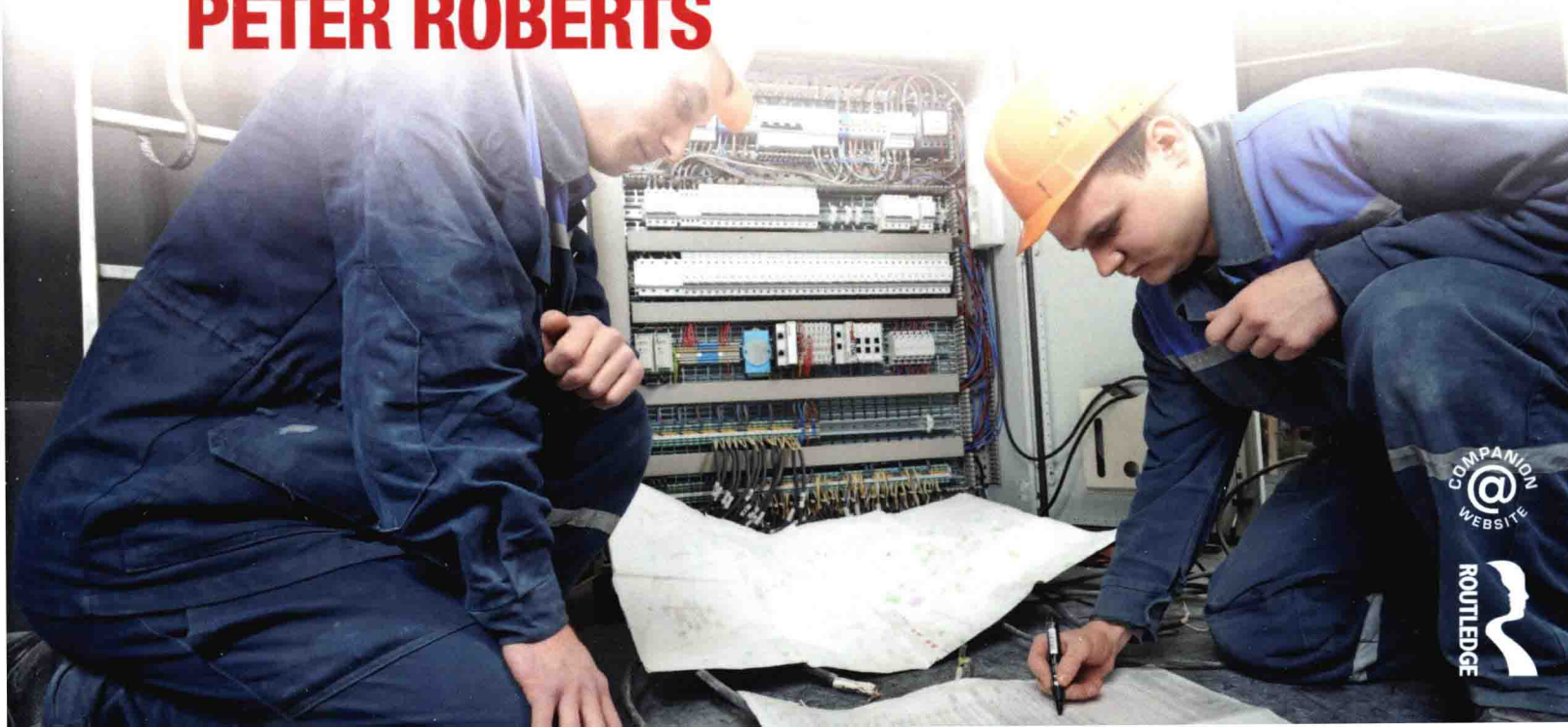




LEVEL 1

ELECTRICAL INSTALLATION WORK

PETER ROBERTS



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ROUTLEDGE



Electrical Installation Work

Level 1

Peter Roberts

First published 2018
by Routledge
2 Park Square, Milton Park, Abingdon, Oxon OX14 4RN

and by Routledge
711 Third Avenue, New York, NY 10017

Routledge is an imprint of the Taylor & Francis Group, an informa business

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British Library Cataloguing-in-Publication Data

