

# T-LEVELS

THE NEXT LEVEL QUALIFICATION

**SAMPLE  
MATERIAL**

# ENGINEERING AND MANUFACTURING

Paul Anderson  
David Hills-Taylor

CORE

 Boost

 HODDER  
EDUCATION  
LEARN MORE

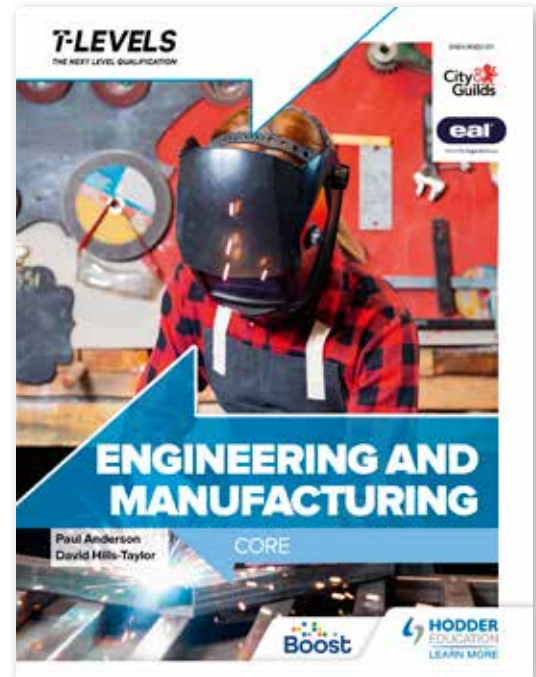
**Tackle the core component of the Engineering and Manufacturing T Level with this comprehensive resource published in association with City & Guilds and EAL.**

**Paperback:**

- 9781398360921
- £34
- Spring 2023

**Boost eBook:**

- 9781398361058
- £11 per pupil per year
- Spring 2023



Head to [www.hoddereducation.co.uk/engineering-t-level](http://www.hoddereducation.co.uk/engineering-t-level) to pre-order your textbook or find out more.

### Digital Product, Design & Development T Level (Core): Boost eBook

Boost eBooks are interactive, accessible and flexible. They use the latest research and technology to provide the very best experience for students and teachers.

- **Personalise.** Easily navigate the eBook with search, zoom and an image gallery. Make it your own with notes, bookmarks and highlights.
- **Revise.** Select key facts and definitions in the text and save them as flash cards for revision.
- **Listen.** Use text-to-speech to make the content more accessible to students and to improve comprehension and pronunciation.
- **Switch.** Seamlessly move between the printed view for front-of-class teaching and the interactive view for independent study.
- **Download.** Access the eBook offline on any device – in college, at home or on the move – with the Boost eBooks app (available on Android and iOS).

To subscribe or register for a free trial, visit  
[www.hoddereducation.co.uk/product/9781398361058](http://www.hoddereducation.co.uk/product/9781398361058)

# Contents

<b>Acknowledgements</b> .....	<b>00</b>
<b>About the authors</b> .....	<b>00</b>
<b>How to use this book</b> .....	<b>00</b>
<b>Introduction</b> .....	<b>00</b>
<b>1</b> Working within the engineering and manufacturing sectors.....	00
<b>2</b> Engineering and manufacturing past, present and future .....	00
<b>3</b> Engineering representations.....	00
<b>4</b> Essential mathematics for engineering and manufacturing.....	00
<b>5</b> Essential science for engineering and manufacturing .....	00
<b>6</b> Materials and their properties .....	00
<b>7</b> Mechanical principles.....	00
<b>8</b> Electrical and electronic principles.....	00
<b>9</b> Mechatronics .....	00
<b>10</b> Engineering and manufacturing control systems .....	00
<b>11</b> Quality management.....	00
<b>12</b> Health and safety principles and coverage.....	00
<b>13</b> Business, commercial and financial awareness .....	00
<b>14</b> Professional responsibilities, attitudes and behaviours .....	00
<b>15</b> Stock and asset management .....	00
<b>16</b> Continuous improvement .....	00
<b>17</b> Project and programme management .....	00
<b>Core Skill A</b> Problem solving.....	00
<b>Core Skill B</b> Primary research.....	00
<b>Core Skill C</b> Communicating.....	00
<b>Core Skill D</b> Collaborating.....	00
<b>Assessment</b> About the exam/ESP.....	00
<b>Glossary</b> .....	<b>00</b>
<b>Answers</b> .....	<b>00</b>
<b>Index</b> .....	<b>00</b>

# Introduction

This sample chapter is taken from the new student book for the T Level Technical Qualifications in Engineering and Manufacturing.

