

# Level 2 Technical Award in Engineering (1145-20)

June 2017 Version 1.3

**Qualification Handbook**

## Qualification at a glance

<b>Industry area</b>	Engineering
<b>City &amp; Guilds qualification number</b>	1145-20
<b>Age group</b>	14 – 16 (Key Stage 4)
<b>Assessment</b>	To gain this qualification, candidates must successfully achieve the following assessments: <ul style="list-style-type: none"> <li>• One externally set, externally moderated assignment</li> <li>• One externally set, externally marked exam, sat under examination conditions</li> </ul>
<b>Grading</b>	This qualification is graded Pass/Merit/Distinction/Distinction* For more information on grading, please see Section 6: Grading.
<b>Approvals</b>	This qualification requires full centre and qualification approval.
<b>Support materials</b>	Sample assessments Guidance for delivery Guidance on use of marking grids
<b>Registration and certification</b>	Registration and certification of this qualification is through the Walled Garden, and is subject to end dates.
<b>External quality assurance</b>	This qualification is externally quality assured by City & Guilds. Internally marked assignments are subject to external moderation. There is no direct claim status available for this qualification.

Title and level	Size (GLH)	TQT	City & Guilds qualification number	Ofqual accreditation number
Level 2 Technical Award in Engineering	120	160	1145-20	601/7241/1

Version and date	Change detail	Section
1.1 May 2016	Small typographical errors	Throughout
	TQT added for qualifications Assessment component titles amended	1. Introduction
	Employer involvement guidance updated throughout	4. Employer involvement
	Summary of assessment methods and conditions	5. Assessment
	Moderation and standardisation of assessment updated throughout	6. Moderation and standardisation of assessment
	Awarding individual assessments Awarding grades and reporting results	7. Grading
	Enquiries about results Re-sits and shelf-life of assessment results Malpractice Access arrangements and special consideration	8. Administration
	1.2 November 2016	Amendment to Exam Specification
Addition of unit 502 as paper based version of 002		4 Assessment
1.3 June 2017	Addition of examination paper based module number	1 Introduction – Assessment requirements and employer involvement 5 Assessment 5 Assessment – Exam specification 7 Grading – Awarding grades and reporting results
	Removal of AO 6-8 from Synoptic Assignments and the readjusted approximate weightings (only if applicable)	5 Assessment – Assessment Objectives
	Revised Exam Specification, Exam Duration and AO weightings	5 Assessment – Exam Specification
	Addition of Provisional Grade Boundaries and Synoptic Assignment	7 Grading
	Branding Changes	City & Guilds logo

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# 1 Introduction

## What is this qualification about?

The following purpose statement relates to the **Level 2 Technical Award in Engineering**.

Area	Description
OVERVIEW	
Who is this qualification for?	<p>This qualification allows you to understand the world of Engineering.</p> <p>If you like to explore how things work and are keen to develop technical skills, then this qualification is for you.</p>
What will the student study as part of this qualification?	<p>You will develop an understanding of how ideas for engineered products are communicated between engineers, including the use of Computer Aided Design (CAD) systems. You will also learn how ideas are turned into prototypes and have the opportunity to develop skills needed to produce and evaluate a prototype.</p> <p>This qualification has two units:</p> <ul style="list-style-type: none"><li>• Engineering communication</li><li>• Engineering development</li></ul>
What knowledge and skills will the student develop as part of this qualification and how might these be of use and value in further studies?	<p>The qualification develops the following knowledge, understanding and skills:</p> <ul style="list-style-type: none"><li>• the use of standard measurement in engineering</li><li>• an understanding of how and why different materials are used in engineered products</li><li>• the features and applications of mechanical and electrical components</li><li>• how to interpret and produce engineering drawings using CAD systems</li><li>• how to use a variety of commercial and prototype technologies</li><li>• how to evaluate products against design criteria.</li></ul> <p>Your understanding developed is fundamental to an introduction to any aspect of engineering, including:</p> <ul style="list-style-type: none"><li>• Aerospace</li><li>• Automotive</li><li>• Civil</li><li>• Mechanical</li><li>• Electrical</li><li>• Electronic</li><li>• Maintenance</li><li>• Design</li><li>• Building services</li><li>• Nuclear</li></ul>

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Your understanding and skills can be developed further through progression to other qualifications, such as A levels or specific to a sector, including

- City & Guilds Level 2 Diploma in Engineering
- City & Guilds Level 3 Advanced Technicals in Engineering

You will also find the understanding and skills useful to progress to an apprenticeship.

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Which subjects will complement this course?

GCSEs in Physics, Chemistry and English will complement this qualification.

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## Qualification structure

For the **Level 2 Technical Award in Engineering** the teaching programme must cover the content detailed in the structure below:

City & Guilds unit number	Unit title	GLH
201	Engineering communication	60
202	Engineering development	60

## Total qualification time (TQT)

Total Qualification Time (TQT) is the total amount of time, in hours, expected to be spent by a Learner to achieve a qualification. It includes both guided learning hours (which are listed separately) and hours spent in preparation, study and assessment.

Title and level	GLH	TQT
Level 2 Technical Award in Engineering	120	160

## Assessment

To achieve the **Level 2 Technical Award in Engineering** candidates must successfully complete **both** mandatory assessment components.

City & Guilds component number	Title
001	Level 2 Engineering - Synoptic assignment (1)*
502	Level 2 Engineering - Theory exam (1)*

*\*Number of mandatory assessments per assessment type*

## 2 Centre requirements

### Approval

New centres will need to gain centre approval. Existing centres who wish to offer this qualification must go through City & Guilds' **full** Qualification Approval Process. There is no fast track approval for this qualification. Please refer to the City & Guilds website for further information on the approval process: [www.cityandguilds.com](http://www.cityandguilds.com)

### Resource requirements

Centre staff should familiarise themselves with the structure, content and assessment requirements of the qualification before designing a course programme.

### Centre staffing

Staff delivering this qualification must be able to demonstrate that they meet the following requirements:

- be technically competent in the areas in which they are delivering
- be able to deliver across the breadth and depth of the content of the qualification being taught
- have recent relevant teaching and assessment experience in the specific area they will be teaching, or be working towards this
- demonstrate continuing CPD.

### Physical resources

Centres must be able to demonstrate that they have access to the equipment and technical resources required to deliver this qualification and its assessments.

