Luminaires	

	LO5 Understand the principles and applications of electrical heating	5.1: Principles of electrical heating 5.2: Electrical heating appliances and components	
303 Electrical design and installation practices and procedures	LO1 Understand the characteristics and applications of supply systems and consumer's equipment	1.1: Earthing arrangements 1.2: Supply systems 1.3: Installation protection	9
	LO2 Understand earthing and protection	2.1: Earthing 2.2: Conductors 2.3: Protection against electric shock	
	LO3 Understand protection against overcurrent	3.1: Overcurrent 3.2: Protective devices 3.3: Fault current capacities	
	LO4 Understand electrical systems and circuits	4.1: Electrical circuits 4.2: Electrical systems	
	LO5 Understand the electrical design procedure	5.1: Diversity factors 5.2: Design currents 5.3: Suitability ratings 5.4: Installation method reference 5.5: Determining rating factors 5.6: Cross-sectional area of conductors 5.7: Voltage drop 5.8: Evaluating thermal constraints	
304 Principles of inspection, testing and commissioning electrical systems	LO1 Understand the requirements safe isolation and inspection of electrical circuits	1.1: Electricity at Work requirements 1.2: Safe isolation 1.3: Health and Safety requirements 1.4: Initial verification of electrical installations	9

		1.5: Items checked during inspection 1.6: Senses used during inspection 1.7: Requirements of electrical installations	
	LO2 Understand the requirements for safe testing and commissioning of electrical installations and testing before circuits are energised	2.1: Tests carried out 2.2: Test instruments 2.3: Test results 2.4: Verifying continuity 2.5: Insulation resistance 2.5: Verifying polarity	
	LO3 Understand the requirements for testing energised installations	3.1: Confirming polarity and measuring earth electrode resistance 3.2: Earth fault loop paths and verifying protection 3.3: Measurement of prospective fault current 3.4: Verifying phase sequence 3.5: Functional testing 3.6: Dealing with clients	
	LO4 Understand the requirements for the completion of electrical installation certificates and associated documentation	4.1: Certification documentation 4.2: Verification documentation	
306 Electrical system fault diagnosis and rectification	LO1 Understand the health and safety requirements relevant to fault diagnosis	1.1: Dangers of electricity 1.2: Health and safety requirements 1.3: Safe working procedures	6
	LO2 Understand the importance of reporting and communication in fault diagnosis	2.1: Fault diagnosis documentation 2.2: Implications of fault diagnosis 2.3: Communication requirements	

	LO3 Understand the nature and characteristics of electrical faults	3.1: Types of faults 3.2: Locations of faults	
	LO4 Understand the fault diagnosis procedure	4.1: Precautions 4.2: Fault diagnosis 4.3: Test instruments 4.4: Analysing test results	
	LO5 Understand the procedures and techniques for correcting electrical faults	5.1: Factors affecting repair or replacement 5.2: Verifying fault correction 5.3: Safe disposal of waste	
	LO6 Perform fault diagnosis	6.1: Fault diagnosis 6.2: Evaluation of symptoms 6.3: Recommending corrective action	
307 Requirements for electrical installations	LO1 Know the fundamental principles and general assessments of BS 7671	1.1: Scope of BS 7671 1.2: Fundamental principles 1.3: Definitions 1.4: Requirements for assessment	12
	LO2 Know the protective measures given in BS 7671	2.1: Protection for safety	
	LO3 Know the requirements for selection and erection of BS 7671	3.1: Requirements for selecting and erecting equipment	
	LO4 Know the requirements for inspection and testing in BS 7671	4.1: Requirements for inspection and testing	
	LO5 Know the requirements for special locations and information within appendices of BS 7671	5.1: Special installations and locations 5.2: Appendices of BS 7671	

		Total marks for sections:	60 marks
		Integration across units*:	15 marks
		Total marks for exam:	**75 Marks**

** Integration across units.* These marks relate to Assessment Objective 4. These marks are awarded to differentiate between levels of performance by candidates taking the exam. The marks are given for how well a candidate has applied their knowledge, understanding and skills from across the units that make up the qualification in an integrated way to meet the requirements of the exam questions.

3. Guidance

Vocabulary of the exam: use of 'command' verbs

The exam questions are written using 'command' verbs. These are used to communicate to the candidate the type of answer required. Candidates should be familiarised with these as part of their exam preparation.

The following guidance has been produced on the main command verbs used in City & Guilds Technicals exams.

A more detailed version of this table, which also includes the command verbs used in the assignments is published in *City & Guilds Technical Qualifications Teaching, Learning and Assessment* guide.

Command verb	Explanation and guidance
Analyse	Study or examine a complex issue, subject, event, etc in detail to explain and interpret, elements, causes, characteristics etc
Calculate	Work out the answer to a problem using mathematical operations
Compare (…and contrast) (or ***describe*** the similarities/differences)	Consider and describe the similarities (and differences) between two or more features, systems, ideas, etc
Define	Give the meaning of, technical vocabulary, terms, etc.
Describe	Give a detailed written account of a system, feature, etc **(..the effect of…on…)** the impact, change that has resulted from a cause, event, etc **(..the process..)** give the steps, stages, etc
Determine	Work out the answer to a problem using a combination of referencing published data and mathematical operations
Differentiate between	Establish and relate the characteristic differences between two or more things, concepts, etc
Discuss	Talk/write about a topic in detail, considering the different issues, ideas, opinions related to it
Distinguish between	Recognise and describe the characteristic differences between two things, or make one thing seem different from another
Evaluate	Analyse and describe the success, quality, benefits, value, etc (of an end product, outcome, etc)
Explain	Make (a situation, idea, process, etc) clear or easier to understand by giving details **(..how..)** Give the stages or steps, etc in a process, including relationships, connections, etc between these and causes and effects.

Give example(s) illustrate/	Use examples or images to support, clarify or demonstrate, an explanation, argument, theory, etc
Give a rationale	Provide a reason/reasons/basis for actions, decisions, beliefs, etc
Identify	Recognise a feature, usually from a document, image, etc and state what it is
Justify	Give reasons for, make a case for, account for, etc decisions, actions, conclusions, etc, in order to demonstrate why they suitable for or correct or meet the particular circumstances, context
Label	Add names or descriptions, indicating their positions, on an image, drawing, diagram, etc
List	Give as many answers, examples, etc as the question indicates (candidates are not required to write in full sentences)
Name	Give the (technical) name of something
Propose	Present a plan, strategy, etc (for consideration, discussion, acceptance, action, etc).
Select	Choose the best, most suitable, etc, by making careful decisions
State	Give the answer, clearly and definitely
Summarise	Give a brief statement of the main points (of something)

Question types

The following explains, and gives examples of, types of questions used in City & Guilds Technical exams. In preparing candidates to take the exam, it is recommended that you familiarise them with the requirements of each question type so that they can be effective and make best use of the time available when sitting the exam.

- An effective candidate will gauge the type and length of response required from the question and the number of marks available (which is given for each question on the exam paper).
- Short answer questions may not require candidates to write in complete sentences. Extended response questions will require a more developed response.
- Candidates should read the exam paper before attempting to answer the questions and should allocate time proportionate to the number of marks available for each question or section.

Question type:	Example question	Mark scheme
Short answer questions - Knowledge	State three renewable energy sources utilised for producing electricity. (3 marks)	Answers may include any of the following; Solar (1 mark) Wind (1 mark) Hydro (1 mark
Short answer questions - Understanding	Explain the reasons for the method that **must** be used when verifying the continuity of the main and supplementary bonding conductors. (3 marks)	Answer to include an explanation such as; As bonding doesn't follow a circuit (R1) path (1) then a long wander lead (1) is required to obtain a reading over the length of the bonding (1) Marks awarded for explanations that include; Required to read at both ends or over length (1) Wander or long lead required (1) As there is no line or there is no path or the leads aren't log enough (1) Recall answers such as to 'get a resistance', 'prove continuity', or check connection - 1 mark only.

No marks permitted for answers relating to parallel paths or earth path.

Extended response questions

Extended response questions are those that require the candidate to write a longer written response using sentences and paragraphs. These usually require candidates to discuss, explain, etc. a topic in some detail. The question is often based on a short case study, scenario or other prompt. The level of detail should be gauged from the question and the number of marks available.