A catalogue record for this book is available from the British Library

Library of Congress Cataloging-in-Publication Data

Names: Roberts, Peter, 1963 March 13- author. Title: Electrical installation work. Level 1 / Peter Roberts. Description: EAL edition. | Abingdon, Oxon ; New York, NY : Routledge, 2017. | Includes bibliographical references and index. Identifiers: LCCN 2016059206 | ISBN 9781138232068 (pbk. : alk. paper) | ISBN 9781315303550 (ebook : alk. paper) Subjects: LCSH: Electric apparatus and appliances--Installation--Textbooks. | Electric wiring, Interior--Textbooks. Classification: LCC TK452 .R5749 2017 | DDC 621.319/24--dc23 LC record available at <https://lccn.loc.gov/2016059206>

ISGN: 978-1-138-30978-4 (hbk)
ISBN: 978-1-138-23206-8 (pbk)
ISBN: 978-1-3153-0355-0 (ebk)

Typeset in Helvetica Neue
by Servis Filmsetting Ltd, Stockport, Cheshire

Printed and bound by CPI Group (UK) Ltd, Croydon, CR0 4YY

Level 1

The best up-to-date textbook for EAL's Level 1 Diploma in Electrical Installation (601/0409/0)

- Fully up to date with the 3rd Amendment of the 17th Edition IET Wiring Regulations
- Expert advice ensured to cover what learners need to know in order to pass their exams or complete their assignments
- Extensive online material to help both learners and lecturers

Written specifically for the EAL Diploma in Electrical Installation, this book has a chapter dedicated to each unit of the syllabus. Every learning outcome from the syllabus is covered in highlighted sections, and there is a checklist at the end of each chapter to ensure that each objective has been achieved before moving on to the next section. End of chapter revision questions will help you check your understanding and consolidate the key concepts learned in each chapter. Fully up to date with the 3rd Amendment of the 17th Edition Wiring Regulations, this book is a must have for any learner working towards EAL electrical installation qualifications, also providing an insight to those who are considering a career in the electrical installation or construction industry.

Peter Roberts is an ex-RAF Chief Technician and is currently an electrical installation lecturer, as well as an EAL question writer, based in Coleg Menai, Bangor, North Wales.

ACKNOWLEDGEMENTS

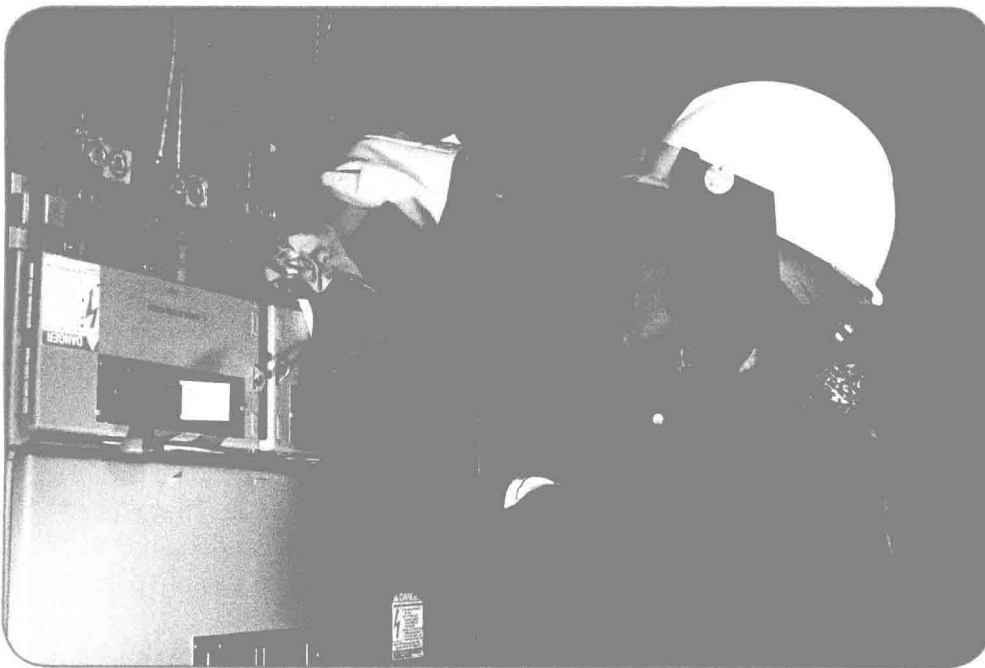
I am extremely grateful to some of the editorial and production staff at Routledge involved in creating this publication, namely: Tony Moore, Seth Townley and Scott Oakley. Equally, I would like to thank Paul Partington and Pete Olito, for fulfilling their promise to proof read, despite their own work commitments. It would also be remiss of me to forget the continual support of my family: my son Garym who came to the rescue with several professional photographs and my daughter Anwen who took time off from her own studies to review many aspects. Special mention must go to my long suffering wife Sian; without her understanding and encouragement, completing such a project would not have been possible.