### Internal Quality Assurance

Internal quality assurance is key to ensuring accuracy and consistency of assessment being marked by tutors. Internal Quality Assurers (IQAs) monitor the work of all tutors involved with a qualification to ensure they are applying standards consistently throughout assessment activities. IQAs must have, and maintain, an appropriate level of technical competence and be qualified to make both marking and quality assurance decisions through a teaching qualification or recent, relevant experience.

### Learner entry requirements

Centres must ensure that all learners have the opportunity to gain the qualification through appropriate study and training, and that any prerequisites stated in the *What is this qualification about?* section are met when registering on this qualification.

### Age restrictions

This qualification is approved for learners aged 14 – 16.

## 3 Delivering technical qualifications

### Delivering a Technical Award – Key tips

Our Technical Awards are high-quality qualifications that give learners a broad introduction to their chosen industry sector. The **Level 2 Technical Award in Engineering** provides learners with exciting opportunities to develop both their applied knowledge and theoretical understanding, alongside their development of key practical and technical skills within the Engineering sector.

### Taking a holistic approach to delivery

Tutors are encouraged to take a holistic approach to the delivery of topics and themes from across the units that make up this Technical Award. Linking key related concepts from across different units will help to develop learners' understanding of the connections between the different elements of knowledge and skills, as well as preparing them to complete the synoptic assessment requirements.

### Engaging with employers to develop links between theory and practice

The use of employers and valuable work-related learning contexts are beneficial in developing links between theory and practice. Trips and visits to a range of industry sector providers can help bring concepts to life, enabling learners to apply and deepen their understanding of

- how key terms, processes and models can be applied in different contexts
- the scale and scope of their industry sector
- the local skills gaps and needs that may exist.

### Use of learning technologies

The use of learning technologies can be useful in developing learners' independent learning skills. Online learning content, provided through a virtual learning environment or similar platform, can offer valuable opportunities for reinforcing key concepts and extending learning outside the classroom. Learners should be challenged to develop both their industry related technical knowledge and understanding along with skills in digital literacy and applied English and mathematics. For example, the safe and appropriate use of online discussion forums may help learners to develop their critical evaluation skills when sharing key resources or debating a key concept or process. Smart devices, audio-visual tools and social media should be harnessed, to support learners in researching and recording industry related practices.

### Development of learning and thinking skills

Learners should be encouraged to develop confidence in their independent research skills, making effective use of both online and offline information sources. Relevant industry magazines and trade journals, along with good quality websites should be signposted as key sources of sector information. Teaching activities should promote the evaluation of different information sources to consider their validity and reliability.

Tutors are encouraged to use creative and collaborative learning activities which inspire and engage learners to confidently apply and evaluate their developing technical knowledge and skills. Learners should be encouraged to take responsibility for their own learning and development; drawing on their own experiences where possible. Meaningful self and peer-assessment activities are encouraged to develop learners' self-awareness and reflective practice as independent, critical thinkers. Inclusive learning activities which challenge stereotypes and develop learners' awareness of diversity in their industry sector are particularly important.

## Support materials

The following resources are available for this qualification:

Description	How to access
Sample assessments Guidance for delivery Guidance on use of marking grids	Available on the qualification pages on the City & Guilds Website: <b><a href="http://www.cityandguilds.com">www.cityandguilds.com</a></b>

## 4 Assessment

### Summary of assessment methods and conditions

Component numbers	Assessment method	Description and conditions
001	Synoptic assignment	<p>The synoptic assignment is <b>externally set, internally marked and externally moderated</b>. The assignment requires candidates to identify and use effectively in an integrated way an appropriate selection of skills, techniques, concepts, theories, and knowledge from across the content area. Candidates will be judged against the assessment objectives.</p> <p>Assignments will be released to centres as per dates indicated in the Assessment and Examination timetable published on our website.</p> <p>Centres will be required to maintain the security of all live assessment materials. Assignments will be password protected and released to centres through a secure method.</p> <p>There will be one opportunity within each academic year to sit the assignment. Candidates who fail the assignment will have one re-sit opportunity. The re-sit opportunity will be in the next academic year, and will be the assignment set for that academic year once released to centres. If the re-sit is failed, the candidate will fail the qualification.</p> <p>Please note that for externally set assignments City &amp; Guilds provides guidance and support to centres on the marking and moderation process.</p>
502	Externally marked exam	<p>The exam is <b>externally set and externally marked</b>, and will be taken online through City &amp; Guilds' computer-based testing platform.</p> <p>The exam is designed to assess the candidate's depth and breadth of understanding across content in the qualification at the end of the period of learning, using a range of question types and will be sat under invigilated examination conditions. See JCQ requirements for details: <a href="http://www.jcq.org.uk/exams-office/ice-instructions-for-conducting-examinations">http://www.jcq.org.uk/exams-office/ice-instructions-for-conducting-examinations</a></p> <p>The exam specification shows the coverage of the exam across the qualification content.</p> <p>Candidates who fail the exam at the first sitting will have <b>one</b> opportunity to re-sit. If the re-sit is failed the candidate will fail the qualification. For exam dates, please refer to the Assessment and Examination timetable.</p>

## **What is synoptic assessment?**

Technical qualifications are based around the development of a toolkit of knowledge, understanding and skills that an individual needs in order to have the capability to work in a particular industry or occupational area. Individuals in all technical areas are expected to be able to apply their knowledge, understanding and skills in decision making to solve problems and achieve given outcomes independently and confidently.

City & Guilds technical qualifications require candidates to draw together their learning from across the qualification to solve problems or achieve specific outcomes by explicitly assessing this through the synoptic assignment component.

In this externally set, internally marked and externally moderated assessment the focus is on bringing together, selecting and applying learning from across the qualification rather than demonstrating achievement against units or subsets of the qualification content. The candidate will be given an appropriately levelled, substantial, occupationally relevant problem to solve or outcome to achieve. For example this might be in the form of a briefing from a client, leaving the candidate with the scope to select and carry out the processes required to achieve the client's wishes, as they would in the workplace.

Candidates will be marked against assessment objectives (AOs) such as their breadth and accuracy of knowledge, understanding of concepts, and the quality of their technical skills as well as their ability to use what they have learned in an integrated way to achieve a considered and high quality outcome.