Example question

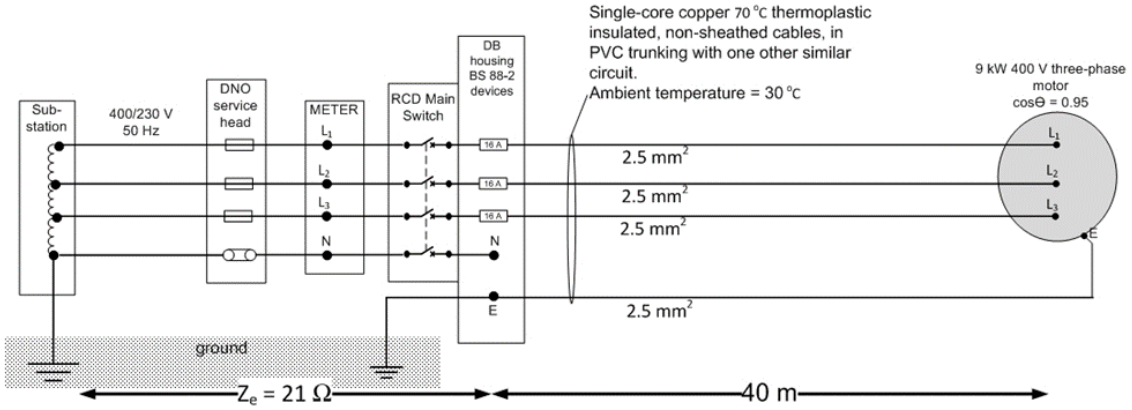

Figure 3

The supply and final circuit arrangement shown in Figure 3 relate to questions 21 a) and b).

a) Identify three important characteristics of the supply for the installation. (3 marks)

b) Evaluate the final circuit design, including the requirements for ADS, for compliance with BS 7671. (12 marks)

Your evaluation should also include recommendations relating to the residual current setting of the RCD main switch.

Mark scheme

a) The supply is a 200 V three-phase four-wire arrangement having a TT earthing arrangement using the mass of earth as the earth return path to the source electrode. Typically, suppliers try to maintain a source electrode resistance of 21 Ω .

Not acceptable are any characteristics within the installation or consumers electrode.

b)

Band 1 (1 – 4 marks)
These candidates may provide answers that state that a 2.5 mm^2 cable is suitably protected by a 16 A circuit breaker without determining load current. They may also give generic RCD values such as 30 mA or 100 mA without any justification (basic comparison).
Research maximum Z_s values from BS 7671 or cable ratings.

Example band 1 response

The 16 A circuit breaker is suitable for a 2.5 mm^2 cable and faults are protected as an RCD is fitted. **(1-2 marks)**

Access to higher marks in this band is with the inclusion of;
For candidates who focus on load
Maximum rating for this cable is 21 A as method B so with 16 A device, this is suitable.

OR for candidates that focus on ADS
The maximum Z_s for this circuit is 2.43 Ω and this is suitable for an RCD (or 30 mA/100 mA RCD)
(3-4 marks)

Band 2 (5 – 8 marks)
Be able to determine load current OR total circuit earth loop impedance
Compare load values to device ratings OR circuit loop impedance to published data OR evaluate a correct RCD value (but not all parts)

Example band 2 response

Design current (I_b)

$\frac{9000}{\sqrt{3}\times400\times0.95} = 13.67\ A\ load\ current\ (I_b)$

Factor for grouping of circuits – 0.8 C_g. No ambient temperature considerations **(5-6 marks)**

Access to higher marks in this band with the inclusion of;

I_z cable = 21 x 0.8 = 16.8 A

As I_z (16.8 A) > I_n (16 A) > I_b (13.7 A) the circuit design is correct **(7-8 marks)**

<u>OR</u> for candidates that focus on ADS

IET OSG 2.5/2.5 R_1+R_2 = 14.82 and temperature factor for operating conditions = 1.2

$$\frac{14.82 \times 40 \times 1.2}{1000} = 0.71\ \Omega\ (R_1 + R_2)$$

Total Z_s= 21+0.71=21.71 Ω **(5-6 marks)**

Access to higher marks in this band with the inclusion of;

Maximum RCD rating to fulfil this using table 41.5 is 500 mA as 21.71 Ω is less than 100 Ω

(7-8 marks)

Band 3 (9 – 12 marks)

Be able to determine all load characteristics and compare to all circuit criteria including all earth fault loop impedance values

Research all data, determine all criteria, compare cable ratings from BS 7671 making assumptions of typical cable type and the application of temperature factors

Example band 3 response

$$\frac{9000}{\sqrt{3} \times 400 \times 0.95} = 13.67\ A\ load\ current\ (I_b)$$