A Big thank you to you all!

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Health and safety in electrical installation



Learning outcomes

The learner will:

1. Know the fundamental aspects of health and safety legislation that apply to electrical installation.
2. Know how to recognise and respond to hazardous situations.
3. Know the basic safe working procedures.
4. Know how to respond to accidents that occur while working.
5. Know the basic procedures for electrical safety.
6. Know the methods of safely using access equipment.
7. Carry out basic safe working practices.
8. Know fire safety procedures.



Learning outcome 1.1

Outline the aims of general health and safety legislation in protecting the workforce and members of the public.

Learning outcome 1.2

Recognise the responsibilities of persons under health and safety legislation.

It is virtually impossible to work in industry today without having to sit through several induction packages or courses designed to prepare an individual for the workplace. A work induction programme, however, should never be thought of as a chore, because this process has taken over 200 years to evolve and even today strives to keep all work-related environments as safe as possible.

During the 1800s, although investigations into workplace accidents were carried out, unfortunately this was not because employers were necessarily interested in their employee's welfare; their involvement would have been directed towards addressing why productivity had been reduced. Although at this time ready replacements could soon be found from what were called workhouses, replacing injured workers was still seen as an inconvenience – the substitute employees needed training, which meant that it took time for productivity to return to normal.

Early laws were finally introduced with regard to the working conditions of child labour in the textile industry through the Factory Act 1802. They limited workhouse children from working at night and capped their working day to 12 hours. This was eventually extended to all workers under the age of 18 through the Factories Act of 1831.

A significant development came about through a further Factories Act in 1833, when factory inspectors were appointed and tasked to overlook how child textile workers were treated and ensure that employers were behaving responsibly. These factory inspectors were given powers, which are similar to the Health and Safety Inspectors of today, since they were permitted to enter mills and actually question workers. They were also able to influence the need to provide guards on machinery as well as recording accidents. It is important to remember that new manufacturing processes were part of the Industrial Revolution, which created great wealth for the government and certain employers. However, it also included widespread abuse of those who were employed within it because the workers of that time had very few human rights. In 1837, it was finally established in law that an employer owes a duty of care to employees and this remains true to this day.

Legislation is passed through Parliament so that it becomes law, in order to enforce its message as well as prosecuting those who do not comply. The Health and Safety at Work Act 1974 (HASWA) was a key piece of legislation, known as an enabling act. This allows the government to pass further legislation known as statutory regulations, which are tied to the HASWA without the need to pass them through Parliament.

The HASWA 1974 also reinforces that responsibilities regarding safety apply to both employers and employees and acts as a reminder that each person has a duty of care to each other and to the public. This is very important, since ignorance of the law is no excuse – if you fail to carry out your duty and injure

Important point

Legislation is passed through Parliament to become statutory law to protect employees.