## **How the assignment is synoptic for this qualification**

The typical assignment brief could be for learners to be provided with engineering information related to an engineering design. For example, they may be presented with a sketch and written design requirements. Learners would be required to interpret the information provided. The key tasks would require them to:

- Produce one or more engineering drawings to represent the idea
- Produce a prototype of the idea from the drawings produced
- Review the prototype against the drawing and design requirements
- Propose how the prototype can be manufactured.

## **External exam for stretch, challenge and integration**

The external assessment will draw from across the full content of the qualification, using a range of shorter questions to confirm breadth of knowledge and understanding. Extended response questions are included, giving candidates the opportunity to demonstrate higher level understanding and integration through discussion, analysis and evaluation, and ensuring the assessment can differentiate between 'just able' and higher achieving candidates.

## Assessment objectives

The assessments for this qualification are set against a set of assessment objectives (AOs) which are used across all City & Guilds Technicals to promote consistency among qualifications of a similar purpose. They are designed to allow judgement of the candidate to be made across a number of different categories of performance.

Each assessment for the qualification has been allocated a set number of marks against these AOs based on weightings recommended by stakeholders of the qualification. This mark allocation remains the same for all versions of the assessments, ensuring consistency across assessment versions and over time.

The following table explains all AOs in detail, including weightings for the synoptic assignments. In some cases, due to the nature of a qualification's content, it is not appropriate to award marks for some AOs. Where this is the case these have been marked as N/A. Weightings for exams (AOs 1, 2 and 4 only) can be found with the exam specification.

Assessment objective	Level 2 Technical Award in Engineering Typical expected evidence of knowledge, understanding and skills	Approximate weighting
<b>AO1</b> Recalls knowledge from across the breadth of the qualification.	This AO is only assessed through the exam.	0%
<b>AO2</b> Demonstrates understanding of concepts, theories and processes from across the breadth of the qualification.	Relationship between lid and base in virtual model, relationship between base, lid and PCB, electrical components used in the virtual and physical models, addition of components to the schematic, selection of measuring devices, parameters for testing, properties of materials and components, manufacturing processes.	25%
<b>AO3</b> Demonstrates technical skills from across the breadth of the qualification.	Degree of accuracy, features of CAD software used effectively, manual dexterity, quality of finish, electrical and mechanical integrity, measuring, testing, health and safety.	35%
<b>AO4</b> Applies knowledge, understanding and skills from across the breadth of the qualification in an integrated and holistic way to achieve specified purposes.	Applying knowledge and understanding across all tasks, justifying recommendations/approaches taken, understanding of electrical and mechanical components in virtual modelling, representation of mechanical features using virtual modelling, interpreting electrical and mechanical drawings to produce physical prototypes, application of understanding of measurement to testing of mechanical and electrical components, application of understanding of material properties and manufacturing processes to the development from a prototype.	25%
<b>AO5</b> Demonstrates perseverance in achieving high standards and attention to detail while showing an understanding of wider impact of their actions.	Meeting specific requirements of the task, attention to detail when completing drawings and modelling (accuracy, neatness, annotation, orientation of components, quality of joints, removal of residue, finishing).	15%

## Exam specification

AO weightings per Exam

AO	Component 002 / 502 weighting (approx. %)
AO1 Recalls knowledge from across the breadth of the qualification.	42.5
AO2 Demonstrates understanding of concepts, theories and processes from across the breadth of the qualification.	42.5
AO4 Applies knowledge, understanding and skills from across the breadth of the qualification in an integrated and holistic way to achieve specified purposes.	15

The way the exam covers the content of the qualification is laid out in the table below:

**Assessment type:** Examiner marked, written exam

**Assessment conditions:** Invigilated examination conditions

**Grading:** X/P/M/D

<b>Exam 002 / 502</b>		<b>Duration: 1hr 30 minutes</b>	
<b>Unit</b>	<b>Outcome</b>	<b>Number of marks</b>	<b>%</b>
201	<ol style="list-style-type: none"> <li>1. Understand engineering drawing conventions</li> <li>2. Understand the operation of Computer Aided Design</li> <li>3. Understand the use of basic components in engineering</li> <li>4. Understand basic units of measurement used in engineering</li> </ol>	32	40
202	<ol style="list-style-type: none"> <li>1. Understand the types and properties of materials that are used to make engineered products</li> <li>2. Understand the methods used to manufacture commercial products</li> <li>3. Understand the methods used to make prototype products</li> <li>4. Understand the importance of design criteria in evaluation</li> </ol>	32	40
N/A	Integration across the units	16	20
<b>Total</b>		<b>80</b>	<b>100</b>

\*These exams are sat under invigilated examination conditions, as defined by the JCQ:  
<http://www.jcq.org.uk/exams-office/ice--instructions-for-conducting-examinations>.

Entry for exams can be made through the City & Guilds Walled Garden.

## 5 Moderation and standardisation of assessment

City & Guilds' externally set assignments for technical qualifications are designed to draw from across the qualifications' content, and to contribute a significant proportion towards the learner's final qualification grade. They are subject to a rigorous external quality assurance process known as external moderation. This process is outlined below. For more detailed information, please refer to 'Marking and moderation - Technicals centre guidance' available to download on the City & Guilds website.

It is vital that centres familiarise themselves with this process, and how it impacts on their delivery plan within the academic year.

### **Supervision and authentication of internally assessed work**

The Head of Centre is responsible for ensuring that internally assessed work is conducted in accordance with City & Guilds' requirements.

City & Guilds requires both tutors and candidates to sign declarations of authenticity. If the tutor is unable to sign the authentication statement for a particular candidate, then the candidate's work cannot be accepted for assessment.

### **Internal standardisation**

For internally marked work<sup>1</sup> the centre is required to conduct internal standardisation to ensure that all work at the centre has been marked to the same standard. It is the Internal Quality Assurer's (IQA's) responsibility to ensure that standardisation has taken place, and that the training includes the use of reference and archive materials such as work from previous years as appropriate.

### **Provision for reworking evidence after submission for marking by the tutor**

It is expected that in many cases a candidate who is struggling with a specific piece of work may themselves choose to restart and rectify the situation during their normal allocated time, and before it gets to the stage of it being handed in for final marking by the tutor.

In exceptional circumstances however, where a candidate has completed the assignment in the required timescales, and has handed it in for marking by the tutor but is judged to have significantly underperformed, may be allowed to rework or supplement their original evidence for remarking prior to submission for moderation. For this to be allowed, the centre must be confident that the candidate will be able to improve their performance without additional feedback from their tutor and within the required timescales ie the candidate has shown they can perform sufficiently better previously in formative assessments.

The reworked and/or supplemented original evidence must be remarked by the tutor in advance of the original moderation deadline and the moderator informed of any candidates who have been allowed to resubmit evidence.

The process must be managed through the IQA. The justification for allowing a resubmission should be recorded and made available on request. The use of this provision will be monitored by City & Guilds.

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<sup>1</sup> For any internally assessed optional unit assignments, the same process must be followed where assessors must standardise their interpretation of the assessment and grading criteria.

## Internal appeal

Centres must have an internal process in place for candidates to appeal the marking of internally marked components, ie the synoptic assignment and any optional unit assignments. This must take place before the submission of marks for moderation. The internal process must include candidates being informed of the marks (or grades) the centre has given for internally assessed components, as they will need these to make the decision about whether or not to appeal.

Centres cannot appeal the outcome of moderation for individual candidates, only the moderation process itself. A request for a review of the moderation process should be made to **appeals@cityandguilds.com**.

## Moderation

Moderation is the process where external markers are standardised to a national standard in order to review centre marking of internally marked assessments. These markers are referred to as 'moderators'. Moderators will mark a representative sample of centre marked, candidates' work from every centre. Their marks act as a benchmark to inform City & Guilds whether centre marking is in line with City & Guilds' standard.

Where moderation shows that the centre is applying the marking criteria correctly, centre marks for the whole cohort will be accepted.

Where moderation shows that the centre is either consistently too lenient or consistently too harsh in comparison to the national standard, an appropriate adjustment will be made to the marks of the whole cohort, retaining the centre's rank ordering.

Where centre application of the marking criteria is inconsistent, an appropriate adjustment for the whole cohort may not be possible on the basis of the sample of candidates' work. In these instances a complete remark of the candidates' work may be necessary. This may be carried out by the centre based on feedback provided by the moderator, or carried out by the moderator directly.

Moderation applies to all internally marked assignments. Following standardisation and marking, the centre submits all marks and candidates' work to City & Guilds. via the moderation platform. The deadline for submission of evidence will be available on Walled Garden. See the *Marking and moderation - Technicals* Centre Guidance document for full details of the requirements and process.

In most cases candidates' work will be submitted directly to the moderator for moderation. This includes written work, photographic and pictorial evidence, or video and audio evidence. For some qualifications there will be a requirement for moderators to visit centres to observe practical assessments being undertaken. This will be for qualifications where the assessment of essential learner skills can only be demonstrated through live observation. The purpose of these visits is to ensure that the centre is assessing the practical skills to the required standards, and to provide the moderators with additional evidence to be used during moderation. These visits will be planned in advance with the centre for all relevant qualifications.

## Post-moderation procedures

Once the moderation process has been completed, the confirmed marks for the cohort are provided to the centre along with feedback from the moderator on the standard of marking at the centre, highlighting areas of good practice, and potential areas for improvement. This will inform future marking and internal standardisation activities.

City & Guilds will then carry out awarding, the process by which grade boundaries are set with reference to the candidate evidence available on the platform.

### **Centres retaining evidence**

Centres must retain assessment records for each candidate for a minimum of three years. To help prevent plagiarism or unfair advantage in future versions, candidate work may not be returned to candidates. Samples may however be retained by the centre as examples for future standardisation of marking.

## 6 Grading

### Awarding individual assessments

Individual assessments will be graded, by City & Guilds, as pass/merit/distinction where relevant. The grade boundaries for pass and distinction for each assessment will be set through a process of professional judgement by technical experts. Merit will usually be set at the midpoint between pass and distinction. The grade descriptors for pass and distinction, and other relevant information (eg archived samples of candidates' work and statistical evidence) will be used to determine the mark at which candidate performance in the assessment best aligns with the grade descriptor in the context of the qualification's purpose. Boundaries will be set for each version of each assessment to take into account relative difficulty.

Please note that as the Merit grade will usually be set at the arithmetical midpoint between pass and distinction, there are no descriptors for the Merit grade for the qualification overall.

### Grade descriptors

#### To achieve a pass, a candidate will be able to

- Demonstrate the broad knowledge and understanding related to the industry/occupational/technical area, its key principles, practices and legislation.
- Describe some of the main factors impacting on the industry/occupational/technical area to show good awareness of how the industry/occupational/technical area is shaped by the social, environmental, and business environment it operates within.
- Use the broad technical and specific terminology commonly used in the industry/occupational/technical area with accuracy.
- Demonstrate the application of relevant theory and understanding to solve straightforward problems.
- Interpret briefs for routine tasks, attending to the key aspects, and showing a secure understanding of the main concepts and themes across the industry/occupational/technical area.
- Carry out routine planning which shows an ability to identify the relevant information in the brief and use broad knowledge and understanding from across the qualification (including basic technical information) to interpret what a fit for purpose outcome would be, developing a plausible plan to achieve it.
- Achieve an outcome which meets the key requirements of the brief with some success.
- Identify and reflect on the most obvious measures of success for the task and evaluate how successful they have been in meeting the intentions of the plan.
- Work safely throughout, independently carrying out routine tasks and procedures, and having some confidence in attempting more complex tasks.

#### To achieve a distinction, a candidate will be able to

- Demonstrate an excellent knowledge and understanding related to the industry/occupational/technical area, its key principles, practices and legislation.
- Analyse the impact of different factors on the industry/occupational/technical area to show good understanding of how it is shaped by the social, environmental, and business environment it operates within.
- Use technical and industry/occupation specific terminology commonly used in the industry area accurately and with confidence.
- Demonstrate the application of relevant theory and understanding to solve problems which are sometimes non-routine.

- Analyse the brief in detail, showing confident understanding of concepts and themes from across the qualification content, bringing these together to develop a clear and stretching plan that would credibly achieve a fit for purpose outcome.
- Achieve an outcome which shows an attention to detail in its planning, development and completion, so that it meets the brief completely and to a high quality.
- Carry out an evaluation focussing on relevant quality points, identifying areas of development/ improvement as well as assessing the fitness for purpose of the outcome.

## Awarding grades and reporting results

The overall qualification grade will be calculated based on aggregation of the candidate's achievement in each of the assessments for the mandatory units, taking into account the assessments' weighting. The Level 2 Technical Award in Engineering will be reported on a four grade scale: Pass, Merit, Distinction, Distinction\*.

All assessments must be achieved at a minimum of Pass for the qualification to be awarded. Candidates who fail to reach the minimum standard for grade Pass for an assessment(s) will not have a qualification grade awarded and will not receive a qualification certificate.

The Approximate pass grade boundary for the synoptic assignment in this qualification are:

Synoptic Assignment	Pass mark (%)
001	40

Please note that each synoptic assignment is subject to an awarding process before final grade boundaries are confirmed

The contribution of assessments towards the overall qualification grade is as follows:

Assessment method	Grade scale	% contribution
Synoptic Assignment (001)	X/P/M/D	60%
Exam (002 / 502)	X/P/M/D	40%

Both synoptic assignments and exams are awarded (see 'Awarding individual assessments', at the start of Section 6, above), and candidates' grades converted to points. The minimum points available for each assessment grade are listed in the table below. A range of points between the Pass, Merit and Distinction boundaries will be accessible to candidates. For example, a candidate that achieves a middle to high Pass in an assessment will receive between 8 and 10 points, a candidate that achieves a low to middle Merit in an assessment will receive between 12 and 14 points. The points above the minimum for the grade for each assessment are calculated based on the candidate's score in that assessment.

	Pass	Merit	Distinction
Assignment (001): 60%	6	12	18
Exam (002 / 502): 40%	6	12	18

The candidate's points for each assessment are multiplied by the % contribution of the assessment and then aggregated. The minimum points required for each qualification grade are as follows:

<b>Qualification Grade</b>	<b>Points</b>
Distinction*	20.5
Distinction	17
Merit	11
Pass	6

Candidates achieving Distinction\* will be the highest achieving of the Distinction candidates.

## 7 Administration

Approved centres must have effective quality assurance systems to ensure valid and reliable delivery and assessment of qualifications. Quality assurance includes initial centre registration by City & Guilds and the centre's own internal procedures for monitoring quality assurance procedures.

Consistent quality assurance requires City & Guilds and its associated centres to work together closely; our Quality Assurance Model encompasses both internal quality assurance (activities and processes undertaken within centres) and external quality assurance (activities and processes undertaken by City & Guilds).

For this qualification, standards and rigorous quality assurance are maintained by the use of:

- internal quality assurance
- City & Guilds external moderation.

In order to carry out the quality assurance role, Internal Quality Assurers (IQAs) must have and maintain an appropriate level of technical competence and have recent relevant assessment experience. For more information on the requirements, refer to *Section 2: Centre requirements* in this handbook.

To meet the quality assurance criteria for this qualification, the centre must ensure that the following procedures are followed:

- suitable training of staff involved in the assessment of the qualification to ensure they understand the process of marking and standardisation
- completion by the person responsible for internal standardisation of the Centre Declaration Sheet to confirm that internal standardisation has taken place
- the completion by candidates and supervisors/tutors of the record form for each candidate's work.

### External quality assurance

City & Guilds will undertake external moderation activities to ensure that the quality assurance criteria for this qualification are being met. Centres must ensure that they co-operate with City & Guilds staff and representatives when undertaking these activities.

City & Guilds requires the Head of Centre to

- facilitate any inspection of the centre which is undertaken on behalf of City & Guilds
- make arrangements to receive, check and keep assessment material secure at all times,
- maintain the security of City & Guilds confidential material from receipt to the time when it is no longer confidential and
- keep completed assignment work and examination scripts secure from the time they are collected from the candidates to their dispatch to City & Guilds.

### Enquiries about results

The services available for enquiries about results include a review of marking for exam results and review of moderation for internally marked assessments.

For further details on enquiries and appeals, process and for copies of the application forms, please visit the **appeals page** of the City & Guilds website at **[www.cityandguilds.com](http://www.cityandguilds.com)**.

## Re-sits and shelf-life of assessment results

Candidates who have failed an assessment or wish to re-take it in an attempt to improve their grade, can re-sit assessments **once only**. The best result will count towards the final qualification. See guidance on individual assessment types in Section 4.

## Factors affecting individual learners

If work is lost, City & Guilds should be notified immediately of the date of the loss, how it occurred, and who was responsible for the loss. Centres should use the JCQ form, JCQ/LCW, to inform City & Guilds Customer Services of the circumstances.

Learners who move from one centre to another during the course may require individual attention. Possible courses of action depend on the stage at which the move takes place. Centres should contact City & Guilds at the earliest possible stage for advice about appropriate arrangements in individual cases.

## Malpractice

Please refer to the City & Guilds guidance notes *Managing cases of suspected malpractice in examinations and assessments*. This document sets out the procedures to be followed in identifying and reporting malpractice by candidates and/or centre staff and the actions which City & Guilds may subsequently take. The document includes examples of candidate and centre malpractice and explains the responsibilities of centre staff to report actual or suspected malpractice. Centres can access this document on the City & Guilds website.

Examples of candidate malpractice are detailed below (please note that this is not an exhaustive list):

- falsification of assessment evidence or results documentation
- plagiarism of any nature
- collusion with others
- copying from another candidate (including the use of ICT to aid copying), or allowing work to be copied
- deliberate destruction of another's work
- false declaration of authenticity in relation to assessments
- impersonation.

These actions constitute malpractice, for which a penalty (eg disqualification from the assessment) will be applied.

Where suspected malpractice is identified by a centre after the candidate has signed the declaration of authentication, the Head of Centre must submit full details of the case to City & Guilds at the earliest opportunity. Please refer to the form in the document *Managing cases of suspected malpractice in examinations and assessments*

## Access arrangements and special consideration

Access arrangements are adjustments that allow candidates with disabilities, special educational needs and temporary injuries to access the assessment and demonstrate their skills and knowledge without changing the demands of the assessment. These arrangements must be made before assessment takes place.

It is the responsibility of the centre to ensure at the start of a programme of learning that candidates will be able to access the requirements of the qualification.

Please refer to the *JCQ access arrangements and reasonable adjustments and Access arrangements - when and how applications need to be made to City & Guilds* for more information. Both are available on the City & Guilds website:

**<http://www.cityandguilds.com/delivering-our-qualifications/centre-development/centre-document-library/policies-and-procedures/access-arrangements-reasonable-adjustments>**

### **Special consideration**

We can give special consideration to candidates who have had a temporary illness, injury or indisposition at the time of the examination. Where we do this, it is given after the examination.

Applications for either access arrangements or special consideration should be submitted to City & Guilds by the Examinations Officer at the centre. For more information please consult the current version of the JCQ document, *A guide to the special consideration process*. This document is available on the City & Guilds website:

**<http://www.cityandguilds.com/delivering-our-qualifications/centre-development/centre-document-library/policies-and-procedures/access-arrangements-reasonable-adjustments>**.

<b>UAN:</b>	T/507/6169
<b>Level:</b>	2
<b>GLH:</b>	60

**What is this unit about?**

All engineered products start with initial ideas. These ideas must be effectively communicated to others in order to develop them further. In order to do this, engineers across the world use a common language in the form of standard conventions and practices.

The purpose of this unit is for learners to develop an understanding of the methods and technologies that use this common language to communicate and visualise products.

The unit addresses various modern drawing conventions and their application for engineering purposes as well as the concept of computer aided design in engineering development.

To be able to interpret and communicate ideas using this common engineering language, learners will need an understanding of the basic components and units of measurement used in engineering.

On completion of this unit, learners will understand and use standard conventions and language to communicate engineering design ideas.

**Learning outcomes**

In this unit, learners will be able to

1. understand engineering drawing conventions
2. understand the operation of Computer Aided Design (CAD)
3. understand the use of basic components in engineering
4. understand basic units of measurement used in engineering.

## Scope of content

This section gives details of the scope of content to be covered in the teaching of the unit to ensure that all the learning outcomes can be achieved. Learners do not need prior knowledge or understanding of engineering.

### **Learning outcome 1: Understand engineering drawing conventions**

**Topic 1.1:** Types of engineering drawings

**Topic 1.2:** Drawing projection methods

#### **Topic 1.1**

Learners will understand the purpose of and be able to use appropriate terminology to describe types of engineering drawings including

- general arrangement
- detail/component
- assembly
- schematic
- wiring
- circuit
- block.

#### **Topic 1.2**

Learners will know how to create engineering drawings using different systems of visual projection including

- orthographic first and third angle projection
- isometric.

Learners will know and be able to apply annotation conventions, including

- types of line (outlines, hidden detail, centre line, projection, dimension, leader)
- terminology and abbreviations
  - General (across flats, centre line, diameter, drawing, material, square)
  - Electrical (resistors, capacitors, diodes, transistors, power supplies)
  - Mechanical (chamfer, countersunk, hexagon head, radius, thread, undercut)
- views (sectional, exploded)
- dimensioning and tolerancing (linear, diameter, radius)
- sheet size, scale, title block.

Learners will know how different formats are used to present engineering data and how these are interpreted to identify information required for engineering drawings. Formats include

- data sheets
- handbooks
- reference tables
- charts.

## **Learning outcome 2: Understand the operation of Computer Aided Design (CAD)**

**Topic 2.1:** Features of a CAD system

**Topic 2.2:** Visual representation of engineering concepts

### **Topic 2.1**

Learners will understand the advantages and disadvantages of using CAD systems compared to manual drawing.

Learners will know and be able to apply the key operations of CAD systems to create and manipulate engineering representations including

- user interfaces
- application settings
- navigating tools.

### **Topic 2.2**

Learners will understand how the concepts of design modelling are used for visual representation of engineering ideas including

- parametric modelling (extrude, revolve, loft, sweep)
- assembling
- rendering
- creating orthographic drawings.

## **Learning outcome 3: Understand the use of basic components in engineering**

**Topic 3.1:** Mechanical components

**Topic 3.2:** Electrical components

### **Topic 3.1**

Learners will understand the representation, purpose and application of features of mechanical components including

- threads
- holes
- chamfers
- countersinking
- knurls
- webs.

### **Topic 3.2**

Learners will understand the representation, purpose and application of basic electrical and electronic components used in electrical design. These will include

- wires (stranded, solid)
- switches (push-button, toggle)
- components (resistors, capacitors, diodes, batteries, motors, lamps, LEDs, sounders (such as buzzers), light dependent resistors, thermistors, transistors, 555 timer (in astable and monostable mode)).

Learners will understand the purpose, representation and application of the following meters

- voltmeter
- ammeter
- ohmmeter
- multimeter.

Learners will understand the purpose of these components and meters within a circuit as input devices, signal processing or output devices.

## **Learning outcome 4: Understand basic units of measurement used in engineering**

**Topic 4.1:** Units of measurement

**Topic 4.2:** Application of measurement

**Topic 4.3:** Measurement devices

### **Topic 4.1**

Learners will know how to use basic engineering units of measurement to describe and quantify engineering designs. These will include

- base units (SI) (length m, mass kg, current A, resistance  $\Omega$ , voltage V, capacitance F)
- derived units (SI) (area m<sup>2</sup>, volume m<sup>3</sup>, power W).

### **Topic 4.2**

Learners will know how to apply measurement to both design creation and evaluation of design success, including

- precision
- accuracy
- uncertainty
- tolerance
- repeatability.

### **Topic 4.3**

Learners will understand when the use of each of the following measurement devices is appropriate and how they are used, including

- steel rule
- vernier callipers
- micrometers
- multimeters.

Learners should be able to use the relevant devices to measure whether prototype products meet the design criteria.

## Guidance for delivery

Staff delivering this unit will have the opportunity to use a wide range of techniques and relate the delivery to different aspects of engineering. Industry experts could be used to give examples of how CAD is used within their area of work. Centres could use product analysis, case studies, DVDs and audio-visual footage of actual products and the associated engineering information to show the use of standard conventions and commonality of language used. Learners can acquire understanding of these standard conventions and common language through practical activities. These would include using CAD software and hand drawing techniques to communicate design ideas.

Tutors are advised to use seminar presentations, research using internet and/or library sources and the use of personal and/or industrial experiences as appropriate.

Centres would benefit from links with local engineering companies who carry out activities that can be related and applied to lessons. Where possible, learners should be provided with the opportunity to visit engineering companies involved in the design of engineered products to show the extent of how standard methods of communication is used across different job roles. Where visits are problematic due to logistical and location issues, centres could use communication technologies for virtual visits, such as using webcams and video-conferencing.

Staff should apply learning within real-life working environments, as this is vital for learner engagement, motivation and development.

## Suggested learning resources

### Books

BS8888:2013 Technical Product Documentation and Specification (BSI) ISBN 978 0 580 81445 7

### Websites

Technology Student

[www.technologystudent.com](http://www.technologystudent.com)

Digital Design and Technology

<http://www.digitaldandt.org/>

Loughborough University

<http://learn.lboro.ac.uk/ludata/cd/cad>

Autodesk

<http://www.autodesk.com/education/home>

<b>UAN:</b>	K/507/6170
<b>Level:</b>	2
<b>GLH:</b>	60

### **What is this unit about?**

All engineered products are developed from initial ideas. The development process involves the evolution of the idea from concept through prototyping, testing features or aspects and evaluation before commercial production.

Through this unit, learners will explore the different materials that products can be made from and how these may affect functionality. They will explore the processes, technologies and techniques used to make and prototype commercial products. Through this, they will also develop an understanding of the differences between prototype products and commercially-produced engineered products. One of the purposes of a prototype is to test to functionality of a design idea. Learners will develop an understanding of the methods used to evaluate design ideas for engineered products.

### **Learning outcomes**

In this unit, learners will be able to

1. understand the types and properties of materials that are used to make engineered products
2. understand the methods used to manufacture commercial products
3. understand the methods used to make prototype products
4. understand the importance of design criteria in evaluation.

## Scope of content

This section gives details of the scope of content to be covered in the teaching of the unit to ensure that all the learning outcomes can be achieved. Learners do not need any prior knowledge of engineering processes or materials in order to understand this unit.

### ***Learning outcome 1: Understand the types and properties of materials that are used to make engineered products***

**Topic 1.1:** Material properties

**Topic 1.2:** Types of Material

#### **Topic 1.1**

Learners will understand the meaning of each of the following properties, along with their units of measurement (where applicable) and how they can be measured:

- Mechanical properties:
  - tensile strength
  - compressive strength
  - hardness
  - toughness
- Physical properties:
  - melting point
  - thermal conductivity
  - electrical conductivity and resistivity
  - density
  - corrosion resistance

#### **Topic 1.2**

Learners will know the typical properties and forms of supply for each of the following types of materials:

- ferrous metals
- non-ferrous metals
- thermoplastic polymers
- thermosetting polymers
- elastomers
- engineering ceramics
- composites
- modern materials
  - graphene
  - nano materials
- smart materials:
  - Shape Memory Alloys (SMA)
  - Quantum Tunnelling Composite (QTC)
  - thermochromic materials
  - photochromic materials.

Learners will understand the relative costs and common applications for these types of material.

## **Learning outcome 2: Understand the methods used to manufacture commercial products**

**Topic 2.1:** Shaping and forming processes

**Topic 2.2:** Joining and finishing processes

### **Topic 2.1**

Learners will know the processes that are used to manufacture engineered products and how these can be carried out safely. Learners will understand which materials can be used with each process and how each process changes the form of the material. Learners will understand the differences between manually-controlled and computer-controlled variants of the processes, where applicable. Learners will understand the advantages and disadvantages of using each of the processes to manufacture products in small quantities. The processes covered must include:

- wasting (material removal):
  - sawing
  - filing
  - turning
  - milling
  - drilling
- shaping:
  - sand casting of metal products
  - injection moulding of plastic products
- forming:
  - vacuum forming of plastic products
  - press forming of metal sheet
- moulding of composite products.

### **Topic 2.2**

Learners will know the methods that are used to join and finish engineered products and how these can be carried out safely. They will understand which materials can be used with each method. Learners will understand the advantages and disadvantages of using each of the methods. The methods covered must include:

- joining methods:
  - welding of metal products:
    - Tungsten Inert Gas (TIG) welding
    - Metal Inert Gas/Metal Active Gas (MIG/MAG) welding
  - mechanical joining methods:
    - nuts and bolts
    - rivets and pop-rivets
  - use of adhesives
    - cyanoacrylates
    - epoxy resin
- electrical termination methods:
  - soldering of electrical components
    - hand soldering
    - production soldering (wave, surface mount technology (SMT))
  - connection blocks
- surface treatment and finishing:
  - electroplating
  - painting
  - plastic coating
  - self-finishing.

## ***Learning outcome 3: Understand the methods used to make prototype products***

**Topic 3.1:** Virtual Modelling

**Topic 3.2:** Block Modelling

**Topic 3.3:** Rapid Prototyping

**Topic 3.4:** Modular kits

**Topic 3.5:** Creating a prototype

### **Topic 3.1**

Learners will understand how a 3D virtual model of a product is produced, for both single items and models made by assembling different parts. They will need to understand how a 3D model can be rendered to give it a realistic appearance.

Learners will understand how an electrical circuit can be modelled using simulation software.

Learners will understand why designers use virtual modelling rather than making a physical model of a product design.

### **Topic 3.2**

Learners will understand the reasons why designers use block modelling. They will understand how a solid model of a product can be produced from foam blocks and how a model can be rendered to give it a realistic appearance.

### **Topic 3.3**

Learners will understand the advantages and disadvantages of rapid prototyping compared to using the conventional machining methods covered in Topic 2. They will understand how models of products are manufactured using the following processes:

- fused deposition modelling (3D printing)
- stereolithography
- selective laser sintering.

### **Topic 3.4**

Learners will understand why designers may use modular kits to model the performance of mechanical and electrical systems. This should include the use of breadboards for electrical circuits.

Learners will understand how models are created using modular approaches and their advantages and disadvantages relative to making functional prototypes from the components that will be used in the final product.

### **Topic 3.5**

Learners will know how to use a range of techniques to produce mechanical and electrical prototypes. This will include:

- virtual modelling
- block modelling
- using modular kits
- using breadboards, stripboards and prototype printed circuit boards (PCBs).

## **Learning outcome 4: Understand the importance of design criteria in evaluation**

**Topic 4.1:** Design criteria

**Topic 4.2:** Evaluation

### **Topic 4.1**

Learners will know how to analyse design criteria and understand how the criteria can be assessed effectively. In addition to dimensions and cost, this should include criteria for aesthetics, sustainability, safety and function.

### **Topic 4.2**

Learners will understand the potential uses and limitations of different types of model and prototype when evaluating against design criteria. They will need to understand how to carry out subjective and objective assessments for different design criteria, including user testing where appropriate.

## **Guidance for delivery**

Staff delivering this unit will have the opportunity to use a wide range of techniques, lectures, guest speakers, industry experts, discussions, case studies, DVDs and audio-visual footage. Tutors are advised to use seminar presentations, site visits, research using internet and/or library sources and the use of personal and/or industrial experiences as appropriate.

The most important of the many learning tools will be supervised practical activities, where the learners develop understanding of the different processes, methods and materials through their practical application in a variety of different engineering contexts. An understanding of health and safety must be integrated at all times into the lessons.

Centres would benefit from links with local engineering companies who carry out activities that can be related and applied to lessons. Where possible, learners should be provided with the opportunity to visit engineering companies involved in the manufacture of bespoke and/or prototype products, to see the different process options in use. Staff should apply learning within real-life working environments, as this is vital for learner engagement, motivation and development.

## **Suggested learning resources**

### **Books**

Manufacturing Processes for Design Professionals Published by: Thames and Hudson, 2007 ISBN: 978-0-500-51375-0	Thompson, R
Sustainable Materials, Processes and Production Published by: Thames and Hudson, 2013 ISBN: 978-0-500-29071-2	Thompson, R
Making It: Manufacturing Techniques for Product Design Published by: Laurence King, 2012 ISBN: 978-1-856-69749-1	Lefteri, C
Prototyping and Low-volume Production Published by: Thames and Hudson, 2011	Thompson, R

ISBN: 978-0-500-28918-1

CAD and Rapid Prototyping for Product Design  
Published by: Laurence King, 2014  
ISBN: 978-1-780-67342-4

Bryden, D

Prototyping and Modelmaking for Product Design  
Published by: Laurence King, 2012  
ISBN: 978-1-856-69876-4

Hallgrimsson, B

Materials for Design  
Published by: Laurence King, 2014  
ISBN: 978-1-780-67344-8

Lefteri, C

Material Innovation: Product Design  
Published by: Thames and Hudson, 2014  
ISBN: 978-0-500-29129-0

Dent, A H; Sherr, L

Engineering Materials 1: An Introduction to Properties, Applications and Design  
Ashby, M F  
Published by: Butterworth-Heinemann, 2011  
ISBN: 978-0-080-96665-6

Jones, D R H;

### **Journals and magazines**

D&T Practice

Designing

Engineering

International Journal of Materials Forming and Machining Processes

### **Websites**

Technology Student

[www.technologystudent.com](http://www.technologystudent.com)

How Stuff Works

[www.howstuffworks.com](http://www.howstuffworks.com)

Efunda

[www.efunda.com](http://www.efunda.com)

Additive 3D

[www.additive3d.com](http://www.additive3d.com)

Dr. Schmid's Support Page

[www3.nd.edu/~manufact/](http://www3.nd.edu/~manufact/)

TCT

[www.tctmagazine.com](http://www.tctmagazine.com)

Eureka magazine

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

## Appendix 1 Sources of general information

The following documents contain essential information for centres delivering City & Guilds qualifications. They should be referred to in conjunction with this handbook. To download the documents and to find other useful documents, go to the **Centres and Training Providers homepage** on [www.cityandguilds.com](http://www.cityandguilds.com).

### ***City & Guilds Centre Manual***

This document provides guidance for organisations wishing to become City & Guilds approved centres, as well as information for approved centres delivering City & Guilds qualifications. It covers the centre and qualification approval process as well as providing guidance on delivery, assessment and quality assurance for approved centres.

It also details the City & Guilds requirements for ongoing centre and qualification approval, and provides examples of best practice for centres. Specifically, the document includes sections on:

- the centre and qualification approval process
- assessment, internal quality assurance and examination roles at the centre
- registration and certification of candidates
- non-compliance and malpractice
- complaints and appeals
- equal opportunities
- data protection
- management systems
- maintaining records
- internal quality assurance
- external quality assurance.

### ***Our Quality Assurance Requirements***

This document explains the requirements for the delivery, assessment and awarding of our qualifications. All centres working with City & Guilds must adopt and implement these requirements across all of their qualification provision. Specifically, this document:

- specifies the quality assurance and control requirements that apply to all centres
- sets out the basis for securing high standards, for all our qualifications and/or assessments
- details the impact on centres of non-compliance

The **centre homepage** section of the City & Guilds website also contains useful information on

**Walled Garden:** how to register and certificate candidates on line

**Events:** dates and information on the latest Centre events

**Online assessment:** how to register for e-assessments.

## Useful contacts

### UK learners

General qualification information

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**E: [learnersupport@cityandguilds.com](mailto:learnersupport@cityandguilds.com)**

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### International learners

General qualification information

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**E: [intcg@cityandguilds.com](mailto:intcg@cityandguilds.com)**

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### Centres

Exam entries, Certificates, Registrations/enrolment, Invoices, Missing or late exam materials, Nominal roll reports, Results

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

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### Single subject qualifications

Exam entries, Results, Certification, Missing or late exam materials, Incorrect exam papers, Forms request (BB, results entry), Exam date and time change

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**E: [singlesubjects@cityandguilds.com](mailto:singlesubjects@cityandguilds.com)**

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### International awards

Results, Entries, Enrolments, Invoices, Missing or late exam materials, Nominal roll reports

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**E: [intops@cityandguilds.com](mailto:intops@cityandguilds.com)**

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### Walled Garden

Re-issue of password or username, Technical problems, Entries, Results, e-assessment, Navigation, User/menu option, Problems

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**E: [walledgarden@cityandguilds.com](mailto:walledgarden@cityandguilds.com)**

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### Employer

Employer solutions, Mapping, Accreditation, Development Skills, Consultancy

**E: [business@cityandguilds.com](mailto:business@cityandguilds.com)**

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If you have a complaint, or any suggestions for improvement about any of the services that we provide, email: **[feedbackandcomplaints@cityandguilds.com](mailto:feedbackandcomplaints@cityandguilds.com)**

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## About City & Guilds

As the UK's leading vocational education organisation, City & Guilds is leading the talent revolution by inspiring people to unlock their potential and develop their skills. City & Guilds is recognised and respected by employers across the world as a sign of quality and exceptional training.

## City & Guilds Group

The City & Guilds Group is a leader in global skills development. Our purpose is to help people and organisations to develop their skills for personal and economic growth. Made up of City & Guilds, City & Guilds Kineo, The Oxford Group and ILM, we work with education providers, businesses and governments in over 100 countries.

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

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