The book is based on the authors' extensive knowledge and experience of teaching Engineering and Manufacturing and is designed to be accessible. This is reflected in both the clear and concise content and the simple, clearly explained and purposeful learning features.

The chapters and section headings follow the structure of the specification. Key term boxes define important terms and phrases, and these are compiled in a glossary at the back of the book for easy reference.

Accessibility has also informed the page design, with numerous artworks and photographs providing visual references for the key concepts covered in the text.

## Engineering common core component

---

The book has been designed to help learners develop the knowledge, understanding and practical skills required for the Engineering common core component of the following qualifications:

- ▶ T Level Technical Qualification in Maintenance, Installation and Repair for Engineering and Manufacturing (8712)
- ▶ T Level Technical Qualification in Engineering, Manufacturing, Processing and Control (8713)
- ▶ T Level Technical Qualification in Design and Development for Engineering and Manufacturing (8714).

It provides complete coverage of the specification's content, range and assessment objectives for the common core component, and learners will gain insight into a broad range of principles and practices that are relevant to the engineering sector. Specifically, they will learn:

- ▶ the job roles, responsibilities, attitudes and behaviours needed to work in the engineering and manufacturing sector
- ▶ essential maths and science for engineering and manufacturing

- ▶ materials and their properties
- ▶ mechanical, electrical, electronic and mechatronic principles
- ▶ control systems, quality management and health and safety within the industry
- ▶ business management skills, including stock management, project management and continuous improvement.

## Occupational Specialisms

---

In order to achieve any of the Technical Qualifications listed above, learners need to complete any standalone Occupational Specialism from their chosen pathway in addition to the Engineering common core component.

Occupational Specialisms are designed to develop the knowledge, skills and behaviours required to enter a particular occupation within the engineering and manufacturing industry. **They are not covered in this book.**

## Assessment

---

For the Engineering common core component, learners need to complete:

- ▶ two externally set exams covering knowledge from the Engineering common core
- ▶ an employer-set project covering knowledge and core skills from the Engineering common core.

## Exams

Both exams include a mixture of short-answer and extended-response questions.

Each exam lasts 2.5 hours, is worth 100 marks and makes up 35% of the total assessment for the core component of the Technical Qualification (so 70% across the two papers).

## Employer-set project

The employer-set project is based on a real industry brief. It is worth 90 marks and makes up 30% of the total assessment for the core component of the Technical Qualification.

## Supporting the assessment

The book is designed to support assessment using a range of features:

- ▶ Test yourself: a range of knowledge-recall questions throughout the book to check learners' understanding
- ▶ Assessment practice: practice questions that allow learners to test their knowledge and understanding at the end of each chapter in preparation for the written exam
- ▶ Project practice: a range of assessment scenarios and focused tasks that allow learners to apply the skills and knowledge they have learned in each chapter to support their preparation for the employer-set project.

These assessment features are all showcased in this sample chapter.

# How to use this book

The following features can be found in this book.

## Learning outcomes

Summaries of the core knowledge outcomes that you must understand and learn

## Health and safety

Important points to ensure safety in the workplace

## Key terms

Definitions of important terms that you need to understand

## Improve your maths

Short activities that encourage you to apply and develop your functional maths skills in context

## Industry tips

Tips and advice to help you in the workplace

## Improve your English

Short activities that encourage you to apply and develop your functional English skills in context

## Research

Research-based activities: either stretch and challenge activities enabling you to go beyond the course, or industry placement-based activities encouraging you to discover more about your placement

## Assessment practice

Knowledge-based practice questions to help prepare you for the exam

## Case study

Scenarios that place knowledge into a fictionalised, real-life context in order to introduce problem solving and dilemmas

## Project practice

Short scenarios and focused activities reflecting one or more of the tasks that you will need to undertake during completion of the employer-set project

## Test yourself

A knowledge-consolidation feature containing questions and tasks to aid understanding and guide you to think about a topic in detail

# 14 Professional responsibilities, attitudes and behaviours



## Introduction

It is vital that engineers understand the wider context within which their work falls, and that they always act appropriately in the workplace. This chapter looks at the main responsibilities of both employers and employees in the engineering workplace and identifies different job roles and to whom they are accountable. You will also learn about the moral and ethical responsibilities of engineers and the importance of professional standards in the engineering sector.