**Tackle a difficult word: enabling**

Allows further regulations to be passed

Important point

Statutory law exists to protect employees.

another person, or even yourself, then the law will punish you. This means that everyone working on a site must recognise their responsibilities when it comes to health and safety. A major statutory regulation that stemmed from the HASWA was the Electricity at Work Regulation 1989; its purpose was to ensure that employers put measures in place to protect their employees from being subjected to electrocution. Measures such as:

- Ensuring safe isolation procedures are in place
- Ensuring that employees are adequately supervised
- Ensuring that all test equipment is approved and appropriate

It is important to distinguish between statutory regulations such as the Electricity at Work Regulations 1989 and BS 7671 the wiring regulations. The wiring regulations are not legal documents; they are non-statutory but contain technical information that is written in such a way as to comply with any legal aspect. A prime example is that all electrical circuits should be provided with fault protection in order that a protective device will operate and isolate the circuit. However, the actual details regarding how this should be carried out are very technical, and are not contained in the Electricity at Work Regulations 1989, but lie within BS 7671. By always referring to the Wiring Regulations, an electrician is following what is known as their code of practice.

Responsibilities

The HASWA is written in such a way that an employer will bear more responsibility than an employee because they must ensure that the workplace is safe as far as is reasonably practicable. In other words, they must take all measures possible to protect their workforce and this includes:

- Providing personal protection equipment (PPE) that is appropriate to work activities
- Providing appropriate training irrespective of the costs involved
- Providing any specialised equipment and tools required for a task
- Continually assess and review workplace hazards

A key objective for any employer to meet is to install safe systems of work; in other words, every effort should be made to ensure that the potential of harm from hazards is either removed or reduced.

Once these safe systems of work are in place, then the employee has a duty of care to abide by them and under no circumstance interfere with them even if this means the job takes longer. For instance, if the employer has identified that PPE such as a safety harness is to be worn whilst working at height, then the employee must wear it. Remember that failure to carry out safety instructions can not only injure yourself and other employees, but possibly harm members of the public or other important visitors being escorted around a site.

Case study

Let us look at a case study involving an employer and a car owner who, after experiencing problems, drove her car to a local garage to be fixed. Having explained the problem, she left the car in the hands of the mechanic who also happened to be the garage owner. The garage owner took charge of the car, drove it up and on to a ramp and then raised it up to examine it underneath. The

?

The definition of a professional person is someone who is paid to do a job of work.



Figure 1.1 Both employers and employees are responsible for embracing health and safety procedures



Key safety point

By law, an employer must provide all relevant equipment required for the workplace; the employee however must wear or use it.

?

You can be prosecuted for injuring yourself.



Key safety point

An employee must co-operate with their employer in maintaining safety including voicing their concern if any safety issues become apparent in the workplace.

Key safety point

Employers must carry out risk assessments and include everyone that could be affected, even customers.

customer, however, had failed to tell the mechanic that there were children asleep in the back of the car. Unfortunately, one of the children woke up, left their seat, opened the car door and fell to the ground – sustaining serious facial injuries.

Question: Who was at fault?

It might surprise you to learn that when applying Health and Safety law, the garage owner was at fault, since from the moment he was handed the keys and took possession of the car, he had a legal requirement to carry out a risk assessment. Had he done so, he would have noticed the children asleep in the back. Why not look at other employers that have been prosecuted by clicking on the following link: Prosecution – HSE RSS feeds: <http://news.hse.gov.uk/category/about-hse/prosecution/page/30/>

This was a serious accident so an investigation was undertaken by an independent organisation; known as the Health and Safety Executive (HSE), it can be thought of as the health and safety police. However, unlike the police they do not need a warrant to enter premises or interview employees.

The HSE stated that the garage owner had failed in his duty of care regarding the customer and her children.

In later years, further European workplace-related regulations, also known as statutory instruments, were introduced and are referred to as the Six Pack Regulations. The HASWA is therefore sometimes referred to as an umbrella act, with the Six Pack Regulations sitting underneath it. Figure 1.2 lists the Acts contained within the Six Pack Regulations.