2.5 mm^2 live conductors installed as method B has a rating of 21 A
Factor for grouping of circuits – 0.8 C_g. No ambient temperature considerations
I_z cable = 21 x 0.8 = 16.8 A

ADS evaluation including RCD
IET OSG 2.5/2.5 R_1+R_2 = 14.82 and temperature factor for operating conditions = 1.2

$$\frac{14.82 \times 40 \times 1.2}{1000} = 0.71\ \Omega\ (R_1 + R_2)$$

Total Z_s= 21+0.71=21.71 Ω
Maximum Z_s for 16 A BS 88-2 device = 2.43 Ω
Maximum RCD rating to fulfil this using table 41.5 is 500 mA as 21.71 Ω is less than 100 Ω

(9-10 marks)

Access to higher marks in this band with the inclusion of;
Comparisons of calculations to data to justify circuit conditions
Protective device rating 16 A which is > 13.67 A therefore device is suitable
As I_z (16.8 A) > I_n (16 A) > I_b (13.7 A) the circuit design is correct.
As Z_s is too high and as this is a TT system, an RCD is required so

$$\frac{50}{21.71} = 2.3\ A$$

so any RCD under 2.3 A or 2300 mA ok **(11-12 marks)**

Examination technique

Candidates with a good understanding of the subject being assessed can often lose marks in exams because they lack experience or confidence in exams or awareness of how to maximise the time available to get the most out of the exam. Here is some suggested guidance for areas that could be covered in advance to help learners improve exam performance.

Before the exam

Although candidates cannot plan the answers they will give in advance, exams for Technical qualifications do follow a common structure and format. In advance of taking the exam, candidates should:

- be familiar with the structure of the exam (ie number and type of questions).
- be aware of the amount of time they have in total to complete the exam.
- have a plan, based on the exam start and finish time for how long to spend on each question/section of the exam.
- be aware of how many marks are available for each question, how much they should expect to write for each question and allow most time for those questions which have the most marks available.

At the start of the exam session

At the start of the exam, candidates:

- should carefully read through the instructions before answering any questions.
- may find it helpful, where possible, to mark or highlight key information such as command words and number of marks available on the question paper.
- identify questions which require an extended written answer and those questions where all or part of the question may be answered by giving bullets, lists etc rather than full sentences.

Answering the questions

Candidates do not have to answer exam questions in any particular order. They may find it helpful to consider, for example:

- tackling first those questions which they find easiest. This should help them get into the 'flow' of the exam and help confidence by building up marks quickly and at the start of the exam.
- tackling the extended answer question at an early stage of the exam to make sure they spend sufficient time on it and do not run out of time at the end of the exam.

Candidates should avoid wasting time by repeating the question either in full or in part in their answer.

Candidates should **always** attempt every question, even questions where they may be less confident about the answer they are giving. Candidates should be discouraged however, from spending too long on any answer they are less sure about and providing answers that are longer and give more detail than should be necessary in the hope of picking up marks. This may mean they have less time to answer questions that they are better prepared to answer.

Extended answer questions

Before writing out in full their answer to extended questions, candidates may find it helpful to identify the key requirements of the question and jot down a brief plan or outline of how they will answer it. This will help clarify their thinking and make sure that they don't get 'bogged down' or provide too much detail for one part of the question at the expense of others.

Towards the end of the exam

Candidates should always set aside time at the end of the exam to read back through and review what they have written in order to make sure this is legible, makes sense and answers the question in full.

If a candidate finds they are running out of time to finish an answer towards the end of the exam, they should attempt to complete the answer in abbreviated or note form. Provided the content is clear and relevant, examiners will consider such answers and award marks where merited.

Further guidance on preparing candidates to take the exam is given in the City & Guilds publication, Technical Qualifications, Teaching, Learning and Assessment which can be downloaded free of charge from City & Guilds website.

4. Further information

For further information to support delivery and exam preparation for this qualification, centres should see:

City & Guilds

Qualification homepage: https://www.cityandguilds.com/qualifications-and-apprenticeships/building-services-industry/electrical-installation/8202-technicals-in-building-services-engineering which includes:

- Qualification handbook
- Synoptic Assignment
- Sample assessments

Technical Qualifications, Resources and Support: www.cityandguilds.com/techbac/technical qualifications/resources-and-support

Joint Council for Qualifications

Instructions for Conducting Examinations: http://www.jcq.org.uk/exams-office/ice---instructions-for-conducting-examinations