## Learning outcomes

By the end of this chapter, you will understand:

- 1 the purpose, function and content of job descriptions
- 2 the behaviours and personal conduct expected in an engineering workplace
- 3 the responsibilities and accountabilities of different roles within an engineering company
- 4 the main duties of an engineering organisation regarding equality, diversity, accessibility and inclusion
- 5 the purpose and importance of continuing professional development (CPD) and professional recognition
- 6 the human factors that affect the work that takes place in an engineering workplace.

## 14.1 Professional conduct and responsibilities in the workplace

### Job descriptions

It is important that people who work in an engineering environment have a clear understanding of their roles and responsibilities. A **job description** is a written document that details exactly what an employee is expected to do in a particular job role. Job descriptions are also often used when a company is advertising for new staff, so that applicants understand what is required of them to be successful.

A job description usually includes:

- ▶ the job title, for example maintenance engineer or health and safety manager
- ▶ information about the purpose of the job
- ▶ an outline of the main roles and responsibilities
- ▶ details of any qualifications and prior experience required.

### Workplace behaviours

In addition to fulfilling the specific technical roles detailed in their job description, engineers are expected to behave in an appropriate manner at work. This includes:

- ▶ ensuring good punctuality and attendance
- ▶ demonstrating a positive attitude to work, both as an individual and within a team
- ▶ treating others, including colleagues, clients and customers, with respect
- ▶ ensuring a professional appearance that is appropriate for the job role being performed.

If these behaviours are not followed, it can have a negative impact on the working environment, for example:

- ▶ If someone is consistently late for work or regularly misses important meetings, this can cause tensions with colleagues who have a good attendance record.
- ▶ An untidy appearance can give a negative impression of the company's professionalism to potential customers.

On the flip side, someone who demonstrates a positive 'can do' attitude is more likely to be able to work to the best of their abilities. This positivity often rubs off on others, who will raise their standards to match.

### Seeking advice and guidance

Sometimes it is necessary for engineers to seek advice and guidance from others within the workplace. This could be regarding a specific engineering task, such as how to complete a particular maintenance activity, or about a wider workplace issue, such as how to resolve a conflict with another colleague or settle a pay dispute.

Usually, the first point of contact for a formal query or dispute is the employee's immediate **line manager** or team leader, who will either deal with the issue personally or escalate it to a more senior or appropriately qualified colleague if necessary. For example, a human resources manager could provide support related to the worker's contract of employment. A query regarding a safety concern may be referred to a health and safety manager.

Less experienced engineers, or those new to the job, will often seek informal help and support from more experienced colleagues. This helps them to develop their knowledge and skills. Some companies operate coaching, mentoring and/or 'buddy' schemes that allow colleagues with different skills and experiences to observe, speak with and learn from one another.



Engineers should always ask for help if they feel unable to successfully or safely complete a task by themselves. Any potential health and safety issues should be reported immediately.

#### Key terms

**Job description:** a written document that outlines the main roles and responsibilities associated with a job.

**Line manager:** someone who has direct responsibility for managing frontline workers, such as production staff or machine operators.



### Test yourself

Think about different scenarios where you may need to ask for support and guidance in the workplace, for example when unsure how to operate a piece of equipment.

- 1 Who would you seek advice from?
- 2 How would you approach them?
- 3 What questions would you ask?

## Personal conduct

### Reputation

The **reputation** of an individual or organisation is how they are perceived by the public based on how they behave or operate. This could be in terms of their competence and/or the quality of their work, their ability to complete jobs on time or how they treat colleagues and customers.

A reputation can be positive or negative. It can also change over time. A good reputation is important because it gives confidence to potential customers and clients that a job will be done well. It is often hard to repair a reputation once it has been damaged.

### Ethical responsibilities

**Ethics** are the moral principles that govern how an individual or organisation behaves. Engineers have a personal responsibility to ensure they act in an ethical manner.

Most companies have their own set of ethical standards that must be followed by all employees. In addition, the Engineering Council has specified a set of ethical principles that its members are expected to follow. To comply, engineers should always:

- ▶ act with integrity and respect, for example by being aware of how their actions could affect others and acting in a trustworthy and reliable manner
- ▶ show respect for life, the law and the overall public good, for example by making sure health and safety issues are taken seriously and considering sustainability issues in their use of materials and resources
- ▶ perform their work with accuracy and rigour, for example by keeping their knowledge and skills up to date and only performing work that they are suitably trained or qualified to complete
- ▶ promote high standards of leadership and communication, for example by encouraging equality, diversity, accessibility and inclusion.