- Health and Safety (Display Screen Equipment) Regulations 1992
- Personal Protective Equipment at Work Regulations 1992
- Management of Health and Safety at Work Regulations 1992
- Workplace (Health, Safety and Welfare) Regulations 1992
- Manual Handling Operations 1992
- Provision and Use of Work Equipment Regulations 1992

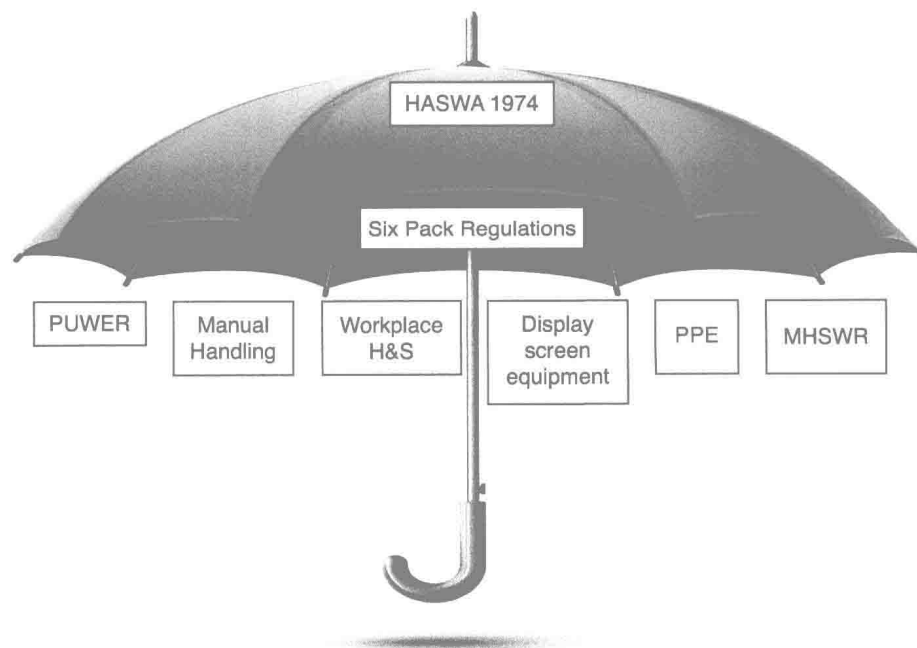


Figure 1.2 The Health & Safety Act 1974, is sometimes referred to as an umbrella act

We will now consider each in turn.

1. Health and Safety (Display Screen Equipment) Regulations 1992

This regulation came about in order to safeguard and specify the minimum safe working conditions required for people who work with display screen equipment such as computers. An employer must carry out a workspace assessment to ensure that all of the following equipment is appropriate for use:

- Display screen
- Keyboard
- User space
- Chair
- Lighting (glare)
- Software

Improper glare and continual exposure to a computer screen can cause headaches, which is why the employers have a duty of care to pay for regular eye checks. Improper chairs, especially when sitting for long periods can cause serious back pain, therefore the chairs used must be appropriate for this kind of work, in order to support a person's posture when seated.

2. Personal Protective Equipment Regulations 2002

The Regulations place a duty of care on the employer to provide appropriate PPE with regard to the work activity but it must also be 'fit for purpose'. In the UK, PPE should also meet other requirements such as being stamped with a CE mark, which proves that it complies with products sold in Europe.

3. Management of Health and Safety at Work Regulations (MHSWR) 1999

This regulation makes sure that employers/managers:

- Carry out risk assessments to highlight workplace hazards
- Write technical procedures to indicate how certain jobs should be carried out
- Employ special permits when employees are required to work in hazardous environments
- Employ specialists if the company or its employees are not qualified in any particular area
- Nominate responsible people to specialise and promote good practice in various areas and disciplines
- Provide information and training to employees
- Co-operate on health and safety matters with other employers who share the same workplace
- Talk with their employees on a regular basis
- Review all their policies and procedures on a regular basis

4. Workplace (Health, Safety and Welfare) Regulations 1992

This regulation ensures that all places of work are safe, by ensuring that all facilities, equipment and systems are maintained in good working order.

5. Manual Handling Operations Regulations 1992

By law, employers must:

- Carry out an assessment of all operations which involve lifting
- Provide adequate training with regard to promoting correct lifting techniques
- Provide mechanical lifting equipment when required



Top tip

Health and Safety is all about applying common sense.



Key safety point

Employers must provide safe systems of work.

