

# 2396-402 Level 4 Principles, Design, Erection and Verification of Electrical Installations.

Chief Examiner's report – **December 2019**



## **About City & Guilds**

City & Guilds is the UK's leading provider of vocational qualifications, offering over 500 awards across a wide range of industries, and progressing from entry level to the highest levels of professional achievement. With over 8500 centres in 100 countries, City & Guilds is recognised by employers worldwide for providing qualifications that offer proof of the skills they need to get the job done.

## **City & Guilds Group**

The City & Guilds Group includes City & Guilds, ILM (the Institute of Leadership & Management, which provides management qualifications, learning materials and membership services), City & Guilds NPTC (which offers land-based qualifications and membership services), City & Guilds HAB (the Hospitality Awarding Body), and City & Guilds Centre for Skills Development. City & Guilds also manages the Engineering Council Examinations on behalf of the Engineering Council.

## **Equal opportunities**

City & Guilds fully supports the principle of equal opportunities and we are committed to satisfying this principle in all our activities and published material. A copy of our equal opportunities policy statement is available on our website.

## **Copyright**

The content of this document is, unless otherwise indicated, © The City and Guilds of London Institute and may not be copied, reproduced or distributed without prior written consent.

However, approved City & Guilds centres and candidates studying for City & Guilds qualifications may photocopy this document free of charge and/or include a PDF version of it on centre intranets on the following conditions:

centre staff may copy the material only for the purpose of teaching candidates working towards a City & Guilds qualification, or for internal administration purposes

candidates may copy the material only for their own use when working towards a City & Guilds qualification

The Standard Copying Conditions (which can be found on our website) also apply.

Please note: National Occupational Standards are not © The City and Guilds of London Institute. Please check the conditions upon which they may be copied with the relevant Sector Skills Council.

## **Publications**

City & Guilds publications are available from our website or from our Publications Sales department, using the contact details shown below.

Every effort has been made to ensure that the information contained in this publication is true and correct at the time of going to press. However, City & Guilds' products and services are subject to continuous development and improvement and the right is reserved to change products and services from time to time. City & Guilds cannot accept liability for loss or damage arising from the use of information in this publication.

## **City & Guilds**

**1 Giltspur Street**

**London EC1A 9DD**

**T +44 (0)844 543 0000**

**F +44 (0)20 7294 2413**

**[www.cityandguilds.com](http://www.cityandguilds.com)**

**[centresupport@cityandguilds.com](mailto:centresupport@cityandguilds.com)**

# Contents

<b>1</b>	<b>Introduction</b>	<b>4</b>
<b>2</b>	<b>Feedback on candidate performance</b>	<b>4</b>
	General feedback	4
	Cable Design Calculations	5
	Knowledge of BS 7671 (Design)	5
	Knowledge of BS 7671 (Selection and Erection)	6
	Verification	6
	Special Locations	6
	Appendices	7
<b>3</b>	<b>National pass rate</b>	<b>8</b>
	Past examination series	8
<b>4</b>	<b>Forthcoming Exam Dates are:</b>	<b>8</b>
<b>5</b>	<b>Note regarding 18<sup>th</sup> Edition of IET Wiring Regulations</b>	<b>8</b>

# 1 Introduction

The purpose of this document is to provide centres with feedback on the performance of candidates in the December 2019 examination for 2396-402 Design, Erection and Verification of Electrical Installations.

The Chief Examiners' Report has been reintroduced as a result of feedback from centres, to give them guidance in preparing candidates for the written examination.

## 2 Feedback on candidate performance

### General feedback

The following comments are intended to help students prepare for the examination by having a better understanding of what is expected of them. The feedback within this report would also be valuable to tutors in understanding candidates' difficulties in answering questions and the areas where more guidance is required.

The December 2019 question paper was found to be in accordance with the scheme requirements.

The examination entry for this series was approximately 195.

This examination contained no errors and was judged to be of the correct level covering the required parts of the test specification.

As BS 7671:2018 became the only current version from January 2019, this assessment only permitted answers reflecting these requirements.

Candidates who simply **quote text** from permitted publications, such as BS 7671, will not score well where questions require an **explanation** or **description**. Candidates must interpret the requirements to suit any given scenario within the question.

Where questions are seeking **why** particular regulations or measures are required, candidates must take care to explain 'why' as opposed to 'what' the requirements are or 'how/where' they are applied.

Several questions required candidates to give a **specific number of responses**. A small but significant number of candidates give more answers than asked for, and whilst this isn't penalised, it could be a waste of the candidate's time. Only the first number of responses asked for will be considered for marking.

Centres should be encouraged to teach candidates the reasons why certain regulations exist, change or are introduced to BS 7671. Understanding why regulations change gives far better insight into why these regulations are essential, and the risks associated. Centres may wish to use resources such as 'Wiring Matters' produced by IET as well as the IET website where articles can be found giving background to some of the topics which are often raised within this assessment. These include risks such as those associated with PME arrangements, support for wiring systems in order to protect firefighters operating in buildings and structures and situations where some installations require surge protection.

Within this assessment, it was very disappointing that some of the most basic of questions were answered with very basic responses such as descriptions relating to high integrity earthing connections. Whilst many were able to **state** what the requirements were, few were able to **explain** these applications including reasons why, and risks associated with these

systems. Good design of an electrical installation is understanding risks associated with an electrical installation and designing out those risks.

**Centres should encourage potential candidates to have recently achieved City & Guilds 2382: Requirements for Electrical Installations, before enrolling onto this course or include a similar course of study as an addition to this course.**

## Cable Design Calculations

Very few candidates correctly identified all the rating factors that applied to this scenario. A significant number of candidates did not calculate the required cable size, but simply selected it from the protective device without consideration of the rating factors. Candidates must show suitable calculations to demonstrate understanding of the subject.

Many candidates did not seem to understand that a distribution circuit will add to the voltage drop of a final circuit and if final circuit voltage drop was pre-determined, such as this scenario, the distribution circuit must be suitably sized to ensure the final circuits do not exceed their maximum permitted values. Few candidates were able to identify that the lighting circuits had tighter restrictions than power circuits, but most candidates based their calculations on the power restrictions meaning the lighting circuits would, after the introduction of the distribution circuit, have voltage drops exceeding permitted values. This led to many candidates incorrectly sizing the conductor for voltage drop

Candidates generally apply a reasonable understanding of design in regard to earth fault loop impedance and the application of the adiabatic equation as Chapter 54 of BS 7671. Whilst some candidates did justify their answers, many were still simply providing calculated values with no justification as to whether these values were compliant or not, with reasons.

A number of candidates used the csa of the line conductor, as opposed to its k value, when applying regulation 543.1.4.

Some candidates would even select a particular cable size and complete the two questions with conclusions that the cable was undersized despite both questions requiring the design of a suitable cable!

## Knowledge of BS 7671 (Design)

Few candidates were able to demonstrate an understanding of the requirement for emergency control with many providing basic responses or quotes from BS 7671.

Two questions related to supply characteristics. A significant number of candidates did not answer in context to the question, and thus gave any characteristic rather than only those that can be determined a specific way.

Once again, few candidates were able to understand the difference between earthing and bonding. When candidates were required to respond on a question relating to earthing, many provided responses relating to bonding. Candidates **must** be able to understand the difference between these protective conductors to effectively select them.

Most candidates provided suitable responses to questions where items from BS 7671 needed recalling or listing such as sources of electromagnetic disturbance.

A large number of candidates who, when asked to determine **short-circuit** current protection, determined **earth fault loop impedance** values and centres need to pay particular attention

to this during delivery. A short circuit is between live conductors and an earth fault is between Line and Earth. One very common error made by most candidates was to calculate the external short circuit impedance using single-phase values despite it being a three-phase supply to the installation and this again, may be due to confusion between earth fault impedance and short circuit impedance. Using an earth loop impedance value to determine short circuit will not attract marks. In addition, the correct adiabatic equation used for short circuit protection is contained in Chapter 43 and should not be confused with the one in Chapter 54 and its values of k.

