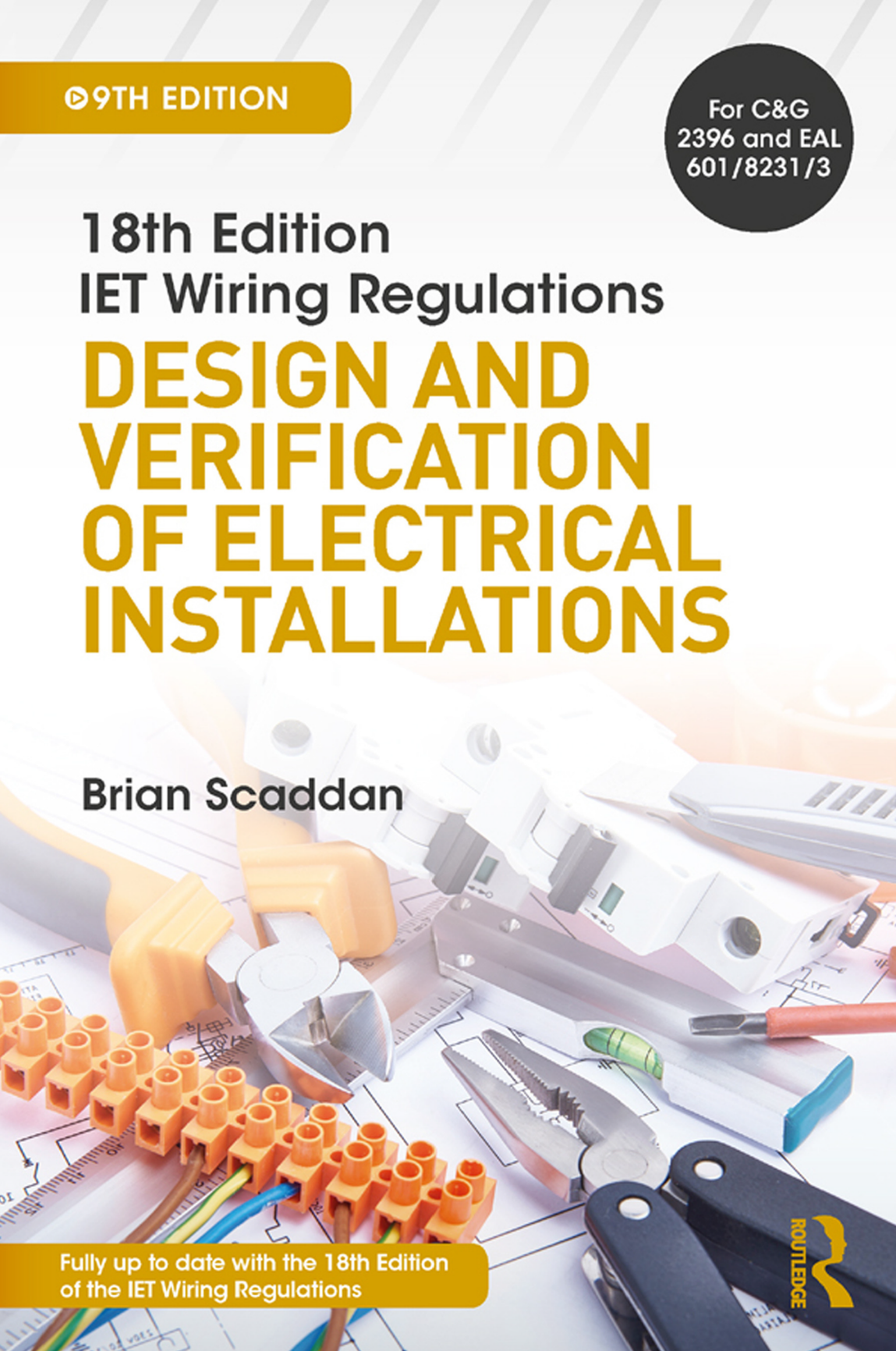
9TH EDITION

For C&G 2396 and EAL 601/8231/3

18th Edition
IET Wiring Regulations

DESIGN AND VERIFICATION OF ELECTRICAL INSTALLATIONS

Brian Scaddan



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ROUTLEDGE

18th Edition
IET Wiring Regulations
Design and Verification of Electrical Installations

This popular guide provides an understanding of basic design criteria and calculations, along with current inspection and testing requirements and explains how to meet the requirements of the IET Wiring Regulations. The book explains in clear language those parts of the regulations that most need simplifying. There are common misconceptions regarding bonding, voltages, disconnection times and sizes of earthing conductors. This book clarifies the requirements and outlines the correct procedures to follow.

This provides an affordable reference for all electrical contractors, technicians and other workers involved in designing and testing electrical installations. The content covers the requirements for both City & Guilds and EAL courses, and contains sample exam questions and answers. It also makes an ideal revision guide.

- Fully up to date with the 18th Edition of IET Wiring Regulations.
- Simplifies the advice found in the Wiring Regulations, explaining what they mean in actual working practice for design and testing.
- Expert advice from an engineering training consultant, supported with colour diagrams, examples and key data.

Brian Scaddan, I Eng, MIET, is an Honorary Member of City & Guilds and has over 45 years' experience in further education and training. He was Director of Brian Scaddan Associates Ltd, an approved training centre offering courses on all aspects of electrical installation contracting, including those for City & Guilds and EAL. He is also a leading author of books on other installation topics.