- Ensure that drivers and operators of elevated work platform such as cherry pickers are trained, authorised and current

6. Provision and Use of Work Equipment Regulations 1998 (PUWER)

PUWER exists to make sure that the tools and equipment in use are appropriate by making sure that:

- They are suitable to the task they are involved in
- They are maintained to stay fit for purpose
- Employees are given training if necessary
- Safety devices or procedures including warning signs are in place

Question?

Which of the Six Pack Regulations did the garage owner fail to comply with regarding the customer and her child? There are **TWO** answers

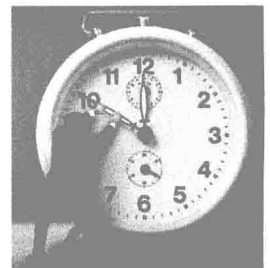
The answer

- Management of Health and Safety at Work Regulations 1992
- Workplace Health, Safety and Welfare Regulations 1992

Remember that the Management of Health and Safety spells out that safe systems of work must be in place and these will include procedures such as risk assessments in order to identify any hazards and especially adopting procedures to protect customers. All workplaces should be organised in such a way that both pedestrians and vehicles can operate in a safe manner.

Time out to discuss what we have learnt about the Health and Safety at Work Act 1974:

- It is a statutory Act designed to protect the workforce
- Employers must provide:
 - PPE, training, suitable and appropriate equipment as well as safe systems of work
- Health and Safety has to be policed by the HSE, in order to ensure that both employers and employees meet their:
 - Duty of care to themselves and others



To review your understanding try this True or False quiz based on certain requirements of health and safety.

Question 1: The Health and Safety Act 1974 is **not** a legal document.

True	False
<input type="checkbox"/>	<input type="checkbox"/>

Question 2: Certain work-based regulations are known as the Six Pack Regulations.

True	False
<input type="checkbox"/>	<input type="checkbox"/>

Question 3: Employees should, by law, have to provide their own PPE.

True	False
<input type="checkbox"/>	<input type="checkbox"/>

Learning outcome 2.1

List the types of general workplace hazards that may be encountered while at work.

Learning outcome 2.2

Recognise the methods that can be used to prevent accidents or dangerous situations occurring during work activities.

The previous learning outcomes discussed how Acts of Parliament and statutory regulations have evolved to protect the workforce in a working environment. Despite this, work related accidents still happen. Statistically the most common cause of accidents are caused through slips, trips and falls; whilst the main cause of deaths in the construction industry stems from working at height.

An employer should ensure that they apply a rigorous system of assessing, preventing and controlling their workplaces from contributing or causing accidents. An employer must ask themselves:

- Can any procedure be changed so that it involves less risk?
- Can any known hazardous substance be replaced with a safer alternative?
- Are the guards or barriers currently used adequate?
- If a hazard cannot be removed, what PPE must be provided to reduce the risk from injury?

All of these elements go towards answering a basic question: is there anything more that can be done to make the job safer?

Let us explore a working environment and at each stage think about what might go wrong, because even simple activities may be hazardous. Certain basic working practices can reduce the number of accidents and their impact.

Husbandry

Husbandry is a vital working practice since people tend to be hoarders. For instance, in certain circumstances, as materials left in waste paper baskets decompose, it can cause problems. Some have even been known to spontaneously combust. Waste, therefore, should be disposed of in a proper manner including separating out hazardous waste, recyclable waste and waste that cannot be recycled which should be sent to landfill.



Figure 1.3 Proper husbandry keeps the workplace not only clean and tidy but safe

Husbandry: A clean and tidy workplace is a safe workplace.

Top tip

Tools and equipment should be checked before and after use.

COSHH: Control of Substances
Hazardous to Health.



**A tidy site is
a safe site**

Figure 1.4 A construction site is potentially very dangerous, which is why it's known as a Special Location

That said, any unused materials should be returned to stores; not only will this keep down an employer's running costs, it does not impact so negatively on the environment.

Tools and equipment should be checked before and after use to make sure they are clean, complete and still fit for purpose. Equipment should have a permanent storage location, which will stop it becoming a trip hazard or, if left unattended, possibly blocking emergency exits. Workstations, benches and surrounding floor areas should be free of dirt or swarf (waste pieces of metal, wood, or plastic) through ensuring that a daily cleaning programme is performed at the end of the day, unless it is necessary before that.

Trailing leads can cause an immediate trip hazard, as well as possibly incurring a risk of electric shock, which means that they should be routed away from any walkways, preferably installing them along existing fence lines.

Slippery or uneven surfaces can lessen surface grip both when walking or when operating mechanical lifting devices. Any spillage involving lubricants such as petrol, diesel or other substances such as oils are a major cause of slip accidents. The same applies to uneven surfaces since they offer less friction and can also cause serious injuries.

All floors should, therefore, be regularly cleaned and warning signs should be erected in order to alert personnel of any uneven surfaces. Some workplaces even have a spillage plan to ensure that when large amounts of fluid such as petrol, oils and lubricants are involved they are dealt with through a proper process without incurring further injury or incident.

Dust and fumes present a hazard regarding inhalation (breathing in) which means that appropriate PPE must be issued in any circumstance when it is not possible to remove such a hazard. Do not forget that if the employer highlights and provides PPE then the employee must cooperate and wear it. Dust-rich environments, if exposed to an ignition source, could potentially cause an explosion, therefore it will be necessary to position appropriate fire-fighting equipment in certain locations.

Depending on the substance, when handling contaminants and irritants ill effects can range from mild irritation of the skin to severe pain and loss of limbs and even loss of life. COSHH risk assessments need to be deployed in order to highlight any specific hazards which could be encountered during its use, as well as highlighting when control measures such as PPE are required.

Handling and transporting equipment or materials

Most cases of back pain are not caused by disease but by minor sprains, strains or injuries, brought about through incorrect manual handling techniques. A very high percentage of injuries are back related, therefore all manual handling activity needs to be reviewed to see if mechanical lifting devices are required, as well as promoting good lifting techniques when lifting lighter loads. All storage areas need to be kept tidy so that they do not become trip hazards in themselves and if materials are required to be stored at height then control measures such as guardrails need to be in place.

The main cause of deaths in the construction industry occurs through activities involving working at height and largely involve employees using unsupported or incorrect access equipment. This means that any activity above ground must be scrutinised through a full risk assessment process in order to pinpoint, for instance, if safety harnesses are required. The operation of scissor lifts or cherry

pickers is controlled so that only authorised and trained personnel are permitted to operate them.

Hazardous malfunctions of equipment

If a piece of equipment fails in its function (that is, fails to do what it is supposed to do) and, as a result of this failure, has the potential to cause harm, then this would be defined as a hazardous malfunction.

All work equipment must be:

- Suitable and safe for its intended use
- Maintained in a safe condition
- Used only by instructed persons
- Provided with suitable safety measures, protective devices and warning signs
- Used correctly and appropriately and given safe storage when not in use

When equipment does become defective, for whatever reason, then it needs to be removed from use, by being labelled unserviceable and physically removed from service, being electrically isolated or segregated by barriers.

That said, if any employee is asked to carry out a procedure and thinks it too dangerous to continue, then they should raise the alarm by reporting the matter immediately to their supervisor; for example, if they notice that machine guards have been removed by an employer in order to speed up production.

Another good working practice is to use tool caddies as shown in Figure 1.5, so that all tools in use are controlled. It can also act as a temporary bin to store waste until such time as it can be disposed of correctly.

The use of shadow boards, an example of which is shown in Figure 1.6, can help identify and ensure that all tools are returned after use. This reduces the



Key safety point

Employees should always refer any safety issues to their immediate supervisor.