A question relating to a Calculated Risk Level for surge protection attracted mixed responses with some providing suitable calculations and comparisons, many missing required factors and many leaving the question unanswered.

## **Knowledge of BS 7671 (Selection and Erection)**

Few candidates were able to provide responses that demonstrated a full understanding of the need to provide a high integrity protective conductor system, where circuits supply items of equipment having a high protective conductor current. Many candidates simply copied from BS 7671 and did not show an understanding of the requirements in relation to the specific question.

Once again, few candidates fully understood the risks associated with through wiring and why it should be avoided without particular precautionary measures.

An item requiring candidates to explain suitable methods for installing cables concealed in walls with **no additional impact protection** provided responses including additional impact protection. Candidates must be encouraged to read questions fully before responding. Many just copied the regulations without specific reference to the scenario given.

## **Verification**

Whilst candidates did demonstrate some knowledge and understanding of continuity and insulation resistance testing, many dropped marks for not fully explaining the correct procedure for testing. It was apparent that many candidates copied precise paragraphs from permitted guidance, without relating it specifically to the questions. Detail was lacking for this scenario with many wasting valuable time fully explaining a safe isolation procedure, and whilst safety is critical, it should be considered that these tests form part of a bigger initial verification process.

The key is in the detail for these items. Quantity of an answer is not important but quality and key detail is. Bullet point type answers are normally a good way to explain a procedure providing the points contain key information.

## **Special Locations**

As well as having an understanding of the requirements of BS 7671 for Special Installations or Locations, candidates at this level need to demonstrate a knowledge of the risks which lead to these further measures. A good understanding of the risks enables designers to select suitable measures including a better understanding of why certain requirements must be met.

On average, most candidates answered these questions to a reasonably good standard in relation to a swimming pool. It should however be noted that many candidates begin their responses well detailing some of the risks, such as 'reduced body resistance' but end up

reciting requirements. The intention of the questions is to address why the requirements are there, not what each requirement states.

## **Appendices**

Whilst it is not the intention of this qualification to assess the detail of energy efficiency as detailed in Appendix 17, it is not unreasonable for questions to seek understanding of the causes of energy losses in fixed wiring. As the material, length and csa of a conductor all contribute to voltage loss, this in turn leads to energy losses and designers should always be aware of the potential overall losses and seek ways to reduce losses in installations.

### 3 National pass rate

The national pass rate for the 2396-402 December examination is as follows:

Exam series	Distinction (%)	Merit (%)	Pass (%)	Fail rate (%)
December 2019	7.6	13.5	28.1	50.8

#### Past examination series

Exam series	Distinction (%)	Merit (%)	Pass (%)	Fail rate (%)
December 2018	2.8	7.8	29.1	60.3
March 2019	0.9	12.2	22.6	64.3
June 2019	0	4.6	30.3	65.1

### 4 Forthcoming Exam Dates are:

Thursday 12<sup>th</sup> March 2020

Thursday 11<sup>th</sup> June 2020

Thursday 3<sup>rd</sup> December 2020

### 5 Note regarding 18<sup>th</sup> Edition of IET Wiring Regulations

Please note that all 2019 series will only accept answers versioned to the 18<sup>th</sup> Edition of the IET Wiring Regulations (BS 7671:2018). Candidates are encouraged to ensure they have received a copy of the corrigendum to BS 7671:2018 published by IET and available at <https://electrical.theiet.org/bs-7671/updates/>

Future assessments will require candidates to have amendment 1 of BS 7671 (2020) which can also be downloaded from the IET website above, once published in February 2020.



---

**Published by City & Guilds**  
**1 Giltspur Street**  
**London**  
**EC1A 9DD**  
**T +44 (0)844 543 0000**  
**F +44 (0)20 7294 2413**  
**[www.cityandguilds.com](http://www.cityandguilds.com)**

**City & Guilds is a registered charity**  
**established to promote education and**  
**training**