### Case study

#### Volkswagen emissions scandal

The Volkswagen emissions scandal is an example of how an engineering company's reputation can be affected by the actions of its employees. In 2015, regulators in various countries began investigating one of the largest vehicle manufacturing companies in the world, the Volkswagen Group, for potential discrepancies between engine emissions test results and their actual road-use outputs. It was suggested that certain diesel-powered vehicles had been fitted with 'defeat device software' that could tell when a car was being tested, so that they looked as though they met the required standards to enable them to be sold.

The scandal caused the company's share price to drop dramatically as market confidence in the company's products fell. The group's chief executive at the time, Martin Winterkorn, said the company had 'broken the trust of our customers and the public'.



#### Questions

- 1 Research the additional impacts of the emissions scandal, both on the company involved and on the wider vehicles market.
- 2 Investigate other examples of where engineering companies have experienced either a positive or negative impact on their reputation.

### Key terms

**Reputation:** how an individual or organisation is perceived by the public based on how they behave or operate.

**Ethics:** the moral principles that guide how an individual or organisation behaves.

**Test yourself**

Discuss, using examples, the importance of acting in an ethical manner when working in an engineering environment.

**Research**

Visit the Engineering Council website: [www.engc.org.uk](http://www.engc.org.uk).

Find, read and check that you understand the ethical standards for engineers set by the Engineering Council.

managers could be left confused about what they are trying to achieve with their teams. It is therefore important that everybody within the organisation understands the responsibilities of their specific roles and executes them to the best of their abilities.

**Accountability** is important within an organisational structure because it ensures performance is of an appropriate standard and allows for potential improvements to be identified. Each worker has a specific person to whom they report and are directly accountable, and who is responsible for managing their performance. Usually this is the next most senior person. For example, a machine operator is usually immediately accountable to the production or manufacturing manager. If an issue cannot be dealt with by their immediate line manager, for example a serious disciplinary matter, it may be sent further up the organisation to be resolved by a more senior colleague.

**Levels of accountability within organisational structures**

**Responsibilities of different roles within an organisation**

There are a number of different job roles within an organisation, each with their own specific responsibilities. Failing to meet these responsibilities can have an impact on other people within the organisation. For example, disorganised management of a production line could mean that machine operators do not have the required materials and consumables available to manufacture a product or part. If directors do not have a clear strategic vision for the organisation,

**Key term**

**Accountability:** being responsible for an action, task or job.

**Test yourself**

Explain why accountability is important in the engineering workplace.

▼ Table 14.1 Responsibilities and accountabilities of different roles within an engineering company

Role within organisation	Main responsibilities	Accountable to
Apprentice	Developing their knowledge and skills while 'on the job' Completing the relevant qualifications for the job role that they are working towards, e.g. machine operator	Line manager Coach/mentor Apprenticeship/training provider
Operator	Safely operating tools, equipment and machinery used to manufacture, test or maintain products	Line/department manager Team leader
Management	Leading and organising teams or groups of employees Setting targets, e.g. for production Reviewing performance of individual team members	Senior managers Directors
Director	Overall management and oversight of the company and its operations Strategic decision-making	Chief executive officer (CEO) Shareholders External regulators

## Main duties of an organisation regarding equality, diversity, accessibility and inclusion

All organisations have duties regarding **equality, diversity, accessibility** and **inclusion**.

- ▶ Equality is about ensuring nobody suffers prejudice based on age, disability, gender reassignment, marriage/civil partnership, pregnancy/maternity, race, religion or belief, sex or sexual orientation. The Equality Act sets out these **protected characteristics** that must be observed by law.
- ▶ Diversity involves employing, accepting and including employees from all backgrounds. Diverse workplaces can bring different perspectives on problems and solutions, cultural insight and localised market knowledge.
- ▶ Accessibility is concerned with the removal of barriers that prevent workers performing their roles, and ensuring equal access to workplace facilities and equipment for all. For example, people with disabilities should be able to perform the same tasks as those who are non-disabled.
- ▶ Inclusion means creating a workplace culture where the different skills, talents and perspectives of all workers are accepted, appreciated, supported and valued.

### Test yourself

Outline the main protected characteristics that are set out in workplace equality legislation.