Figure 1.5 Tool caddies keep your tools under control

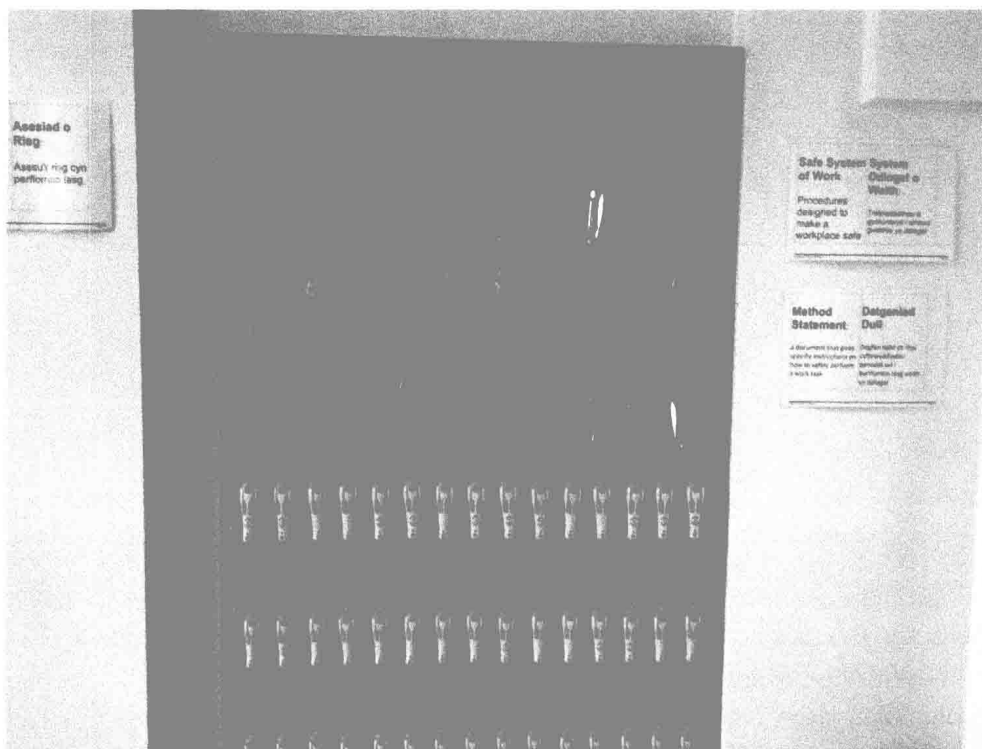


Figure 1.6 Shadow boards indicate when a tool is missing or lost

possibility of a tool becoming a trip hazard or even injuring another employee, as well as possibly coming into contact with machinery or live electrical supplies and causing further damage.

Risk assessments have already been mentioned as a means of bringing about a safe system of work, but we will now expand on how this is carried out alongside two other key safety procedures.

Key safety point



The definition of a hazard is anything with a potential to cause harm.

Risk assessments

This is a procedure that tries to identify which employees are subjected to work-based hazards and introduce control measures to reduce the possibility of them being harmed. The HSE recommends a 5-step approach:

- Identify any hazards
- Decide who might be harmed and how
- Evaluate the risks by comparing current control measures against precautions
- Record any significant findings
- Review your assessment and update if necessary

Method statement

A method statement is a written procedure detailing how a work activity is going to be carried out, including identifying any special tools or equipment required.

Permit to work

A permit to work is a procedure that is used in particularly hazardous environments. Before any work can be carried out, the work must be authorised by the permit and cleared after the task has taken place.

A method statement is a systematic procedure.

A permit to work is a procedure used in hazardous environments.

General health and safety activity

This activity contains two sets of matching terms and each matching pair should be given the same number. The first one has been done for you: 'The Health and Safety Act 1974 = 1' matched with 'Enabling act that acts as a health and safety umbrella = 1'

The Health and Safety Act 1974 = 1	Manual Handling Regulations 1992 = 2	Enabling act that acts as a health and safety umbrella = 1	Regulation that ensures employers train their employees with correct lifting techniques =
Personal Protection Equipment Regulations 2002 =	Workplace Health and Safety Regulations 1992 =	Regulation that ensures employers provide PPE = 3	Regulation that ensures employers provide a safe working environment = 4

Signs

Risks and hazards can also be highlighted in the workplace through various workplace signs and fall into five different categories. They include:

1. Blue Mandatory signs can be thought of as 'You Must'. For example, Figures 1.7 and 1.8 indicate that you must wear protective footwear and eye protection, respectively.