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In memory of
Ted Stocks
A friend and colleague

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Preface

There are many electrical operatives who, quite innocently I am sure, select wiring systems based on the old adage of 'that's the way it's always been done' or 'we always use that size of cable for that circuit', etc. Unfortunately this approach, except for a few standard circuits, is quite wrong. Each wiring system should be designed to be fit for purpose and involves more than arbitrary choices.

The intention of this book is to illustrate the correct procedure for basic design of installations from initial assessment to final commissioning. It will also be of use to candidates studying for a C&G or EAL Design qualification.

Brian Scaddan, July 2018

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CHAPTER 1

Design

Important terms/topics covered in this chapter:

- Assessment of general characteristics
- Basic protection
- Fault protection
- IP and IK codes
- The earth fault loop path
- Supplementary equipotential bonding
- Overcurrent
- Let-through-energy
- Selectivity
- Undervoltage
- Overvoltage
- Isolation and switching
- Design current
- Diversity
- Nominal rating of protection
- Rating factors
- Current carrying capacity of conductors
- Voltage drop
- Shock risk and thermal constraints.

At the end of this chapter the reader should,

- understand the need to assess all relevant characteristics of the installation,
- have reinforced their knowledge of Basic and Fault protection and how such protection is achieved,
- understand how 'let-through-energy' can cause damage to cables,
- be able to distinguish between 'Isolation' and 'Switching',
- be able to determine suitable wiring systems for particular applications,
- be able to carry out basic design calculations to determine cable sizes,
- recognize various types of installation diagram.

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Any design to the 18th Edition of the IET Wiring Regulations BS 7671 must be primarily concerned with the safety of persons, property and livestock. All other considerations such as operation, maintenance, aesthetics, etc., while forming an essential part of the design, should never compromise the safety of the installation.

The selection of appropriate systems and associated equipment and accessories is an integral part of the design procedure, and as such cannot be addressed in isolation. For example, the choice of a particular type of protective device may have a considerable effect on the calculation of cable size or shock risk, or the integrity of conductor insulation under fault conditions.

Perhaps the most difficult installations to design are those involving additions and/or alterations to existing systems, especially where no original details are available, and those where there is a change of usage or a refurbishment of a premises, together with a requirement to utilize as much of the existing wiring system as possible.

So, let us investigate those parts of the Wiring Regulations that need to be considered in the early stages of the design procedure.

ASSESSMENT OF GENERAL CHARACTERISTICS

Regardless of whether the installation is a whole one, an addition, or an alteration, there will always be certain design criteria to be considered before calculations are carried out. Part 3 of the 18th Edition, 'Assessment of General Characteristics', indicates six main headings under which these considerations should be addressed. These are:

1. Purpose, supplies and structure
2. External influences
3. Compatibility
4. Maintainability
5. Recognized safety services
6. Assessment of continuity of service.

Let us look at these headings in a little more detail.

Purpose, supplies and structure

- For a new design, will the installation be suitable for its intended purpose?
- For a change of usage, is the installation being used for its intended purpose?
- If not, can it be used safely and effectively for any other purpose?
- Has the maximum demand been evaluated?
- Can diversity be taken into account?
- Are the supply and earthing characteristics suitable?
- Are the methods for protection for safety appropriate?
- If standby or safety supplies are used, are they reliable?
- Are the installation circuits arranged to avoid danger and facilitate safe operation?

External influences

Appendix 5 of the IET Regulations classifies external influences which may affect an installation. This classification is divided into three sections, the environment (A), how that environment is utilized (B) and construction of buildings (C). The nature of any influence within each section is also represented by a number. Table 1.1 gives examples of the classification.

With external influences included on drawings and in specifications, installations and materials used can be designed accordingly.

Compatibility

It is of great importance to ensure that damage to, or mal-operation of, equipment cannot be caused by harmful effects generated by other equipment even under normal working conditions. For example, MIMS cable should not be used in conjunction with discharge lighting, as the

Table 1.1 Examples of Classifications of External Influences

Environment	**Utilization**	**Building**
Water	Capability	Materials
AD6 Waves	**BA3** Handicapped	**CA1** Non-combustible

insulation can break down when subjected to the high starting voltages; the operation of residual current devices (RCDs) may be impaired by the magnetic fields of other equipment; computers, PLCs, etc. may be affected by normal earth leakage currents from other circuits.

Maintainability

The Electricity at Work Regulations 1989 require every system to be maintained such as to prevent danger; consequently, all installations require maintaining, some more than others, and due account of the frequency and quality of maintenance must be taken at the design stage. It is usually the industrial installations that are mostly affected by the need for regular maintenance, and hence, consultation with those responsible for the work is essential in order to ensure that all testing, maintenance and repair can be effectively and safely carried out. The following example may serve to illustrate an approach to consideration of design criteria with regard to a change of usage.

Example 1.1

A vacant two-storey light industrial workshop, 12 years old, is to be taken over and used as a Scout/Guide HQ. New shower facilities are to be provided. The supply is three-phase 400/230 V and the earthing system is TN-S.

The existing electrical installation on both floors comprises steel trunking at a height of 2.5 m around all perimeter walls, with steel conduit, to all socket outlets and switches (metal-clad), to numerous isolators and switch-fuses once used to control single- and three-phase machinery, and to the lighting which comprises fluorescent luminaires suspended by chains from the ceilings. The ground floor is to be used as the main activity area and part of the top floor at one end is to be converted to house separate male and female toilet and shower facilities accommodating two 8 kW/230 V shower units in each area.

If the existing electrical installation has been tested and inspected and shown to be safe: