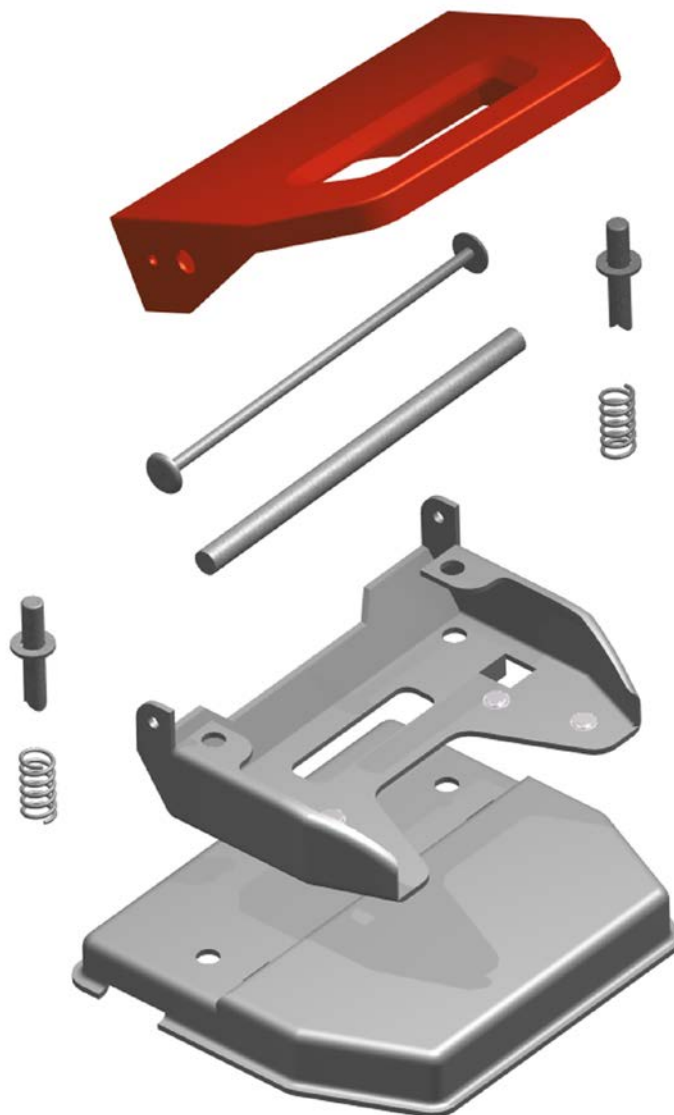


Level 3 Award and Certificate in Computer Aided Design and Manufacturing (7579-03)

Qualification handbook for centres



About City & Guilds

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

City & Guilds Group

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

Equal opportunities

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

Copyright

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

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

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

The *Standard Copying Conditions* (which can be found on the City & Guilds website) also apply.

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

Publications

City & Guilds publications are available on the City & Guilds website or from our Publications Sales department at the address below or by telephoning +44 (0)20 7294 2850 or faxing +44 (0)20 7294 3387.

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

City & Guilds

1 Giltspur Street

London EC1A 9DD

T +44 (0)20 7294 2800

F +44 (0)20 7294 2400

www.cityandguilds.com

centresupport@cityandguilds.com

Level 3 Award and Certificate in Computer Aided Design and Manufacturing (7579-03)

Qualification handbook for centres

Qualification title	Number	Ofqual ref.
Level 3 Award in 2D Computer Aided Design	7579-03	500/6779/5
Level 3 Award in Computer Aided Manufacturing (2D)	7579-03	500/6779/5
Level 3 Certificate in Computer Aided Design and Manufacturing (2D)	7579-03	500/6676/6
Level 3 Award in 3D Computer Aided Design	7579-03	500/6779/5
Level 3 Award in Computer Aided Manufacturing (3D)	7579-03	500/6779/5
Level 3 Certificate in Computer Aided Design and Manufacturing (3D)	7579-03	500/6677/8

Version and date	Change detail	Section
1.2 February 2014	Removed last registration/ certification dates (centres to refer to Walled Garden)	About this document

City & Guilds
Believe you can



www.cityandguilds.com

Contents

1	About this document	5
2	About the qualifications	6
2.1	Accreditation details	6
2.2	Aims of the qualifications	7
2.3	Rules of combination	8
2.4	Level 3 Award in Computer Aided Manufacturing (2D)	8
2.5	Level 3 Certificate in Computer Aided Design and Manufacturing (2D)	9
2.6	Level 3 Award in 3D Computer Aided Design	10
2.7	Level 3 Award in Computer Aided Manufacturing (3D)	10
2.8	Level 3 Certificate in Computer Aided Design and Manufacturing (3D)	11
2.9	Relevant sources of information	12
3	Centre requirements	14
3.1	Obtaining centre and qualification approval	14
3.2	Fast Track Approval	15
3.3	Global online assessment (GOLA)	15
3.4	Resource requirements	16
3.5	Registration and Certification	16
3.6	Quality Assurance	17
4	Course design and delivery	18
5	Units	20
5.1	About the units	20
Unit 205	Re-Instate the Work Area	22
Unit 301	2D Computer Aided Design	24
Unit 302	3D Computer Aided Design	39
Unit 303	(2D) Computer Aided Part Programming	50
Unit 304	(2D) CNC Machining	63
Unit 305	(2D) CNC Co-ordinate Measuring Machine Inspection	68
Unit 306	(3D) Computer Aided Part Programming	71
Unit 307	(3D) CNC Machining	79
Unit 308	(3D) CNC Co-ordinate Measuring Machine Inspection	83
Unit 309	(3D) Rapid Prototyping	86
6	Assessment	89
6.1	Assignments	89
6.2	Test specifications	90
Appendix 1	Relationships to other qualifications	92
Appendix 2	Sources of general information	94

City & Guilds
Believe you can



www.cityandguilds.com

1 About this document

This document contains the information that centres need to offer the following qualifications:

Qualification titles and levels	City & Guilds qualification numbers	Ofqual accreditation numbers	Last registration date	Last certification date
Level 3 Award in 2D Computer Aided Design	7579-03	500/6779/5	Please refer to the Walled Garden for last registration / certification dates	
Level 3 Award in Computer Aided Manufacturing (2D)	7579-03	500/6779/5		
Level 3 Certificate in Computer Aided Design and Manufacturing (2D)	7579-03	500/6676/6		
Level 3 Award in 3D Computer Aided Design	7579-03	500/6779/5		
Level 3 Award in Computer Aided Manufacturing (3D)	7579-03	500/6779/5		
Level 3 Certificate in Computer Aided Design and Manufacturing (3D)	7579-03	500/6677/8		

2 About the qualifications

2.1 Accreditation details

Accreditation details

These qualifications are

- accredited by the Qualifications and Curriculum Authority at Level 1, 2 and 3 of the QCF

Qualifications and Credit Framework (QCF)

The QCF replaces the National Qualifications Framework (NQF) in England and Northern Ireland, and is intended to replace the regulated pillar within the Qualifications and Credit Framework for Wales (CQFW). It is also intended to align with the Scottish Credit and Qualifications Framework (SCQF). The QCF provides a way of recognising achievement through the award of credit for units and qualifications. Units within the framework are allocated a:

- level to indicate the level of difficulty
- credit value to indicate the size of the unit. 10 hours of **learning time** = 1 credit value.

Learning time is a notional measure of the amount of time a typical candidate might be expected to take to complete all the learning relevant to achievement of the learning outcomes. It differs from Guided Learning Hours (GLH) which represent only those hours a tutor/trainer or facilitator are present and contributing to the learning process because it takes into account all learning relevant to the learning outcomes regardless of where, when and how it has taken place.

The QCF recognises learning by awarding credit each time a candidate successfully completes a unit. Candidates can accumulate and transfer credit achievement over time.

A unit is the smallest part of learning for which credit is awarded. Candidates can also gain credit for full qualifications.

For further information about the QCF, CQFW and the SCQF, please refer to the websites for each country listed at Appendix 1.

2 About the qualifications

2.2 Aims of the qualifications

2D Computer Aided Design - this qualification is intended to cover a wide range of 2D drawing and editing commands and routines to aid the application and modification of the CAD software. The user will become familiar with the necessary techniques required to produce and edit drawings of medium complexity and prepare the drawings for output to hard copy. It is intended that this unit can be delivered within the context of a wide range of design and drawing specialisations. The specialised areas can be used as a vehicle to deliver the performance outcomes, and as such will be reflected in the assessment of this unit. Also it will cover Health and Safety matters that are associated with safe working practices.

3D Computer Aided Design - this qualification is concerned with developing the ability to apply the drafting procedures required to create and modify existing 3D objects either surfaces or solids at any position within Three Dimensional Space. Also it will cover Health and Safety matters that are associated with safe working practices.

Computer Aided Manufacturing - this qualification will allow candidates to demonstrate knowledge and use a CAPP system to produce an NC file from imported 3D CAD models, use a CNC machine to produce a component from NC data generated on a CAPP system. Also candidates will be able to use a CNC CMM machine to inspect produced components and produce a result table and be able to use a rapid prototype machine to produce a part from an imported 3D CAD model.

2 About the qualifications

2.3 Rules of combination

Rules of combination are used to define the structure of qualifications. The rules of combination specify the credits which must be achieved through a particular combination of units to gain a full qualification.

Each of the awards outlined in this document is a 'self contained' single unit. The following tables outline the qualification number, size of the qualification, the credit value and accreditation unit reference.

Individual Practical Assessment Handbook's have been produced for each of the Parametric Modelling awards. These can be found on the City & Guilds website

Level 3 Award in 2D Computer Aided Design

To achieve the Level 3 Award in 2D CAD learners must achieve 10 credits from the mandatory units listed in the table below:

Accreditation unit reference	City & Guilds unit number	Unit title	Mandatory/ optional for full qualification	Credit value
L/600/3271	Unit 301	2D Computer Aided Design	Mandatory	10
n/a	Unit 310	2D CAD GOLA on-line test	Mandatory	n/a

2.4 Level 3 Award in Computer Aided Manufacturing (2D)

To achieve the Level 3 Award in Computer Aided Manufacturing (2D) learners must achieve 8 credits from the mandatory units listed in the table below:

Accreditation unit reference	City & Guilds unit number	Unit title	Mandatory/ optional for full qualification	Credit value
-------------------------------------	--------------------------------------	-------------------	---	---------------------

M/600/3277	Unit 303	(2D) Computer Aided Part Programming	Mandatory	4
A/600/3279	Unit 304	(2D) CNC Machining	Mandatory	2
M/600/3280	Unit 305	(2D) CMM	Mandatory	1
T/600/3121	Unit 205	Re-instate the Work Area(s)	Mandatory	1

2.5 Level 3 Certificate in Computer Aided Design and Manufacturing (2D)

To achieve the Level 3 Certificate in Computer Aided Design and Manufacturing learners must achieve 18 credits from the mandatory units listed in the table below:

Accreditation unit reference	City & Guilds unit number	Unit title	Mandatory/ optional for full qualification	Credit value
D/600/3274	Unit 302	3D Computer Aided Design	Mandatory	10
M/600/3277	Unit 303	(2D) Computer Aided Part Programming	Mandatory	4
A/600/3279	Unit 304	(2D) CNC Machining	Mandatory	2
M/600/3280	Unit 305	(2D) CMM	Mandatory	1
T/600/3121	Unit 205	Re-instate the Work Area(s)	Mandatory	1
n/a	Unit 310	3D CAD GOLA on-line test	Mandatory	n/a

2.6 Level 3 Award in 3D Computer Aided Design

To achieve the Level 3 Award in 3D CAD learners must achieve 10 credits from the mandatory units listed in the table below:

Accreditation unit reference	City & Guilds unit number	Unit title	Mandatory/ optional for full qualification	Credit value
D/600/3274	Unit 302	3D Computer Aided Design	Mandatory	10
n/a	Unit 311	3D CAD GOLA on-line test	Mandatory	n/a

2.7 Level 3 Award in Computer Aided Manufacturing (3D)

To achieve the Level 3 Award in Computer Aided Manufacturing (3D) learners must achieve 9 credits from the three mandatory units and one of two optional units listed in the table below :

Accreditation unit reference	City & Guilds unit number	Unit title	Mandatory/ optional for full qualification	Credit value
F/600/3283	Unit 306	(3D) Computer Aided Part Programming	Mandatory	5
J/600/3284	Unit 307	(3D) CNC Machining	Mandatory	2
T/600/3121	Unit 205	Re-instate the Work Area	Mandatory	1
R/600/3286	Unit 308	(3D) CMM	Optional	1
Y/600/3287	Unit 309	Rapid Prototyping	Optional	1

2.8 Level 3 Certificate in Computer Aided Design and Manufacturing (3D)

To achieve the Level 3 Certificate in Computer Aided Design and Manufacturing (3D) learners must achieve 19 credits from the five mandatory units and one of two optional units listed in the table below :

Accreditation unit reference	City & Guilds unit number	Unit title	Mandatory/ optional for full qualification	Credit value
D/600/3274	Unit 302	3D Computer Aided Design	Mandatory	10
F/600/3283	Unit 306	(3D) Computer Aided Part Programming	Mandatory	5
J/600/3284	Unit 307	(3D) CNC Machining	Mandatory	2
T/600/3121	Unit 205	Re-instate the Work Area	Mandatory	1
R/600/3286	Unit 308	(3D) CMM	Optional	1
Y/600/3287	Unit 309	Rapid Prototyping	Optional	1
n/a	Unit 311	3D CAD GOLA on-line test	Mandatory	n/a

2 About the qualification

2.9 Relevant sources of information

Related publications

City & Guilds also provides the following documents specifically for these qualifications:

Publication	Available from
Practical Assessment Handbooks	website
Centre Guides	website
Learner Guides	website
FAQ	website
Fast track approval form/generic fast track approval form	website

Other essential City & Guilds documents

There are other City & Guilds documents which contain general information on City & Guilds qualifications:

- ***Providing City & Guilds qualifications – a guide to centre and qualification approval***
contains detailed information about the processes which must be followed and requirements which must be met for a centre to achieve 'approved centre' status, or to offer a particular qualification.
- ***Ensuring quality***
contains updates on City & Guilds assessment and policy issues.
- ***Centre toolkit***
contains additional information on *Providing City & Guilds qualifications*, in a CD-ROM, which links to the internet for access to the latest documents, reference materials and templates. The *Centre Toolkit* is sent to centres when they receive approved centre status. It is also available from to order at an additional cost.
- ***Online catalogue/shop***
contains details of general regulations, registration and certification procedures and fees.

For the latest updates on our publications and details of how to obtain them and other City & Guilds resources, please refer to the City & Guilds website.

City & Guilds websites

Website	Address	Purpose and content
City & Guilds main website	www.cityandguilds.com	This is the main website for finding out about the City & Guilds group, accessing qualification information and publications.
SmartScreen	www.smartscreen.co.uk	SmartScreen is the City & Guilds online learning support website. It gives registered subscribers access to qualification-specific support materials.
Walled Garden	www.walled-garden.com	The Walled Garden is a qualification administration portal for approved centres, enabling them to register candidates and claim certification online.

Contacting City & Guilds by e-mail

The following e-mail addresses give direct access to our Customer Relations team.

e-mail	Query types
learnersupport@cityandguilds.com	all learner enquiries, including <ul style="list-style-type: none">• requesting a replacement certificate• information about our qualification• finding a centre.
centresupport@cityandguilds.com	all centre enquiries
walledgarden@cityandguilds.com	all enquiries relating to the Walled Garden, including <ul style="list-style-type: none">• setting up an account• resetting passwords.

3 Centre requirements

3.1 Obtaining centre and qualification approval

Only approved organisations can offer City & Guilds qualifications. Organisations approved by City & Guilds are referred to as **centres**.

Centres must meet a set of quality criteria including:

- provision of adequate resources, both physical and human
- clear management information systems
- effective assessment and quality assurance procedures including candidate support and reliable recording systems.

An organisation that has not previously offered City & Guilds qualifications must apply for approval to become a centre. This is known as the **centre approval process (CAP)**. Centres also need approval to offer a specific qualification. This is known as the **qualification approval process (QAP)**. In order to offer these qualifications, organisations which are not already City & Guilds centres must apply for centre and qualification approval at the same time. Existing City & Guilds centres will only need to apply for qualification approval for these particular qualifications.

Full details of the procedures and forms for applying for centre and qualification approval are given

City and Guilds branch offices will support new centres through the approval process. They will appoint an External Verifier. They will also provide details of fees applicable for approvals. The local office will be the point of contact for all enquiries for these qualifications and will be responsible for monitoring the delivery and assessments through reports submitted by External Verifiers. They will be the first point of contact for any enquiries regarding the multiple choice examination.

Assessments must not be undertaken until qualification approval has been obtained and candidates have been registered.

City & Guilds reserves the right to withdraw qualification or centre approval for reasons of debt, malpractice or non-compliance with City & Guilds' policies, regulations, requirements, procedures and guidelines, or for any reason that may be detrimental to the maintenance of authentic, reliable and valid qualifications or that may prejudice the name of City & Guilds.

3 Centre requirements

3.2 Fast Track Approval

Centres approved to offer the Level 3 Certificate in 2D CAD (4353-02) and the Level 3 Certificate in 3D CAD (4353-03) may apply for approval in the new Level 3 Award in 2D Computer Aided Design (7579-03-301) and the Level 3 Award in 3D Computer Aided Design (7579-03-302) using the **fast track approval form**, available from the City & Guilds website.

Centres may apply to offer the new qualifications using the fast track form

- providing there have been no changes to the way the qualifications are delivered, and
- if they meet all of the approval criteria specified in the fast track form guidance notes.

Fast track approval is available for 12 months from the launch of the qualification. After this time, the qualification is subject to the **standard** Qualification Approval Process. It is the centre's responsibility to check that fast track approval is still current at the time of application.

3.3 Global online assessment (GOLA)

The assessment includes assignments and multiple-choice tests which covers the knowledge requirements for **each** Unit. The multiple choice test will be delivered on-line through the City & Guilds GOLA system with no paper-based alternative. Centres are required to register as a GOLA centre before any tests can be scheduled. The form for this is available from the website **www.city-and-guilds.co.uk/e-assessment**

A centre only needs to register once for GOLA

There is a GOLA helpline number - centre enquiries and technical enquiries about GOLA can be directed to this number **0845 241 0070**.

Centres can also e-mail: **gola@city-and-guilds.co.uk**

3 Centre requirements

3.4 Resource requirements

Physical resources

Centres must have an adequate learning environment. Resources should be accessible and reflect the nature of the qualification. They must also ensure that they have the staff and access to sufficient equipment so that candidates have the opportunity to cover all of the activities of the qualification.

Centre staff

Centre staff must satisfy the requirements for occupational expertise for these qualifications. Staff should be technically competent and experienced in the units for which they are delivering, teaching, training and assessing learning

3.5 Registration and Certification

Candidates must be registered at the beginning of their course. Centres should submit registrations using the Walled Garden, or Form S (Registration), under qualification and complex number -7579-03

When all assessment requirements have been successfully completed, internally and externally verified, candidate results should be submitted on the Walled Garden or Form S (Results). Centres should note that results will not be processed by City & Guilds where verification records are not complete.

Candidates achieving all of the required units will be issued with the full Level 3 Certificate. Candidates achieving one or more units within the Computer Aided Manufacturing qualifications will receive a Certificate of Unit Credit listing the unit(s) achieved.

For information on the registration and certification periods for the qualification, centre should refer to the City & Guilds Directory of qualifications.

Full details of City & Guilds' administrative procedures for this qualification are provided in the *Directory of qualifications*, provided online to City & Guilds registered centres. This information includes details on:

- registration procedures
- enrolment numbers
- fees
- claiming certification.

These details are also available on the **www.cityandguilds.com**

3 Centre requirements

3.6 Quality Assurance

Internal quality assurance

Approved centres must have effective quality assurance systems to ensure optimum delivery and assessment of qualifications.

Quality assurance includes initial centre approval, qualification approval and the centre's own internal procedures for standardising and monitoring quality. Centres are responsible for internal quality assurance, ensuring that there are appropriate opportunities for open communication between the course team, scheme co-ordinator and external verifier. City & Guilds is responsible for external quality assurance.

Full details and guidance on the internal and external quality assurance requirements and procedures, are provided in *Providing City & Guilds Qualifications* and in the centre toolkit. This document also explains the tasks, activities and responsibilities of quality assurance staff.

All candidates' evidence must be available for external verification, Centres are also required to retain copies of candidates' assessment and internal verification records for three years after certification.

National standards and rigorous quality assurance are maintained by use of:

- City & Guilds assignment, marked by the centres according to externally set marking criteria
- Portfolio evidence assessed against set criteria
- Internal (centre) quality assurance
- City & Guilds external verification.

To meet the quality assurance criteria for this qualification, the centre must ensure that the following internal roles are undertaken:

- quality assurance co-ordinator
- primary assessor
- independent assessor
- internal verifier.

External quality assurance

External verifiers are appointed by City & Guilds to approve centres, and to monitor the assessment and internal quality assurance carried out by centres. External verification is carried out to ensure that assessment is valid and reliable, and that there is good assessment practice in centres.

To carry out their quality assurance role, external verifiers must have appropriate occupational and verifying knowledge and expertise. City & Guilds external verifiers attend training and development designed to keep them up-to-date, to facilitate standardisation between verifiers and to share good practice.

Further details of the role of external verifiers are given in *Providing City & Guilds qualifications*.

4 Course design and delivery

Recommended delivery strategies

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

Provided that the requirements for the qualifications are met, centres may design course programmes of study in any way that they feel best meets the needs and capabilities of their candidates. Relationship tables are provided in Appendix 1 Relationships to other qualifications to assist centres with the design and delivery of the qualification.

Centres may wish to include topics as part of the course programme which will not be assessed through the qualifications for example to address local, organisational or government needs. Provided the aims, outcomes and knowledge requirements are met, centres have the flexibility to deliver the qualification in as many hours as they deem appropriate.

Data protection and confidentiality

Centres offering these qualifications may need to provide City & Guilds with personal data for staff and candidates. Centres will need to abide by the legal requirements of the country that they operate in. Centres and staff will be expected to maintain the confidentiality required by the laws and policies of national governments and the centres that offer the qualifications.

Health and safety

The requirement to follow safe working practices is an integral part of all City & Guilds qualifications and assessments, and it is the responsibility of centres to ensure that all relevant health and safety requirements are in place before candidates commence the programme.

Should a candidate fail to follow health and safety practice and procedures during an assessment, the assessment must be stopped. The candidate should be informed that they have not reached the standard required to successfully pass the assessment and told the reason why. Candidates may retake the assessment at a later date, at the discretion of the centre. In case of any doubt, guidance should be sought from the external verifier.

Initial assessment and induction

Centres will need to make an initial assessment of each candidate prior to the start of their programme. Candidates should have a reasonable level of English language and literacy skills.

The initial assessment should identify any specific training needs the candidate has, and the support and guidance they may require when working towards their qualification. The results of initial assessment will assist centres and tutors with the design and delivery of the courses to meet the particular needs of their candidates for both the class based and practical aspects of the course. Centres should provide an induction programme to ensure the candidate fully understands the requirements of the qualifications they will work towards, their responsibilities as a candidate, and the responsibilities of the centre. It may be helpful to record the information as part of the learning contract/individual learning plan.

Equal opportunities

It is a requirement of centre approval that centres have an equal opportunities policy (see *Providing City & Guilds qualifications*).

The regulatory authorities require City & Guilds to monitor centres to ensure that equal opportunity policies are being followed.

The City & Guilds equal opportunities policy is set out on the City & Guilds website, in *Providing City & Guilds qualifications*, in the *Directory of qualifications*, and is also available from the City & Guilds Customer Relations department.

Access to assessment

City & Guilds' guidance and regulations on access to assessment are designed to facilitate access for assessments and qualifications for candidates who are eligible for adjustments to assessment arrangements. Access arrangements are designed to allow attainment to be demonstrated. For further information, please see Access to assessment and qualifications, available on the City & Guilds website.

Results and certification

All candidates for City & Guilds qualifications receive a Notification of Candidates Results giving details of their performance.

Centres will also receive a consolidated results list detailing the performance of all candidates they enter, whether they are successful or not.

Further information about the issue of results and certification for centres is available online at www.cityandguilds.com or by contacting the City & Guilds Operations Support Service enquiries team

Appeals

Centres must have their own, auditable, appeals procedure that must be explained to candidates during their induction. Appeals must be fully documented by the quality assurance co-ordinator and made available to the external verifier or City & Guilds.

Further information on appeals is given in *Providing City & Guilds qualifications*. There is also information on appeals for centres and learners on the City & Guilds website or available from the Customer Relations department.

5 Units

5.1 About the units

Structure of units

The units in these qualifications are written in a standard format and comprise the following:

- City & Guilds reference number
- title
- level
- credit value
- unit aim
- relationship to NOS/other qualifications
- endorsement by a sector or other appropriate body
- statement of guided learning hours
- assessment and grading
- learning outcomes which are comprised of a number of practical and/or knowledge based assessment criteria
- guidance notes.

Summary of units

City & Guilds unit number	Title	QCF unit number	Credits
205	Re-instate the Work Area	T/600/3121	1
301	2D Computer Aided Design	L/600/3271	10
302	3D Computer Aided Design	D/600/3274	10
303	(2D) Computer Aided Part Programming	M/600/3277	4
304	(2D) CNC Machining	A/600/3279	2
305	(2D) CMM	M/600/3280	2
306	(3D) Computer Aided Part Programming	F/600/3283	5
307	(3D) CNC Machining	J/600/3284	2
308	(3D) CMM	R/600/3286	1
309	(3D) Rapid Prototyping	Y/600/3287	1
310	3D CAD GOLA on-line test	n/a	n/a
311	3D CAD GOLA on-line test	n/a	n/a

Unit 205

Re-Instate the Work Area

Level: 2

Credit value: 1

Unit aim

To restore the work area(s)

Learning outcomes

There is **one** learning outcomes to this unit. The learner will be able to:

1. Re-instate the work area(s)

Guided learning hours

It is recommended that **10** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

This unit is linked to the Type the Relevant Name Here NOS 000.

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by SEMTA.

Key Skills

This unit may help candidates to gain confidence in, and possibly generate portfolio evidence for, the following Key Skills:

- Communication
- Information and Communication Technology
- Improving Own Learning and Performance
- Problem Solving

Assessment and grading

This unit will be assessed by:

- One centre set knowledge test.
- Pass/fail.

Unit 205

Outcome 1

Re-Instate the Work Area

Re-instate the work area

Assessment Criteria

Practical Skills

The learner can:

1. comply with relevant Health and Safety Legislation
2. restore work area(s)
3. safely dispose of waste

Underpinning Knowledge

The learner can:

4. identify and comply with relevant Health and Safety Legislation
 - i) Health and Safety at Work Act 1974
 - ii) Display Screen Equipment (DSE) Act 1992
 - iii) Management of Health & Safety at Work Regulations 1999
 - iv) Workplace Health & Safety & Welfare 1992
 - v) COSHH 2002
 - vi) Provision and Use of Work Equipment Regulations 1998
 - vii) Manual Handling Operations 1992
 - viii) Waste Regulations
5. explain requirements for restoring work area
 - i) good housekeeping
 - a) lighting
 - b) seating
 - c) isolation of equipment
 - d) cleaning of machines and equipment
 - e) storage and inspection of tooling
 - f) storage and inspection of equipment used
 - g) disposal of waste
6. identify disposal methods for waste/hazardous material
 - i) segregation
 - ii) labelling
 - iii) disposal methods
7. describe remedial actions required to solve waste problems in terms of
 - I) spillages
 - II) losses
 - a) coolant
 - b) oils
 - c) financial
 - III) damage
 - a) containers
 - b) storage
 - c) facilities
 - d) environment

Unit 301

2D Computer Aided Design

Level: 3

Credit value: 10

Unit aim: To cover a wide range of 2D drawing and editing commands and routines to aid the application and modification of the CAD software. The learner will become familiar with the necessary techniques required to produce and edit drawings of medium complexity and prepare the drawings for output to hard copy.

Learning outcomes

There are **thirteen** learning outcomes to this unit. The learner will be able to:

1. use a layering system and different line type styles
2. define and use a system for grouping objects to form blocks or libraries
3. produce isometric drawings within the 2D environment
4. define and use an adjustable co-ordinate system based on user requirements
5. use complex dimensioning routines
6. use different drawing spaces and complex multi viewing areas
7. produce hard copies of drawings
8. make inquiries of an existing drawing and place reference points
9. use a means of pre-command object selection in order to carry out editing processes
10. change the properties of a number of drawn entities
11. edit blocks/symbols and hatched areas
12. modify continuous lines formed by a connected sequence of lines or arcs
13. use a method to remove unused items and rename other items logically

Guided learning hours

It is recommended that **90** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

This unit is linked to the Engineering Woodworking, Pattern and Model Making Level 3, unit 21 Producing Drawings for Patterns and Models using 2D Computer Aided Techniques.

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by SEMTA.

Key Skills

This unit may help candidates to gain confidence in, and possibly generate portfolio evidence for, the following Key Skills:

- Application of Number
- Information and Communication Technology
- Improving Own Learning and Performance

Assessment and grading

This unit will be assessed by:

- two assignments covering practical skills – pass/fail
- one GOLLA on-line test covering underpinning knowledge – pass/credit/distinction.

Unit 301

Outcome 1

2D Computer Aided Design

Use a layering system and different line type styles

Assessment Criteria

Practical Skills

The learner can:

1. import a number of line type styles for use within a CAD drawing and manipulate the scale of the line type
2. create a number of new layers for use with a CAD drawing
3. change and manipulate the properties of a layer, such as colour and line type
4. demonstrate the use all the available layer controls to change the status of the layer
5. produce a 2D CAD drawing using a range of line types and layers
6. set up and use simple multiple viewing areas within the same drawing window to see different aspects of a drawing

Underpinning Knowledge

The learner can:

1. explain the process of importing different line types and why it is necessary to manipulate the scales of line types of different objects
2. explain the purpose of using a layering system for the production of a CAD drawing
3. explain how a layer can be controlled and how the properties of that layer can be manipulated.
4. explain the concept of using multiple views and it's benefits in practice

Unit 301

Outcome 2

2D Computer Aided Design

Define and use a system for grouping objects to form blocks or libraries

Assessment Criteria

Practical Skills

The learner can:

1. create a block/symbol from a previously drawn component consisting of multiple entities
2. save a created block/symbol independently of the drawing for use within a different drawing
3. insert a block/symbol into a drawing from within the original drawing and from external source
4. convert an inserted block/symbol back into its original constituent parts
5. create and insert attributed blocks/symbols into a CAD drawing
6. attach an external drawing to the current drawing

Underpinning Knowledge

The learner can:

1. explain the benefits of creating blocks/symbols for use in a CAD drawing
2. explain the benefits of exporting blocks/symbols for use within a range of CAD drawings
3. identify the need to convert an inserted block/symbol back into its original constituent parts
4. explain the benefits of creating attributed blocks/symbols for use in a CAD drawing
5. explain the benefits of attaching an external drawing for use in the current drawing

Unit 301

Outcome 3

2D Computer Aided Design

Produce isometric drawings within the 2D environment

Assessment Criteria

Practical Skills

The learner can:

1. set up the 2D drawing environment to aid the production of an isometric drawing: e.g. using drawing aids
2. produce an isometric drawing within the 2D CAD environment using a range of techniques
3. create isometric circles for use on an isometric drawing

Underpinning Knowledge

The learner can:

1. explain the purpose of producing an isometric drawing and the related rules that need to be adhered to
2. explain the procedures for setting up the CAD environment ready to produce an isometric drawing production
3. explain the purpose of the available drawing aids to assist isometric drawing production
4. identify the use of different planes within the isometric drawing and how that effects the production of isometric circles

Unit 301

Outcome 4

2D Computer Aided Design

Define and use an adjustable co-ordinate system based on user requirements

Assessment Criteria

Practical Skills

The learner can:

1. create a new user co-ordinate system (UCS)
2. locate a new UCS position in relation to an existing drawn entity
3. manipulate the UCS icon to follow any new origin position
4. rotate the UCS about its own origin
5. name and save multiple UCSs and switch between them.

Underpinning Knowledge

The learner can:

1. identify the difference between the world co-ordinate system (WCS) and a user co-ordinate system (UCS)
2. explain the need for a UCS
3. explain the need to identify the location of a new UCS by the means on an icon
4. explain the reasons for naming a UCS and toggling between different UCS origins

Assessment Criteria**Practical Skills**

The learner can:

- 1 set up a new user defined dimension style, including the following:
 - i) manipulate the properties of lines and arrows
 - ii) manipulate the properties (including style and size) of text used
 - iii) alter scale and location of where dimension lines and text are placed
 - iv) set the appropriate units (including alternative) for the dimensioning, relating to the drawing to be produced
 - v) modify tolerance settings as appropriate
- 2 adjust the set up and style of the dimensions, as appropriate, whilst dimensioning a drawing
- 3 carry out the following dimensioning techniques
 - i) aligned
 - ii) angular
 - iii) baseline
 - iv) continued
 - v) labelling/leaders
 - vi) positioning of centre marks
- 4 update any existing dimension to take on the properties of the new dimension style.

Underpinning Knowledge

The learner can:

- 1 explain the need to set up a user defined dimension style
- 2 explain the different types of dimensioning technique available

Unit 301

Outcome 6

2D Computer Aided Design

Use different drawing spaces and complex multi viewing areas

Assessment Criteria

Practical Skills

The learner can:

1. set up a drawing space in order to layout a drawing ready for printing
2. create a number of different drawing space layouts, to illustrate different parts of a drawing
3. create multiple view areas within the same layout to show different aspects of a drawing
4. toggle between different types of space in order to make alterations to a drawing, as appropriate
5. apply a range of standard scales to the different view areas which when printed can be measured.

Underpinning Knowledge

The learner can:

1. identify the purpose of the range of different drawing spaces available
2. explain why view scaling is applied to view areas in a drawing
3. explain why a drawing space may be used to layout a drawing ready for printing

Assessment Criteria

Practical Skills

The learner can:

1. activate the plot function and select the appropriate plotter for the task and check that the plotter configuration is correct
2. set up the appropriate plot settings for the drawing that is to be printed, including:
 - i) paper size
 - ii) units
 - iii) orientation
 - iv) scale
 - v) plot area
 - vi) positioning
3. produce a hardcopy of the drawing from a range of different available drawing spaces and to a range of different scales
4. produce hardcopies of a drawing from a range of different multiple drawing space layouts and to scale.

Underpinning Knowledge

The learner can:

1. explain the purpose of producing a hardcopy of a drawing
2. explain the reasons for previewing a plot
3. explain the processes involved in producing a hardcopy
4. explain the benefits of producing hardcopies of a drawing from multiple drawing space layouts

Unit 301

Outcome 8

2D Computer Aided Design

use a means of pre-command object selection in order to carry out editing processes

Assessment Criteria

Practical Skills

The learner can:

1. apply the use of the CAD software to list the details of an existing entity
2. apply the use of the CAD software to provide information about the distance between two existing points and the length of a line
3. apply the use of the CAD software to provide information about the location of a specific point on the X, Y axis
4. apply the use of the CAD software to calculate the area of a specific shape
5. apply the use of the technique to draw points to divide a line into a number of segments
6. apply the use of the technique to draw points to measure and locate specific distances along a line.

Underpinning Knowledge

The learner can:

1. explain the purpose of making inquiries about the details concerning entities that have been previously drawn
 - i) measuring distances
 - ii) point identification
 - iii) areas of shapes
2. explain the reason why a line would need to be divided or measured
3. explain the routines involved with making inquiries

Unit 301

Outcome 9

2D Computer Aided Design

Use a means of pre-command object selection in order to carry out editing processes

Assessment Criteria

Practical Skills

The learner can:

1. demonstrate the use of an appropriate method to select objects prior to command input : grips
2. activate defining points on an object that will allow the following editing commands to be carried out:
 - i) stretch
 - ii) move
 - iii) rotate
 - iv) scale
 - v) mirror
3. demonstrate the use of both keyboard entry and mouse control to carry out the editing commands

Underpinning Knowledge

The learner can:

1. explain why pre-command selections can speed up editing routines
2. explain the routines involved with pre-command selection
 - i) cold grips
 - ii) hot grips

Unit 301

Outcome 10

2D Computer Aided Design

Change the properties of a number of drawn entities

Assessment Criteria

Practical Skills

The learner can:

1. apply the use of appropriate commands to edit and modify the following properties of entities:
 - i) colour
 - ii) layer location
 - iii) line type
 - iv) line type scale
 - v) text contents, style, height, justification
 - vi) size of lines and circles
2. transfer the actual properties of one drawn entity to another, therefore inheriting those properties.

Underpinning Knowledge

The learner can:

1. explain why drawing properties would require modification
2. explain the routines involved in carrying out properties modification of an entry
3. explain why drawn entities sometimes need to be transferred from one layer to another
4. name all the routines and variations of those routines that involve modifying properties of drawn entities

Assessment Criteria

The learner can:

1. remove previously drawn single entities from a block/symbol that has already been created and used on a drawing, that will also redefine all other previously inserted blocks/symbols
2. add new entities to a block/symbol that has already been created and used on a drawing, that will also redefine all other previously inserted blocks/symbols
3. ensure that future block/symbol insertions have adopted any edited changes
4. modify a block/symbol that has been saved separately and save the changes made
5. modify an existing hatch pattern in terms of colour, angle, style and scale.

Underpinning Knowledge

The learner can:

1. explain the benefits of being able to add or delete entities from an existing block/symbol that has multiple insertions within a drawing
2. explain the routines involved with modifying existing block/symbols
3. describe the system of reference edits to change the block/symbol appearance
4. explain the routines involved with modifying existing hatched areas

Unit 301

Outcome 12

2D Computer Aided Design

Modify continuous lines formed by a connected sequence of lines or arcs

Assessment Criteria

Practical Skills

The learner can:

1. edit an existing line to adopt a new width
2. edit an existing line to add an additional segment
3. edit an existing line to join two lines together
4. convert existing entities to form a line
5. edit an existing line to add and remove a spline or curve fit
6. apply an alternative line type to a line.

Underpinning Knowledge

The learner can:

1. explain the complexity of the line and the benefits of the editing commands that can be used to modify the line
2. explain the routines involved with modifying lines

Unit 301

Outcome 13

2D Computer Aided Design

Use a method to remove unused items and rename other items logically

Assessment Criteria

Practical Skills

The learner can:

1. delete the following unused items from a drawing
 - blocks/symbols
 - layers
 - line types
 - text styles
 - dimension styles
2. rename the following items found within a drawing
 - blocks/symbols
 - layers.

Underpinning Knowledge

The learner can:

1. explain the benefits of removing unused items from a drawing
2. explain the routines involved with removing unused items from a drawing
3. explain the routines with renaming blocks/symbols and layers

Unit 302

3D Computer Aided Design

Level: 3

Credit value: 10

Unit aim

Allows the learner to develop the ability to apply the drafting procedures required to create and modify existing 3D objects either surfaces or solids at any position within Three Dimensional Space.

Learning outcomes

There are **nine** learning outcomes to this unit. The learner will be able to:

1. Apply appropriate commands to set the 3D modelling environment
2. Create and use working planes at any required position/attitude within 3D Space
3. Define and use co-ordinate points at any position within 3D Space
4. Apply appropriate commands to construct the whole or part of a 3D model using the best available method - surface or solid modelling
5. Apply appropriate commands to modify 3D solid objects
6. Apply appropriate commands to perform 3D operations on existing objects
7. Apply appropriate commands to manipulate a 3D model
8. Apply appropriate commands to view 3D model in a variety of display formats
9. Print/plot/export 3D models

Guided learning hours

It is recommended that **90** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

This unit is linked to the Engineering Technical Support Level 3, unit 5 Produce Engineering Drawings/Models using 3D Computer Aided Techniques.

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by SEMTA.

Key Skills

This unit may help candidates to gain confidence in, and possibly generate portfolio evidence for, the following Key Skills:

- Application of Number
- Information and Communication Technology
- Improving Own Learning and Performance
- Problem Solving

Assessment and grading

This unit will be assessed by:

- Two assignments covering practical skills – pass/fail.
- One GOLA on-line test covering underpinning knowledge – pass/credit/distinction.

Unit 302

Outcome 1

3D Computer Aided Design

Apply appropriate commands to set the 3D modelling environment

Assessment Criteria

Practical Skills

The learner can:

1. set appropriate drawing aids and drawing parameters
2. set appropriate system variables for the CAD system to control the appearance of the 3D objects
3. set appropriate multiple view windows to aid the construction of 3D models
4. set-up a drawing space in order to layout a drawing ready for printing
5. create and use a template(s) for the 3D environment.

Underpinning Knowledge

The learner can:

1. explain how the 3D modelling environment can be aided by setting
 - i) the drawing limits and /or paper size
 - ii) drawing layers
 - iii) appearance of the user co-ordinate system icon
 - iv) drawing aids (grips, snap)
2. explain how the CAD system variables can be adjusted to control the appearance of 3D models during, and after, construction of the model
3. explain that system variables can be set to define the number of facets when creating a 3D meshed surface
4. explain how multiple view ports/windows can be set on the display to
 - i) display numerous three dimensional views of the model
 - ii) display the model in normal, hidden or shaded mode
 - iii) enable entities to be drawn using the view windows as an interface between the views, without leaving the current/active command
5. explain how to set up a drawing space in order to layout a drawing ready for printing

Unit 302

3D Computer Aided Design

Outcome 2

Create and use working planes at any required position/attitude within 3D Space

Assessment Criteria

Practical Skills

The learner can:

1. restore and use the default co-ordinate system
2. create and apply User Co-ordinate Systems for the construction of 3D models
3. save and restore User Co-ordinate Systems that have been assigned meaningful names
4. change the position and appearance of the User Co ordinate System icon or indicator.

Underpinning Knowledge

The learner can:

1. define the term 'default co-ordinate system'
2. define the term 'User Co-ordinate System/working planes'
3. explain the relevance between User Co-ordinate System and the default co-ordinate system
4. explain how a User Co-ordinate System can be created by
 - i) select a new origin
 - ii) selecting 3 points on the working plane
 - iii) rotate about the X axis
 - iv) rotate about the Y axis
 - v) rotate about the Z axis
 - vi) defining a Z axis
 - vii) select an object or entity to define the working plane
5. define the term 'UCS icon'
6. explain how the UCS icon can be displayed
 - i) at the UCS origin
 - ii) in 2D mode
 - iii) in 3D mode
 - iv) in an invisible mode
7. explain how a User Co-ordinate System is a working plane, that can be located anywhere in three dimensional space, applied and manipulated by the user to aid in the construction of a 3D model

Unit 302

Outcome 3

3D Computer Aided Design

Define and use co-ordinate points at any position within 3D Space

Assessment Criteria

Practical Skills

The learner can:

1. apply the use of 3D points that are entered in absolute, relative and polar co-ordinates in relation to the current user co-ordinate system
2. apply the use of 3D points that are entered in default absolute co-ordinates whilst in a user coordinate system
3. apply the use of appropriate filtering techniques to create another point / object from an existing point / object in 3D space.

Underpinning Knowledge

The learner can:

1. recognise that co-ordinates of points can be defined in relation to the
 - i) default co-ordinate system
 - ii) UCS origin
 - iii) last point selected
2. explain that the co-ordinates of points can be defined by a distance in the X, Y and Z direction from the last point selected
3. explain that the co-ordinates of points can be defined by the distance and angular direction from the last point selected
4. describe filtering techniques to create another point/entity to another point/entity in 3D space.

Unit 302

Outcome 4

3D Computer Aided Design

Apply appropriate commands to construct the whole or part of a 3D model using the best available method - surface or solid modelling

Assessment Criteria

Practical Skills

The learner can:

1. apply the use of the CAD software to construct and display; a wire frame model, a surface model and /or a solid model
2. create 2D objects, closed outline shapes and regions whilst using a variety of user co-ordinate systems
3. create a variety of 3D primitives; either directly or by other methods
4. extrude a closed outline shape or region to create a new 3D object
5. revolve an open object, closed outline shape or region about an axis to create a new 3D object
6. construct a 2D multi segment line as a single entity
7. extrude an existing 2D object along a 2D path to create a new 3D object
8. create surface meshes using a variety of methods
9. dimension a 3D model in at least two planes.

Underpinning Knowledge

The learner can:

1. recognise that a Wire Frame Model is a series of lines or arcs assembled together in three dimensional space
2. recognise that a Surface Model is a series of surfaces assembled together in three dimensional space.
3. recognise that a Solid Model is a series of masses assembled together in 3D space
4. recognise 2D drawing and editing commands that can be used in a 3D environment
5. explain the sequence of operations to convert 2D entities to multi segment single entity
6. explain the sequence of operations to convert 2D entities to co-planer closed bounded shape or region
7. explain how a closed shape or region can
 - i) revolve about an axis to create a 3D solid model
 - ii) extrude in the Z axis to create a 3D solid object
 - iii) extrude along a path to create a 3D solid object
8. explain how open entity shapes can
 - i) revolve about an axis to create a 3D surface object
 - ii) be used to create 3D surface meshes
9. explain the term 3D solid model primitive
10. explain the term 3D surface model primitive
11. explain the dimensioning feature on a 3D model
12. explain that dimensioning may have a fixed scale or have a scale related to the display factor

Unit 302

Outcome 5

3D Computer Aided Design

Apply appropriate commands to modify 3D solid object

Assessment Criteria

Practical Skills

The learner can:

1. perform Boolean operations on 3D solid objects
2. cut a 3D solid object into two parts or use a command to cut away part of a 3D solid object
3. construct fillets and chamfers on selected edges of 3D solid objects
4. modify faces of 3D solid objects using various 3D editing commands
5. modify the shape of a 3D solid object using imprint and shell
6. modify individual face and edge colour of a 3D solid object.

Underpinning Knowledge

The learner can:

1. explain how a complex 3D model can be constructed by applying the common Boolean operations including the:
 - i) union of two or more solid model objects or primitives
 - ii) subtraction of a number of solid model objects or primitives from another
 - iii) intersection of two or more solid objects
2. explain how to modify the edges or corners of a 3D model to incorporate a fillet radius or chamfer

Unit 302

3D Computer Aided Design

Outcome 6

Apply appropriate commands to perform 3D operations on existing objects

Assessment Criteria

Practical Skills

The learner can:

1. create and use a 3D library item
2. create multiple copies of objects in 3D space
3. create mirror image of entities or objects in 3D space
4. apply the use of appropriate commands to rotate objects in 3D space.

Underpinning Knowledge

The learner can:

1. explain how a 3D library can be created and used at any location and orientation in the 3D drawing environment
2. explain how to create uniformly spaced multiple copies of objects on 3D space in a:
 - i) polar array
 - ii) rectangular array
3. explain how to create a mirror image of an entity, object or model at any position in 3D space by selecting a mirror plane using options including:
 - i) 3 points on a plane
 - ii) an object
 - iii) XY axis
 - iv) YZ axis
 - v) ZX axis
4. explain how to rotate an entity, object or 3D model about an axis defined by the options including:
 - i) an object
 - ii) a view
 - iii) the X axis
 - iv) the Y axis
 - v) the Z axis
 - vi) 2 points anywhere in 3D Space.

Unit 302

3D Computer Aided Design

Outcome 7

Apply appropriate commands to manipulate a 3D model

Assessment Criteria

Practical Skills

The learner can:

1. produce cut-away views of 3D models
2. produce cross sectional views of 3D models
3. obtain mass properties of a 3D solid model
4. apply the use of a command to send mass property analysis data to an external destination.

Underpinning Knowledge

The learner can:

1. explain how the CAD software can be used to slice or cut away the front or back part of a 3D model, or retain both, using a cutting plane designed by selecting a point on:
 - i) an object
 - ii) the Z axis
 - iii) a view
 - iv) the XY plane
 - v) the YZ plane
 - vi) the ZX plane
 - vii) or by selecting 3 points in three dimensional space
2. explain how the CAD software can be used to create a cross sectional view of a 3D model using a cutting plane designated by selecting a point on:
 - i) an object
 - ii) the Z axis
 - iii) a view
 - iv) the XY plane
 - v) the YZ plane
 - vi) the ZX plane
 - vii) or by selecting 3 points in the three dimensional space
3. explain how the CAD software is used to find mass properties of a 3D model, including:
 - i) mass
 - ii) volume
 - iii) centroid
 - iv) moments of inertia
4. explain that mass is calculated using the formula: $\text{Mass} = \text{Volume} \times \text{Density}$
5. explain the mass properties analysis data of the 3D model can be exported to an external destination

Unit 302

Outcome 8

3D Computer Aided Design

Apply appropriate commands to view 3D model in a variety of display formats

Assessment Criteria

Practical Skills

The learner can:

1. view 3D models from various points in 3D space
2. view 3D models in a variety of display modes e.g. hidden, shaded
3. save and recall views of the 3D model for use within the drawing at a later date
4. manipulate and save multiple view window layouts to aid in the display of the 3D model.

Underpinning Knowledge

The learner can:

1. explain that 3D models can be viewed from any position in 3D space and these views can be saved with meaningful names
2. explain that the display window can be split into numerous viewing areas and that each area is able to view the 3D model from different directions in 3D space at different scale factors
3. explain that the 3D model can be viewed with all edges visible or with only edges that would be seen from the viewing position visible
4. explain that the model may be displayed in a variety of ways from simple wire frame to full photo realistic rendering
5. explain that the visual state of layers can be set globally or differently for selected display windows.

Assessment Criteria

Practical Skills

The learner can:

1. produce hardcopy of a 3D model in a variety of display formats
2. produce hardcopy of a final presentational drawing displaying multiple views, some views to use the hidden line removal feature
3. plot to devices other than the hardware printer/plotter
4. export the CAD file in various formats.

Underpinning Knowledge

The learner can:

1. explain why the final presentational drawings are produced displaying multiple views
2. explain how views of 3D model with all edges visible or with only edges that would be seen from the viewing position visible can be printed/plotted
3. explain that 3D views of the model can be printed/plotted
4. explain that orthographic views of the 3D model can be printed/plotted
5. explain that the 'printed' output from a CAD system can be in the form of software files eg PDF, WDF, which can be use to view CAD output on another system that does not have CAD facilities.
6. explain that a CAD system is able to export drawing files in a format other than the local drawing format eg. WMF, STL, ACIS

Unit 303

(2D) Computer Aided Part Programming

Level: 3

Credit value: 4

Unit aim

Use a CAPP system to produce an NC file from imported 3D CAD models.

Learning outcomes

There are **eleven** learning outcomes to this unit. The learner will be able to:

1. set up a workstation and associated hardware
2. import model geometry produced on a CAD system
3. produce a production plan for manufacturing component
4. apply profile strategies to model
5. apply pocket strategies to model
6. apply hole strategies to model
7. apply turning cycles for roughing and finishing diameters and faces
8. apply drilling and boring cycles
9. apply threading cycles to models
10. apply grooving cycles to models.
11. post process machining information

Guided learning hours

It is recommended that **40** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

This unit is linked to the Mechanical Manufacturing Engineering suite 3, unit 31 Carrying Out CNC Machine Tool Programming.

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by SEMTA.

Key Skills

This unit may help candidates to gain confidence in, and possibly generate portfolio evidence for, the following Key Skills:

- Communication
- Information and Communication Technology
- Improving Own Learning and Performance
- Problem Solving

Assessment and grading

This unit will be assessed by:

- One assignment covering practical skills.
- One centre set knowledge test.
- All pass/fail.

Unit 303

Outcome 1

(2D) Computer Aided Part Programming

Set up a workstation and associated hardware

Assessment Criteria

Practical Skills

The learner can:

1. correctly open CAPP software
2. set up folders for storage of machining and NC files
3. set up input/output devices
4. use desktop functions to maximise efficiency
5. apply workspace draw properties and attributes
6. initiate relevant icons and menu options needed

Underpinning Knowledge

The learner can:

7. explain the minimum hardware specifications to run chosen software
 - i) processor speed
 - ii) hard disc space required
 - iii) RAM
 - iv) video/graphics card size/speed
 - v) operating system
8. evaluate methods of files storage and transfer
 - i) hard drive
 - ii) network file server
 - iii) external hard drive
 - iv) USB memory stick
 - v) CD/DVD ROM
 - vi) SD (secure digital) cards
 - vii) websites
 - viii) e-mail
9. identify and describe the uses of input and output devices
 - i) plotter
 - ii) printer
 - iii) mouse
 - iv) keyboard
 - v) VDU
10. be familiar with standard desktop functions
 - i) maximise/minimise windows
 - ii) change size of windows
 - iii) tile windows
 - iv) drag/drop between
 - v) copy/paste information
11. compare draw properties and attributes of the system
 - i) draw properties
 - ii) attributes
12. analyse icons and menu options needed
 - i) icons
 - ii) menu options

Unit 303

Outcome 2

(2D) Computer Aided Part Programming

Import model geometry produced on a CAD system

Assessment Criteria

Practical Skills

The learner can:

1. initiate data transfer files to import model
2. identify features for machining
3. apply orientation commands for correct presentation of model
4. set datum/origins needed
5. convert entities to suit CAM system
6. create form of supply boundaries around part

Underpinning knowledge

The learner can:

7. differentiate between commonly used transfer files for 3D models
 - i) .DXF
 - ii) .IGES
 - iii) .SLDPRT
 - iv) .X_T (Parasolid)
 - v) .PRT (Pro Eng)
8. analyse features for machining
 - i) solid features
 - ii) surface features
 - iii) forgings
9. compare the use of orientation commands
 - i) translate
 - ii) rotate
 - iii) 3D rotate
10. understand the use of origins/datums
 - iv) manipulate orientation of model
 - v) correctly present features/areas for optimum machining conditions
 - vi) control 4th axis if available
11. recognise entities
 - vii) bodies
 - viii) faces
 - ix) edges
12. explain material form of supply.
 - x) solid billets
 - xi) forgings
 - xii) castings

Unit 303

Outcome 3

(2D) Computer Aided Part Programming

Produce a production plan for manufacturing component

Assessment Criteria

Practical Skills

The learner can:

1. produce route plan identifying machines and machining order
2. develop work holding sheet(s)
3. produce operators instruction sheet(s)
4. produce tooling sheet(s)

Underpinning knowledge

The learner can:

5. evaluate and select CNC machine(s) for efficient production
 - i) size
 - ii) spindle speed
 - iii) axis rapid rates
 - iv) spindle power
 - v) operating system
 - vi) memory size
6. review workholding considerations for machining
 - i) minimum number of setups
 - ii) presentation of features/surfaces to be cut
 - iii) use of 4th (5th) axis
7. describe suitable workholding methods
 - i) direct to table
 - ii) vice
 - iii) fixture
 - iv) 4th axis
 - v) chuck
 - vi) faceplate
8. compare types and position of clamping
 - i) freedoms of movement
 - ii) number of clamps
 - iii) collision avoidance
 - iv) clamp shape
 - v) clamping pressure
 - vi) power clamping
9. evaluate and select tooling from database
 - i) work material to be cut
 - ii) profiles to be cut
 - iii) roughing cycles
 - iv) semi finishing cycles
 - v) finishing cycles
10. calculate feeds/speeds for selected tools
 - i) tool manufacturers data sheets
 - ii) material to be cut
 - iii) type of tool

Unit 303

Outcome 4

(2D) Computer Aided Part Programming

Apply profile strategies to model

Assessment Criteria

Practical Skills

The learner can:

1. define initial options
2. select profile strategy(s) appropriate to model geometry
3. indentify and select relevant tools from database
4. apply machining parameters
5. run machining simulation.

Underpinning Knowledge

The learner can:

6. summarise types of initial options
 - i) part number
 - ii) description
 - iii) units
 - iv) post processor details
 7. describe the uses of profile cycles used on a system
 - i) internal profile
 - ii) external profile
 8. select suitable tooling from database
 - i) end mill
 - ii) slot drill
 - iii) ball nose
 - iv) face mill
 9. summarise the use of machining parameters
 - i) tool entry/exit conditions
 - ii) stepover
 - iii) retract/clearance planes
 - iv) machining levels
 - v) finish depth of cut
 - vi) step depth of cut
 - vii) direction of cut
 - viii) finish allowance
 - ix) speeds/feeds
 - x) cutter diameter compensation
 10. define errors indentified by simulation
- Note: simulation should take place after each stage to check for:
- i) tool collisions
 - ii) undercutting
 - iii) plunging
 - iv) tool fouling

Assessment Criteria**Practical Skills**

The learner can:

1. analyse and select pocketing strategy(s) appropriate to model geometry
2. identify and select relevant tools from database
3. apply machining parameters
4. run machining simulation.

Underpinning knowledge

The learner can:

5. describe the use of pocket cycles
 - i) internal
 - ii) with island(s)
 - iii) angled wall
 - iv) corner radius
 6. describe suitable tooling from database
 - i) end mill
 - ii) slot drill
 - iii) ball nose
 - iv) taper ball nose
 - v) any other appropriate tooling
 7. summarise the use of machining parameters
 - i) tool entry/exit conditions
 - ii) stepover
 - iii) retract/clearance planes
 - iv) machining levels
 - v) total depth of cut
 - vi) step depth of cut
 - vii) direction of cut
 - viii) finish allowance
 - ix) z entry conditions
 - x) speeds/feeds
 - xi) wall angle
 - xii) bottom radius
 8. define errors identified by simulation
- Note: simulation should take place after each stage to check for:
- i) tool collisions
 - ii) undercutting
 - iii) plunging
 - iv) tool fouling.

Assessment Criteria**Practical Skills**

The learner can:

1. analyse and select appropriate cycles for holes types
2. identify and select relevant tools from database
3. apply machining parameters
4. run machining simulation

Underpinning knowledge

The learner can:

5. describe the use of hole cycles
 - i) drill
 - ii) spot drill/centre drill
 - iii) thread/tapping
 - iv) boring
 - v) countersink
 6. describe suitable tooling from database for type of hole
 - i) slot drill
 - ii) twist drill
 - iii) reamer
 - iv) U drill
 - v) taps
 - vi) boring bar
 - vii) any other appropriate tooling
 7. summarise the use of machining parameters
 - i) tool entry/exit conditions
 - ii) retract/clearance planes
 - iii) depth of cut
 - iv) peck depths
 - v) number of pecks
 - vi) finish allowance
 - vii) speeds/feeds
 - viii) pitch
 - ix) thread depth
 8. define errors identified by simulation
- Note: simulation should take place after each stage to check for
- i) rapid collisions
 - ii) undercutting
 - iii) plunging
 - iv) tool fouling

Unit 303

Outcome 7

(2D) Computer Aided Part Programming

Apply turning cycles for roughing and finishing diameters and faces

Assessment Criteria

Practical Skills

The learner can:

1. define initial options
2. select appropriate turning cycles
3. identify and select relevant tools from database
4. apply machining parameters
5. run machining simulation

Underpinning knowledge

The learner can:

6. summarise types of initial options
 - i) part number
 - ii) description
 - iii) units
 - iv) material
 - v) tool change position
 - vi) post processor details
 - vii) clamping device data
 - viii) spindle designation
 - ix) tailstock utilisation
 - x) turret definitions
7. describe the uses of turning cycles on system
 - i) rough face only
 - ii) rough turn only
 - iii) rough turn and face
 - iv) finish face only
 - v) finish turn only
 - vi) finish turn and face
 - vii) finish selected

(Note – these cycles used for internal features as well).
8. describe suitable tooling from database
 - i) tool holder designation
 - ii) tip grade
 - iii) tip geometry
 - iv) tip radius
9. summarise the use of machining parameters
 - i) internal/external cutting
 - ii) retract/clearance data
 - iii) depth of cut
 - iv) direction of cut
 - v) finish allowance
 - vi) speeds/feeds
 - vii) tool nose radius compensation details
 - viii) cycle start position
10. define errors identified by simulation
 - i) tool collisions
 - ii) dangerous rapid moves
 - iii) tool fouling

Unit 303

Outcome 8

(2D) Computer Aided Part Programming

Apply drilling and boring cycles

Assessment Criteria

Practical Skills

The learner can:

1. analyse and select appropriate drilling cycles
2. identify and select relevant tools from database
3. apply machining parameters
4. run machining simulation.

Underpinning knowledge

The learner can:

5. describe the type and use of hole cycles
 - i) centre drilling
 - ii) plain drilling
 - iii) deep hole drilling
 - iv) reaming
 - v) tapping
 6. describe tools used for hole production
 - i) slot drill
 - ii) centre drill
 - iii) twist drill
 - iv) U drill
 - v) reamer
 - vi) taps
 - vii) boring bar
 - viii) any other appropriate tools
 7. summarise the use of machining parameters
 - i) tool entry/start position
 - ii) retract/clearance planes
 - iii) total depth
 - iv) peck depth
 - v) thread depth
 - vi) speeds/feeds
 8. define errors identified by simulation
- Note – simulation should take place after each stage to check for:
- I) tool collisions
 - II) undercutting
 - III) plunging
 - IV) tool fouling

Unit 303

Outcome 9

(2D) Computer Aided Part Programming

Apply threading cycles to models

Assessment Criteria

Practical Skills

The learner can:

1. analyse and select internal/external threading cycles
2. identify and select relevant tools from database
3. apply machining parameters
4. run machining simulation.

Underpinning knowledge

The learner can:

5. describe the use of threading cycles
 - i) internal
 - ii) external
6. analyse features on threading tools
 - i) holder designation
 - ii) tip grade
 - iii) thread angle
 - iv) tip radius
 - v) pitch range
 - vi) maximum depth of cut
7. summarise the use of machining parameters
 - i) cycle start position
 - ii) thread start position
 - iii) thread end position
 - iv) depth of thread
 - v) first cut depth
 - vi) number of passes
 - vii) number of spring passes
 - viii) pitch
 - ix) flank angle
8. define errors identified by simulation

Note – simulation should take place after each stage to check for:

- i) rapid collisions
- ii) undercutting
- iii) plunging
- iv) tool fouling

Assessment Criteria**Practical Skills**

The learner can:

1. analyse and select internal/external grooving cycles
2. identify and select relevant tools from database
3. apply machining parameters
4. run machining simulation

Underpinning knowledge

The learner can:

5. describe the use of grooving cycles
 - i) internal groove
 - ii) external groove
 - iii) undercut diameter
 - iv) undercut face
 - v) parting off
 6. analyse features on grooving tools
 - i) holder designation
 - ii) tip grade
 - iii) tip width
 - iv) tip radius
 - v) tip geometry
 - vi) maximum cut depth
 7. summarise the use of machining parameters
 - i) start cycle position
 - ii) groove width
 - iii) groove depth
 - iv) depth of groove
 - v) first cut depth
 - vi) stepover
 - vii) radius top
 - viii) radius bottom
 - ix) wall angle left
 - x) wall angle right
 8. define errors identified by simulation
- Note – simulation should take place after each stage to check for:
- i) rapid collisions
 - ii) undercutting
 - iii) plunging
 - iv) tool fouling

Assessment Criteria**Practical Skills**

The learner can:

1. run machining simulation
2. check for machining errors
3. post process machining information
4. optimise and edit cutting conditions
5. post process and simulate edited data
6. safely store NC files for transfer

Underpinning knowledge

The learner can:

7. describe common simulation features
 - i) visual representation of cutter path
 - ii) different views available
 - iii) section views for pockets
 - iv) different tool colours
8. analyse machining errors
 - i) gouging
 - ii) undercutting
 - iii) plunging
 - iv) tool fouling
 - v) rapid collisions
9. compare post processor types and information generated
 - i) general
 - a) CAPP system cycles used
 - b) CAPP system repeats used
 - c) CAPP system roughing/finishing used
 - d) Some editing of NC data required
 - ii) specific/custom
 - a) CNC cycles used
 - b) CNC sub programmes/repeats used
 - c) CNC mirrors/rotations used
 - d) No editing of NC data
10. identify areas to increase efficiency
 - i) Feedrate
 - ii) Spindle speed
 - iii) Depth of cuts
 - iv) Number of strategies
 - v) Tool change positions
11. define reasons to re-post process
 - i) programme updated
 - ii) error avoidance
 - iii) machining times re-calculated
12. describe storage and transfer methods for NC data
 - i) Expanded data
 - ii) Hard disk
 - iii) Network file server
 - iv) DNC link

Note – terms used will vary with different CAD/CAM systems.

Unit 304 (2D) CNC Machining

Level: 3

Credit value: 2

Unit aim

Use a CNC machine to produce a component from NC data generated on a CAPP system.

Learning outcomes

There are **three** learning outcomes to this unit. The learner will be able to:

1. Set up tooling and workholding
2. Load program and prove in a safe manner
3. Use inspection equipment to ensure compliance with design specification

Guided learning hours

It is recommended that **20** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

This unit is linked to the Mechanical Manufacturing Engineering Suite 3, Unit 30 Loading and Proving CNC Machine Tool Programs

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by SEMTA.

Key Skills

This unit may help candidates to gain confidence in, and possibly generate portfolio evidence for, the following Key Skills:

- Communication
- Information and Communication Technology
- Improving Own Learning and Performance
- Problem Solving

Assessment and grading

This unit will be assessed by:

- One assignment covering practical skills.
- One centre set knowledge test.
- All pass/fail

Assessment Criteria**Practical Skills**

The learner can:

1. load and clamp workholding
2. load and clamp workpiece
3. set datum
4. load tools
5. set tool length offsets
6. set diameter offsets

Underpinning Knowledge

The learner can:

7. critically compare the different types of workholding
 - i) fixtures
 - ii) pallets
 - iii) fourth axis (chucks etc)
 - iv) vice
 - v) face plates
8. describe methods of aligning work
 - i) tenons
 - ii) indicators
 - iii) probes
9. describe the different types of datum setting devices
 - i) optical
 - ii) dial test indicator (DTI)
 - iii) wobble bar
 - iv) probe
10. distinguish the different characteristics of tooling (milling/turning)
 - i) tool materials
 - ii) holder geometry
 - iii) tip geometry
 - iv) slot drills
 - v) end mills
 - vi) face mills
 - vii) 'U' drills
 - viii) boring bars
 - ix) facing tools
 - x) threading tools
 - xi) finishing tools
11. explain the use of tool setting devices
 - i) light sensor
 - ii) feeler gauge
 - iii) probes (tool-length)
 - iv) probes (tool diameter)
12. review the need for tool length offsets and diameter offsets
 - i) difference in tool lengths
 - ii) distance to work surface
 - iii) adjustment to wear
 - iv) tool breakage sensor
 - v) cutter diameter compensation

- vi) adjustment to work piece size.

Unit 304

(2D) CNC Machining

Outcome 2

Load program and prove in a safe manner

Assessment Criteria

Practical Skills

The learner can:

1. load CNC program from CAM system
2. test run program in a safe manner
3. follow operator instructions in CNC manner
4. run full cycle to produce component in a safe manner

Underpinning knowledge

The learner can:

5. describe methods of storage and transfer of files
 - i) databases
 - ii) CD
 - iii) USB
 - iv) DNC
 - v) Drip feed
6. evaluate safe methods of testing programs
 - i) simulation
 - ii) dry run
 - iii) machine lock
 - iv) single block
 - v) axis lock
7. interpret CNC program operator instruction codes and actions required
 - i) machine stop
 - ii) optional stop
 - iii) block delete
 - iv) coolant commands
 - v) tool change commands
8. identify the controls available to run full cycle machining
 - vi) emergency stop
 - vii) rapid override
 - viii) feed override
 - ix) speed override

Unit 304

(2D) CNC Machining

Outcome 3

Use inspection equipment to ensure compliance with design specification

Assessment Criteria

Practical Skills

The learner can:

1. safely unload component from machine
2. clean and deburr component
3. check/inspect component
4. list and report alterations to machining parameters

Underpinning knowledge

The learner can:

5. review safety considerations for machine conditions when unloading components
 - i) position of component
 - ii) hazards from tooling
 - iii) compressed air dangers
 - iv) coolant clearance
 - v) handling sharp components
6. identify safety hazards with machined components
 - i) handling sharp components
 - ii) compressed air hazards
 - iii) safe use of hand tools
7. evaluate inspection procedures
 - i) manual measuring instruments
 - ii) inspection equipment (from gauges/templates)
 - iii) in process gauging
 - iv) optical projectors
 - v) CMM
8. summarise machine parameters adjusted
 - i) cutter length offsets
 - ii) cutter diameter offsets
 - iii) feed overrides

Unit 305

(2D) CNC Co-ordinate Measuring Machine Inspection

Level: 3

Credit value: 1

Unit aim

Use a CNC CMM machine to inspect produced components and produce a result table.

Learning outcomes

There is **one** learning outcome to this unit. The learner will be able to:

1. Inspect components produced on CNC machines

Guided learning hours

It is recommended that **10** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

This unit is linked to the Engineering Technical Support Level 3, Producing Operating Programs for Co-ordinate Measuring Machines (CMM)

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by SEMTA.

Key Skills

This unit may help candidates to gain confidence in, and possibly generate portfolio evidence for, the following Key Skills:

- Communication
- Information and Communication Technology
- Improving Own Learning and Performance
- Problem Solving

Assessment and grading

This unit will be assessed by:

- One assignment covering practical skills.
- One centre set knowledge test.
- All pass/fail.

Unit 305

(2D) CNC Co-ordinate Measuring Machine Inspection

Outcome 1

Inspect components produced on CNC machines

Assessment Criteria

Practical Skills

The learner can:

1. identify machine to use
2. set up CMM machine
3. set up and calibrate probe
4. locate and secure work piece
5. measure features for dimensional tolerance
6. measure features for geometric tolerance
7. produce results table

Underpinning Knowledge

The learner can:

8. identify types of machine configuration
 - i) vertical
 - ii) horizontal
 - iii) gantry/bridge
 - iv) articulated
9. describe start up procedures for machine
 - i) compressed air
 - ii) CMM software
 - iii) power
10. identify types of probes and set up procedures
 - i) touch probe
 - ii) video probe
 - iii) laser probe
 - iv) multi axis touch probe
 - v) orientation
 - vi) probe calibration
11. evaluate means to locate and secure workpiece
 - i) direct to table
 - ii) parallels
 - iii) vee blocks
 - iv) angle plates
 - v) correct orientation
 - vi) axis direction
 - vii) datum set
12. identify common features to inspect for dimensional tolerance
 - i) diameter
 - ii) bores
 - iii) taper bores
 - iv) cylinder
 - v) shoulders
 - vi) steps
 - vii) angles
 - viii) grooves
 - ix) undercuts
 - x) threads
 - xi) slots

- xii) eccentrics
 - xiii) splines
 - xiv) gears
13. identify common features to inspect for geometric tolerance
- i) flatness
 - ii) roundness
 - iii) squareness
 - iv) straightness
 - v) concentricity
 - vi) distortion
 - vii) surface finish
14. describe items required on result table
- i) list of features checked
 - ii) measurement list
 - iii) geometric tolerance list
 - iv) comparison with model/drawing

Unit 306

(3D) Computer Aided Part Programming

Level: 3

Credit value: 5

Unit aim

Use a CAPP system to produce an NC file from imported 3D CAD models.

Learning outcomes

There are **seven** learning outcomes to this unit. The learner will be able to:

1. set up a workstation and associated hardware
2. import 3D model geometry produced on a CAD system
3. produce a production plan for the component manufacture
4. apply chosen roughing strategies to model
5. apply appropriate semi-finish strategies to model
6. apply finishing strategies to 3D models
7. post process machining information

Guided learning hours

It is recommended that **40** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

This unit is linked to the Mechanical Manufacturing Engineering Suite 3, unit 31 Carrying Out CNC Machine Tool Programming.

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by SEMTA.

Key Skills

This unit may help candidates to gain confidence in, and possibly generate portfolio evidence for, the following Key Skills:

- Communication
- Information and Communication Technology
- Improving Own Learning and Performance
- Problem Solving

Assessment and grading

This unit will be assessed by:

- One assignment covering practical skills
- One centre set knowledge test.
- All pass/fail.

Unit 306

Outcome 1

(3D) Computer Aided Part Programming

Set up a workstation and associated hardware

Assessment Criteria

Practical Skills

The learner can:

1. correctly open CAPP software
2. set up folders for storage of machining and NC files
3. set up input/output devices
4. use desktop functions to maximise efficiency
5. apply workspace draw properties and attributes
6. initiate relevant icons and menu options needed

Underpinning Knowledge

The learner can:

7. explain the minimum hardware specifications to run chosen software
 - i) processor speed
 - ii) hard disc space required
 - iii) RAM
 - iv) video/graphics card size/speed
 - v) operating system
8. evaluate methods of files storage and transfer
 - i) hard drive
 - ii) network file server
 - iii) external hard drive
 - iv) USB memory stick
 - v) CD/DVD ROM
 - vi) SD (secure digital) cards
 - vii) websites
 - viii) e-mail
9. identify and describe input and output devices used
 - i) plotter
 - ii) printer
 - iii) mouse
 - iv) keyboard
 - v) VDU
 - vi) any other appropriate devices
10. be familiar with standard desktop functions
 - i) maximise/minimise windows
 - ii) change size of windows
 - iii) tile windows
 - iv) drag/drop between windows
 - v) copy/paste information
11. compare draw properties and attributes of the system
 - i) draw properties
 - ii) attributes
12. analyse icons and menu options needed
 - i) task bars
 - ii) icons
 - iii) status bars
 - iv) menus

Unit 306

(3D) Computer Aided Part Programming

Outcome 2

Import 3D model geometry produced on a 3D CAD system

Assessment Criteria

Practical Skills

The learner can:

1. initiate data transfer files to import model
2. identify features for machining
3. apply orientation commands for correct presentation of model
4. set datum/origins needed
5. convert entities to suit CAM system
6. create form of supply boundaries around part

Underpinning knowledge

The learner can:

7. differentiate between commonly used transfer files for 3D models
 - i) .DXF
 - ii) .IGES
 - iii) .SLDPRT
 - iv) .X_T (Parasolid)
 - v) .PRT (Pro Eng)
8. analyse features for machining
 - i) solid features
 - ii) surface features
9. compare the use of orientation commands
 - i) translate
 - ii) rotate
 - iii) 3D rotate
10. understand the use of origins/datums
 - i) manipulate orientation of model
 - ii) correctly present features/areas for optimum machining conditions
 - iii) control 4th axis if available
11. recognise entities
 - i) bodies
 - ii) faces
 - iii) edges
12. explain material form of supply.
 - i) solid billets
 - ii) forgings
 - iii) castings

Unit 306

Outcome 3

(3D) Computer Aided Part Programming

Produce a production plan for manufacturing component

Assessment Criteria

Practical Skills

The learner can:

1. produce route plan identifying machines and machining order
2. develop work holding sheet(s)
3. produce operators instruction sheet(s)
4. produce tooling sheet(s)

Underpinning knowledge

The learner can:

5. evaluate CNC machine(s) for efficient production
 - i) size
 - ii) spindle speed
 - iii) axis rapid rates
 - iv) axis feedrates
 - v) spindle power
 - vi) operating system
 - vii) memory size
6. review workholding considerations for 3D machining
 - i) minimum number of setups
 - ii) presentation of features/surfaces to be cut
 - iii) use of 4th (5th) axis
7. describe suitable workholding methods
 - i) direct to table
 - ii) vice
 - iii) fixture
 - iv) 4th axis
 - v) chuck
 - vi) faceplate
8. compare types and position of clamping
 - i) freedoms of movement
 - ii) number of clamps
 - iii) collision avoidance
 - iv) clamp shape
 - v) clamping pressure
 - vi) power clamping
9. evaluate tooling from database
 - i) work material to be cut
 - ii) profiles to be cut
 - iii) roughing cycles
 - iv) semi finishing cycles
 - v) finishing cycles
10. calculate feeds/speeds for selected tools
 - i) tool manufacturers data sheets
 - ii) material to be cut
 - iii) type of tool

Unit 306

Outcome 4

(3D) Computer Aided Part Programming

Apply chosen roughing strategies to model

Assessment Criteria

Practical Skills

The learner can:

1. define initial options
2. select profile strategy(s) appropriate to model geometry
3. identify and select relevant tools from database
4. create machining limits/boundaries
5. apply machining parameters
6. implement roughing strategies
7. run machining simulation.

Underpinning Knowledge

The learner can:

8. summarise types of initial options
 - i) part number
 - ii) description
 - iii) units
 - iv) post processor details
 9. describe the types and uses of roughing cycles used on system
 - i) zig zag
 - ii) pocket
 - iii) system dependant
 - iv) and other cycles as appropriate
 10. evaluate suitable tooling from database
 - i) end mill
 - ii) slot drill
 - iii) bull nose
 - iv) ball nose
 - v) taper ball nose
 11. explain the uses of machining limits/boundaries to control tool movement
 - i) to limit
 - ii) on limit
 - iii) past limit
 12. summarise the use of machining parameters
 - i) tool entry/exit conditions
 - ii) stepover
 - iii) retract/clearance planes
 - iv) machining levels
 - v) depth of cut
 - vi) stepover
 - vii) direction of cut
 - viii) finish allowance
 - ix) Z depth plunge limits
 13. define errors identified by simulation
- Note: simulation should take place after each stage to check for:
- i) gouging
 - ii) undercutting
 - iii) plunging
 - iv) tool fouling

Unit 306

Outcome 5

(3D) Computer Aided Part Programming

Apply appropriate semi-finish strategies to 3D models

Assessment Criteria

Practical Skills

The learner can:

1. analyse and select semi-finishing strategy(s) appropriate to remaining model geometry
2. identify and select relevant tools from database
3. create suitable machining limits/boundaries
4. apply machining parameters
5. implement semi-finishing strategies
6. run machining simulation.

Underpinning knowledge

The learner can:

7. describe the use of semi finishing cycles
 - i) waterline
 - ii) zig zag
 - iii) flat area
 - iv) steep area
8. evaluate suitable tooling from database
 - i) end mill
 - ii) slot drill
 - iii) bull nose
 - iv) ball nose
 - v) taper ball nose
9. explain the uses of machining limits/boundaries
 - i) to limit
 - ii) on limit
 - iii) past limit
10. summarise the use of machining parameters
 - i) tool entry/exit conditions
 - ii) stepover
 - iii) retract/clearance planes
 - iv) machining levels
 - v) depth of cut
 - vi) direction of cut
 - vii) finish allowance
 - viii) z depth plunge limits
11. define errors identified by simulation

Note: simulation should take place after each stage to check for:

- i) gouging
- ii) undercutting
- iii) plunging
- iv) tool fouling
- v) rapid collisions
- vi) complete defined area clearance.

Assessment Criteria**Practical Skills**

The learner can:

1. analyse and select finishing strategy(s) appropriate remaining to model geometry
2. identify and select relevant tools from database
3. create suitable machining limits/boundaries
4. apply machining parameters
5. implement semi finishing strategies
6. run machining simulation

Underpinning knowledge

The learner can:

7. describe the use of finishing cycles
 - i) pocket
 - ii) rest
 - iii) fine detail/features
 - iv) profile
 - v) projection
8. justify tool selection for remaining geometry
 - i) end mill
 - ii) slot drill
 - iii) bull nose
 - iv) ball nose
 - v) taper ball nose
9. explain the uses of machining limits/boundaries to control tool movement
 - x) tool limit
 - xi) on limit
 - xii) past limit
10. summarise the use of machining parameters
 - i) tool entry/exit conditions
 - ii) stepover
 - iii) retract/clearance planes
 - iv) machining levels
 - v) depth of cut
 - vi) direction of cut
 - vii) finish allowance
 - viii) Z depth plunge limits
11. define errors identified by simulation

Note: simulation should take place after each stage to check for

- i) gouging
- ii) undercutting
- iii) plunging
- iv) tool fouling
- v) rapid collisions
- vi) complete defined area clearance

Assessment Criteria

Practical Skills

The learner can:

1. run machining simulation
2. check for machining errors
3. post process machining information
4. optimise and edit cutting conditions
5. post process and simulate edited data
6. safely store NC files for transfer

Underpinning knowledge

The learner can:

7. describe common simulation features
 - i) visual representation of cutter path
 - ii) different views available
 - iii) section views for pockets
 - iv) different tool colours
8. analyse 3D machining errors
 - i) gouging
 - ii) undercutting
 - iii) plunging
 - iv) tool fouling
 - v) rapid collisions
9. compare post processor types and information generated
 - i) general
 - ii) specific
 - iii) CNC system data
 - iv) Expanded NC data
10. identify areas to increase efficiency
 - i) feedrate
 - ii) spindle speed
 - iii) depth of cuts
 - iv) number of strategies
 - v) tool change positions
11. define reasons to re-post process
 - i) programme updated
 - ii) error avoidance
 - iii) machining times re-calculated
12. describe storage and transfer methods for NC data
 - i) expanded data
 - ii) hard disk
 - iii) network file server
 - iv) DNC link

Unit 307 (3D) CNC Machining

Level: 3

Credit value: 2

Unit aim

Use a CNC machine to produce a component from NC data generated on a CAPP system.

Learning outcomes

There are **three** learning outcomes to this unit. The learner will be able to:

2. Set up tooling and workholding
3. Load program into machine and prove in a safe manner
4. Unload, clean and inspect component

Guided learning hours

It is recommended that **20** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

This unit is linked to the Mechanical Manufacturing Engineering Suite3, Unit 30 Loading and Proving CNC Machine Tool Programmes.

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by SEMTA.

Key Skills

This unit may help candidates to gain confidence in, and possibly generate portfolio evidence for, the following Key Skills:

- Communication
- Information and Communication Technology
- Improving Own Learning and Performance
- Problem Solving

Assessment and grading

This unit will be assessed by:

- One assignment covering practical skills.
- One centre set knowledge test.
- All pass/fail

Assessment Criteria

Practical Skills

The learner can:

1. load and clamp workholding
2. load and clamp workpiece
3. set datum
4. load tools
5. set tool length offsets
6. set diameter offsets

Underpinning Knowledge

The learner can:

7. critically compare the different types of workholding
 - i) fixtures
 - ii) pallets
 - iii) fourth axis (chucks etc)
 - iv) vice
8. describe methods of aligning work
 - i) tenons
 - ii) indicators
 - iii) probes
9. describe the different types of datum setting devices
 - i) optical
 - ii) dial test indicator (DTI)
 - iii) wobble bar
 - iv) probe
10. distinguish the different characteristics of tooling
 - i) tool materials
 - ii) ball nose
 - iii) bull nose
 - iv) taper ball nose
 - v) radius
 - vi) multi flute
11. explain the use of tool setting devices
 - i) light sensor
 - ii) feeler gauge
 - iii) probes (tool-length)
 - iv) probes (tool diameter)
12. review the need for tool length offsets and diameter offsets
 - i) difference in tool lengths
 - ii) distance to work surface
 - iii) adjustment to wear
 - iv) tool breakage sensor
 - v) cutter diameter compensation
 - vi) adjustment to work piece size.

Assessment Criteria

Practical Skills

The learner can:

1. load CNC program from CAM system
2. test run program in a safe manner
3. follow operator instructions in CNC manner
4. run full cycle to produce component in a safe manner

Underpinning knowledge

The learner can:

5. describe methods of storage and transfer of files
 - i) databases
 - ii) CD
 - iii) USB
 - iv) DNC
 - v) Drip feed

Note – expanded data CNC files are usually of a large size, often too large for machine tool memory.