### Research

Read and discuss BAE Systems' diversity and inclusion policy: [www.baesystems.com/en/sustainability/people/diversity-and-inclusion](http://www.baesystems.com/en/sustainability/people/diversity-and-inclusion)

What do you think the organisation is doing well in this area? What aspects of the policy do you think need to be improved?

## 14.2 Continuous professional development (CPD) and professional recognition

### What is continuous professional development (CPD)?

**Continuous** (or **continuing**) **professional development** (CPD) is about ensuring that an individual can continue to develop their skills, abilities and experience after formally qualifying for their job role. It can take many different forms, such as face-to-face or remote training courses, observation of colleagues, and coaching, mentoring or buddying schemes. It can also include taking further qualifications relevant to current or future potential job opportunities within a company or sector. For example, a manufacturing engineer may wish to take a management qualification to put them in a good position when applying for a production manager role.



### Key terms

**Equality:** ensuring nobody suffers prejudice based on the protected characteristics set out in the Equality Act 2010.

**Diversity:** employing, accepting and including employees from all backgrounds.

**Accessibility:** ensuring equal access to workplace facilities and equipment for all and removing barriers to achieve this.

**Inclusion:** creating a workplace culture where the different skills, talents and perspectives of all workers are accepted, appreciated, supported and valued.

**Protected characteristics:** nine aspects of a person's identity set out in the Equality Act. The Act legally protects people from being discriminated against on the basis of these characteristics.

**Continuous professional development (CPD):** the learning activities that workers engage in to improve the knowledge and skills needed to perform their current or future job roles.

Many aspects of CPD require the engineer to take a level of personal responsibility for their needs and requirements. For example, it is reasonable to expect a professional engineer to keep up to date with current safety standards related to their role.

### How CPD motivates staff and improves performance

New processes, technologies and ways of working are constantly being developed within the engineering sector, so it is vital that engineers continually update their knowledge and skills. For example, training on a range of new machines increases the skillset of the operator and allows more flexibility of staffing for the company. This in turn can lead to greater efficiency and productivity.

Effective CPD is also essential for maintaining workforce morale and motivating staff to perform as well as possible. For example, sessions focusing on the wider ethos and goals of the company increase staff's sense of belonging and contribute to increased confidence, enthusiasm, discipline and loyalty.

CPD allows workers to keep up to date with changes to legislation, quality standards and company **standard operating procedures (SOPs)**. For example, if changes are made to wiring regulations, all engineers working on electrical equipment need to be retrained so they can follow the new procedures safely and effectively. Failure to do this could leave the company or individual engineer open to prosecution.

#### Test yourself

Explain the purpose and benefits of effective CPD in the workplace.

## Professional standards and recognition

**Professional bodies** set the **professional standards** that they expect their members to follow.

- ▶ The Engineering Council acts as the main regulatory authority for chartered and incorporated engineers.
- ▶ The Institution of Engineering and Technology (IET) sets and reviews various professional and technical standards, most notably the wiring regulations for electrical engineers (BS 7671).

- ▶ The Institution of Mechanical Engineers (IMechE) mainly sets and reviews standards relating to the field of mechanical engineering.

Appropriately qualified and experienced engineers can apply for chartered status. This is a peer-reviewed process that is managed by the Engineering Council. To achieve this level of recognition, applicants must demonstrate extremely high levels of professional competence in their specialist field. Chartered engineers are highly sought after by companies and can command high salaries.

Outstanding performance within the engineering industry can also be recognised and rewarded through professional awards. For example, the British Engineering Excellence Awards (BEEAs) are held annually. Categories include Design Engineer of the Year, Electronic Product of the Year and High-Impact Innovator of the Year.

#### Key terms

**Standard operating procedures (SOPs):** step-by-step instructions for routine operations. These are put together by an organisation, and all workers must follow them.

**Professional bodies:** organisations that represent, support and set the standards of work and behaviour for a profession.

**Professional standards:** agreed standards, set by professional bodies, that describe the skills, knowledge and behaviours that characterise excellent practice and support within a profession.

#### Test yourself

Explain, using examples, the benefits of professional recognition within the engineering sector.

#### Research

Investigate the requirements for and benefits of Chartered Engineer status: [www.engc.org.uk/ceng](http://www.engc.org.uk/ceng)

## 14.3 Human factors within engineering and manufacturing contexts

### Human characteristics

Any workplace is only as successful as the people who work in it. Therefore, **human characteristics** must be considered and taken into account at all times.

**Physical characteristics** are defining features of a person's body, for example their strength or appearance. **Mental characteristics** are to do with how a person thinks, for example their ability to accept change in the working environment or their confidence in dealing with new situations.

The characteristics, capabilities and limitations of people should be taken into account when setting expectations, scheduling work and defining job roles. For example, machine operators can become tired over the course of long shifts. Therefore mistakes or accidents are more likely to occur if they do not take enough breaks or holiday time to recuperate. A higher level of errors results in reduced production efficiency and increased waste.

A company can also develop a poor reputation for its treatment of workers if it does not take their physical and mental needs into consideration, potentially leading to difficulties in recruiting staff. Where workers have physical or mental disabilities, it is the responsibility of the employer to make reasonable adjustments to ensure they can perform their role.

#### Test yourself

Explain the difference between physical and mental characteristics.

#### Health and safety

Workers suffering from fatigue are more likely to make mistakes that can endanger both themselves and others working around them. Engineers should never operate machinery, tools or equipment when they are tired.

### Workplace design

Effective **workplace design** allows tasks to be performed safely and efficiently. It also allows management to have good oversight of the work being carried out.

The design considerations and assessment criteria depend on the types of task carried out in the workplace. For example, in a production facility, machines should be located so as to minimise the amount of movement required for the different product parts being manufactured. Other considerations could include:

- ▶ whether the layout is open plan, closed or a mixture of the two
- ▶ the proximity of different departments and teams for maximum efficiency
- ▶ the spacing of machinery to ensure safety and reduce disruption from noise
- ▶ how and where tools and equipment are stored
- ▶ how the design fits with the company ethos and working style
- ▶ where meetings and presentations can be held
- ▶ access to power and computer equipment
- ▶ areas for workers to take breaks and eat
- ▶ seating and furniture for comfort and ergonomics.



#### Key terms

**Human characteristics:** the physical and mental features of people.

**Physical characteristics:** defining features of a person's body.

**Mental characteristics:** characteristics relating to how a person thinks.

**Workplace design:** how the workplace is arranged to ensure maximum safety and efficiency.

The workplace should also be designed so that all employees can both access and make use of the facilities and equipment. For example, reduced-height CAD/CAM workstations allow ease of operation by wheelchair users.

**Test yourself**

Describe examples of good and bad design for engineering workplaces.

**Key term**

**Human error:** mistakes made by people.

**Health and safety**

Good workplace design can improve safety. For example, having enough space between machines avoids operators getting in each other's way when working.

**Test yourself**

Explain how worker stress can affect productivity in an engineering workplace.

**Human error**

Mistakes made by people can result in production errors and safety issues in an engineering and manufacturing environment. Although the likelihood of **human error** can never be fully eliminated, it can be reduced.

▼ **Table 14.2 Causes of human error and how they can be avoided**

Cause of human error	How it can be avoided
Insufficient training	Ensure all workers are suitably qualified for their role. Ensure workers are trained in the safe operation of all tools and equipment that they need to use. Use standard operating procedures. Provide and engage in ongoing CPD.
Fatigue	Ensure appropriate limits on working hours. Ensure workers take regular breaks. Ensure workers do not operate tools or machinery while tired.
Excessive workload	Plan effectively to ensure workers have enough time to complete tasks allocated to them. Allocate tasks, tools, equipment and resources effectively. Ensure good teamworking.
Stress	Encourage mental wellbeing within the workplace. Make use of flexible hours and remote working. Provide opportunities for counselling and mental health support.

**Assessment practice**

- 1 Explain the purpose of a job description.
- 2 State *two* expected behaviours in an engineering workplace.
- 3 Explain the importance of a positive reputation for an engineering company.
- 4 Give two examples of CPD in an engineering workplace.
- 5 Describe what is meant by ethical responsibilities in the workplace.
- 6 Give two examples of physical characteristics.
- 7 Give two examples of mental characteristics.
- 8 Explain the importance of good workplace design in manufacturing engineering.
- 9 Insufficient training and fatigue are two causes of human error in an engineering workplace. Name *two other* causes of human error in this type of environment.
- 10 Explain how the effects of fatigue can be reduced in an engineering workplace.

**Project practice**

You work for a manufacturing company that has just appointed a group of new apprentice machine operators. You have been asked to produce a presentation outlining their basic roles, responsibilities and accountabilities.

You should use appropriate digital software to produce the presentation and then deliver it to the group. The presentation should be no longer than 20 minutes.

The Publishers would like to thank the following for permission to reproduce copyright material.

### Photo credits

p.1 © Drazen/stock.adobe.com; p.2 © Gorodenkoff/stock.adobe.com; p.3 © Sanpom/stock.adobe.com; p.5 © Rawpixel.com/stock.adobe.com; p.7 © Industrieblick/stock.adobe.com

### Acknowledgements

Every effort has been made to trace all copyright holders, but if any have been inadvertently overlooked, the Publishers will be pleased to make the necessary arrangements at the first opportunity.

Although every effort has been made to ensure that website addresses are correct at time of going to press, Hodder Education cannot be held responsible for the content of any website mentioned in this book. It is sometimes possible to find a relocated web page by typing in the address of the home page for a website in the URL window of your browser.

Hachette UK's policy is to use papers that are natural, renewable and recyclable products and made from wood grown in well-managed forests and other controlled sources. The logging and manufacturing processes are expected to conform to the environmental regulations of the country of origin.

Orders: please contact Hachette UK Distribution, Hely Hutchinson Centre, Milton Road, Didcot, Oxfordshire, OX11 7HH. Telephone: +44 (0)1235 827827. Email [education@hachette.co.uk](mailto:education@hachette.co.uk) Lines are open from 9 a.m. to 5 p.m., Monday to Friday. You can also order through our website: [www.hoddereducation.co.uk](http://www.hoddereducation.co.uk)

ISBN: 978 1 3983 7431 7

© David Hills-Taylor 2022

First published in 2022 by  
Hodder Education,  
An Hachette UK Company  
Carmelite House  
50 Victoria Embankment  
London EC4Y 0DZ

[www.hoddereducation.co.uk](http://www.hoddereducation.co.uk)

Impression number 10 9 8 7 6 5 4 3 2 1

Year 2026 2025 2024 2023 2022

All rights reserved. Apart from any use permitted under UK copyright law, no part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording, or held within any information storage and retrieval system, without permission in writing from the publisher or under licence from the Copyright Licensing Agency Limited. Further details of such licences (for reprographic reproduction) may be obtained from the Copyright Licensing Agency Limited, [www.cla.co.uk](http://www.cla.co.uk)

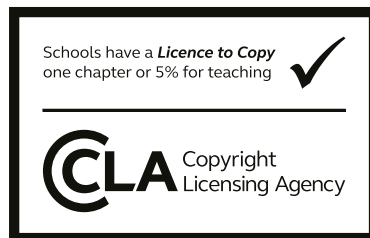
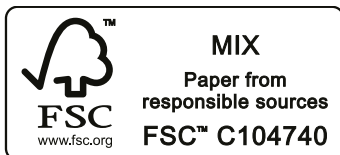
Cover photo © Parilov Evgeniy – stock.adobe.com

Illustrations by Integra

Typeset in India by Integra

Printed in UK

A catalogue record for this title is available from the British Library.



# ENGINEERING AND MANUFACTURING

## CORE

**Tackle the core component of the Engineering and Manufacturing T Level with this comprehensive resource published in association with City & Guilds and EAL.**

With topics ranging from essential maths and science to mechanical, electrical and electronic principles and engineering project management, this clear and accessible textbook will guide your learners through the qualification's core unit and will equip learners with a solid understanding of the key principles, concepts, theories and skills needed to shape a career in engineering and manufacturing.

- ➔ Track and strengthen knowledge using learning outcomes at the beginning of every chapter and 'Test Yourself' questions throughout.
- ➔ Improve understanding of important terminology with a 'Key Terms' feature, as well as a detailed glossary.
- ➔ Contextualise learning with real-world case studies that explore some of the dilemmas learners can expect to face in the workplace and reflection tasks to ensure they are set up for success.
- ➔ Understand how to avoid hazards and minimise risk with regular health and safety reminders.
- ➔ Prepare for exams and the Employer Set Project using tips, assessment practice and model answers.
- ➔ Build the functional skills needed to thrive in the industry with English and maths exercises.
- ➔ Develop professional skills with helpful tips from expert authors Paul Anderson and David Hills-Taylor, who draw on their extensive teaching and industry experience.

**'T Level' is a registered trade mark of the Institute for Apprenticeships and Technical Education.**

**The T Level is a qualification approved and managed by the Institute for Apprenticeships and Technical Education.**