6. evaluate safe methods of testing programs
 - i) simulation
 - ii) dry run
 - iii) machine lock
 - iv) single block
 - v) axis lock
7. interpret CNC program operator instruction codes and actions required
 - i) machine stop
 - ii) optional stop
 - iii) block delete
 - iv) coolant commands
 - v) tool change commands
8. identify the controls available to run full cycle machining
 - i) emergency stop
 - ii) rapid overdrive
 - iii) feed override
 - iv) speed override

Unit 307

Outcome 3

(3D) CNC Machining

unload, clean and inspect component

Assessment Criteria

Practical Skills

The learner can:

1. safely unload component from machine
2. clean and deburr component
3. check/inspect component
4. list and report alterations to machining parameters

Underpinning knowledge

The learner can:

5. review safety considerations for machine conditions when unloading components
 - i) position of component
 - ii) hazards from tooling
 - iii) compressed air dangers
 - iv) coolant clearance
 - v) handling sharp components
6. identify safety hazards with machined components
 - i) handling sharp components
 - ii) compressed air hazards
 - iii) safe use of hand tools
7. evaluate inspection procedures
 - i) manual measuring instruments
 - ii) inspection equipment (from gauges/templates)
 - iii) in process gauging
 - iv) optical projectors
 - v) CMM
8. summarise machine parameters adjusted
 - i) cutter length offsets
 - ii) cutter diameter offsets
 - iii) feed overrides
 - iv) speed overrides

Unit 308

(3D) CNC Co-ordinate Measuring Machine Inspection

Level: 3

Credit value: 1

Unit aim

Use a CNC Co-ordinate measuring machine to probe machined part for XYZ co-ordinates and compare with imported CAD data.

Learning outcomes

There is **two** learning outcome to this unit. The learner will be able to:

1. Import CAD model and generate inspection program.
2. Set up machine and run inspection program

Guided learning hours

It is recommended that **10** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

This unit is linked to the Engineering Technical Support Level 3, Producing Operating Programmes for Co-ordinate Measuring Machines (CMM).

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by SEMTA.

Key Skills

This unit may help candidates to gain confidence in, and possibly generate portfolio evidence for, the following Key Skills:

- Communication
- Information and Communication Technology
- Improving Own Learning and Performance
- Problem Solving

Assessment and grading

This unit will be assessed by:

- One assignment covering practical skills.
- One centre set knowledge test.
- All pass/fail

Unit 308

(3D) CNC Co-ordinate Measuring Machine Inspection

Outcome 1

Import CAD model and generate inspection program

Assessment Criteria

Practical Skills

The learner can:

1. import CAD model data
2. identify features to measure
3. select probe type
4. generate inspection program on computer
5. save results table

Underpinning Knowledge

The learner can:

6. describe types of data transfer files
 - i) .dxf
 - ii) .iges
 - iii) .step
 - iv) .dmis
 - v) .vda fs
7. analyse model features
 - i) face
 - ii) pocket
 - iii) boss
 - iv) cyclinder
 - v) pocket
8. identify types of probes
 - i) touch
 - ii) photo (still)
 - iii) video
 - iv) laser
 - v) lcd
9. itemise essential components in inspection components
 - i) axis alignment
 - ii) datum position
 - iii) probing axis(s)
 - iv) touching frequency
 - v) stepover
 - vi) rapid override zones
10. explain data on results table
 - i) xyz points
 - ii) comparison with component result table

Unit 308

(3D) CNC Co-ordinate Measuring Machine Inspection

Outcome 2

Set up machine and run inspection program

Assessment Criteria

Practical Skills

The learner can:

1. identify suitable machine
2. identify and mount suitable probe
3. calibrate probe
4. position and secure component in chosen axis
5. activate control software
6. generate results table

Underpinning Knowledge

The learner can:

7. describe machine types and configurations
 - i) manual
 - ii) CNC
 - iii) articulated
 - iv) gantry
8. compare probe mounting and orientation
 - i) single point
 - ii) multi axis (rotate)
 - iii) combination probe
9. describe probe calibration procedures
 - i) test sphere
 - ii) number of touches
 - iii) direction of probe
10. describe working axis
 - i) linear (xyz)
 - ii) efficiency of direction
11. analyse types of software
 - i) digital readout
 - ii) computer data storage
 - iii) CNC control
12. itemise components on result table
 - i) probe points listed xyz
 - ii) comparison with model
 - iii) differences highlighted

Unit 309

(3D) Rapid Prototyping

Level: 3

Credit value: 1

Unit aim

Use a rapid prototype machine to produce a part from an imported 3D CAD model.

Learning outcomes

There is **two** learning outcome to this unit. The learner will be able to:

1. Prepare and set up machine.
2. Build and post process model.

Guided learning hours

It is recommended that **10** hours should be allocated for this unit. This may be on a full-time or part-time basis.

Details of the relationship between the unit and relevant national occupational standards

This unit is linked to the Engineering Woodworking, Pattern and Model Making Level 3 Unit 27, Producing Components by Rapid Prototyping Techniques.

Endorsement of the unit by a sector or other appropriate body

This unit is endorsed by SEMTA.

Key Skills

This unit may help candidates to gain confidence in, and possibly generate portfolio evidence for, the following Key Skills:

- Communication
- Information and Communication Technology
- Improving Own Learning and Performance
- Problem Solving

Assessment and grading

This unit will be assessed by:

- One assignment covering practical skills.
- One centre set knowledge test.
- All pass/fail

Unit 309

Outcome 1

(3D) Rapid Prototyping

Prepare and set up machine.

Assessment Criteria

Practical Skills

The learner can:

1. produce stereolithography file (.stl) (CAD software)
2. import .stl file to rapid prototype (computer)
3. choose correct orientation for model(s)
4. layout model(s) in working envelope (computer)
5. load machine with build materials
6. prepare bed for build
7. start machine using correct procedures

Underpinning Knowledge

The learner can:

8. demonstrate an understanding of .stl files
 - vi) planer triangles
 - vii) number of triangles (resolution of finished model)
 - viii) cross section Z axis slices
 - ix) thickness of slices
9. explain methods of file transfer
 - ix) CD
 - x) DNC
 - xi) USB
 - xii) internet
10. compare orientations for model geometry
 - vi) height of models
 - vii) efficiency of build
11. justify model layout for maximum efficiency
 - vi) area of work table
 - vii) volume of workplace
 - viii) maximum number of models
12. describe materials commonly used on rapid prototype machines
 - i) metal compounds
 - ii) photo polymer resin
 - iii) paper laminate
 - iv) wax
 - v) ceramics
 - vi) plastics
13. explain the importance of bed preparation
 - i) bottom edge formation
 - ii) minimum amount of dress
 - iii) removal from work table
14. recognise Health and Safety requirements for process
 - i) hazards from resins
 - ii) hazards from powders
 - iii) hazards from adhesives
 - iv) dangers from compressed air
 - v) misuse of lasers

Unit 309

(3D) Rapid Prototyping

Outcome 2

Build and post process model.

Assessment Criteria

Practical Skills

The learner can:

1. identify machine type used
2. run machine to produce cross section layers
3. remove part from machine and clean
4. cure/harden/seal part
5. remove any sacrificial supports
6. inspect part

Underpinning Knowledge

The learner can:

7. evaluate different techniques and equipment in common use
 - i) stereolithography
 - ii) laminate object
 - iii) fused deposition
 - iv) 3D inkjet printing
 - v) selective laser melting
 - vi) multijet (thermojet)
 - vii) direct metal laser sintering
8. explain basic prototyping processes
 - i) CAD model
 - ii) .stl format
 - iii) slice .stl file into cross sectional layers
 - iv) build model layer on layer
9. recognise uses and limitations of the processes above
 - i) visual aid
 - ii) casting shell
 - iii) investment casting
 - iv) injection moulding
10. describe reason for using sacrificial supports
 - i) support during build
 - ii) support during cleaning
 - iii) fragile sections
11. identify curing materials/processes
 - i) resins
 - ii) glues
 - iii) paints
 - iv) heat
12. justify success of produced part
 - i) visual confirmation
 - ii) ergonomic conformation
 - iii) identify manufacturing constraints
 - iv) cost compared to traditional machining
 - v) customer specifications

6 Assessment

6.1 Assignments

Full assignment details can be found in the Practical Assessment Handbooks which are located on the 7579 webpage. These are listed as:

- 7579-03 Level 3 2D CAD Practical Assessment Handbook
- 7579-03 Level 3 2D CAD Practical Assessment Handbook
- 7579-03 Level 3 CAM (2D) Practical Assessment Handbook
- 7579-03 Level 3 CAM (3D) Practical Assessment Handbook

6.2 Test specifications

The test specifications for the 2D and 3D CAD GOLA units are listed below:

7579-03-310 2D CAD GOLA Test

Duration: 45 minutes

Unit number	Outcome	No. of questions	%
301	1 - use a layering system and different line type styles	3	10
301	2 - define and use a system for grouping objects to form blocks or libraries	3	10
301	3 - produce isometric drawings within the 2D environment	3	10
301	4 - define and use an adjustable co-ordinate system based on user requirements	3	10
301	5 - use complex dimensioning routines	1	3.3
301	6 - use different drawing spaces and complex multi viewing areas	2	6.7
301	7 - produce hard copies of drawings	3	10
301	8 - make inquiries of an existing drawing and place reference points	2	6.7
301	9 - use a means of pre-command object selection in order to carry out editing processes	1	3.3
301	10 - change the properties of a number of drawn entities	3	10
301	11 - edit blocks/symbols and hatched areas	3	10
301	12 - modify continuous lines formed by a connected sequence of lines or arcs	1	3.3
301	13 - use a method to remove unused items and rename other items logically	2	6.7
Total		30	100

Grading will be Fail, Pass, Credit or Distinction.

7579-03-311 3D CAD GOLA Test**Duration:** 45 minutes

Unit number	Outcome	No. of questions	%
302	1 - Apply appropriate commands to set the 3D modelling environment	2	6.7
302	2 - Create and use working planes at any required position/attitude within 3D Space	2	6.7
302	3 - Define and use co-ordinate points at any position within 3D Space	2	6.7
302	4 - Apply appropriate commands to construct the whole or part of a 3D model using the best available method - surface or solid modelling	5	16.7
302	5 - Apply appropriate commands to modify 3D solid objects	5	16.7
302	6 - Apply appropriate commands to perform 3D operations on existing objects	4	13.3
302	7 - Apply appropriate commands to manipulate a 3D model	4	13.3
302	8 - Apply appropriate commands to view 3D model in a variety of display formats	2	6.7
302	9 - Print/plot/export 3D models	4	13.2
Total		30	100

Grading will be Fail, Pass, Credit or Distinction.

Appendix 1 Relationships to other qualifications

Links to other qualifications and frameworks

City & Guilds has identified the connections to previous qualifications. This mapping is provided as guidance and suggests areas of overlap and commonality between the qualifications. It does not imply that candidates completing units in one qualification are automatically covering all of the content of the qualifications listed in the mapping.

Centres are responsible for checking the different requirements of all qualifications they are delivering and ensuring that candidates meet requirements of all units/qualifications. For example, units within a QCF qualification may be similar in content to units in the NQF qualification which the candidate may have already undertaken and this may present opportunities for APL.

These qualifications have connections to the:

NQF units		QCF units	
Unit Number/Title		Unit Number/Title	
Y/102/4704	Level 3 Certificate in CAD (2D Computer Aided Design)	L/600/3271	2D Computer Aided Design
D/102/4705	Level 3 Certificate in CAD (3D Computer Aided Design)	D/600/3274	3D Computer Aided Design

Key/Essential Skills (England, Wales and Northern Ireland)

Key Skills signposting

These qualifications include opportunities to develop and practise many of the underlying skills and techniques described in Part A of the standard for each Key Skills qualification. Where candidates are working towards any Key Skills alongside these qualifications they will need to be registered with City & Guilds for the Key Skills qualifications.

It should not be assumed that candidates will necessarily be competent in, or able to produce evidence for, Key Skills at the same level as these qualifications.

The 'signposts' below identify the **potential** for Key Skills portfolio evidence gathering that can be naturally incorporated into the completion of each unit. Any Key Skills evidence will need to be separately assessed and must meet the relevant standard defined in the QCA document '*Key skills qualifications standards and guidance*' (available from www.cityandguilds.com/keyskills).

Unit number	Communication	Application of Number	Information and Communication Technology
101	C2.2, C2.3		IT2.1
102	C2.2, C2.3		IT2.1
103	C2.2, C2.3		IT2.1

Unit number	Problem Solving	Improving Own Learning and Performance	Working With Others
101	PS2.1, PS2.2, PS2.3	LP2.1, LP2.2, LP2.3	
102	PS2.1, PS2.2, PS2.3	LP2.1, LP2.2, LP2.3	
103	PS2.1, PS2.2, PS2.3	LP2.1, LP2.2, LP2.3	

Appendix 2 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.

Centre Guide – Delivering International Qualifications contains detailed information about the processes which must be followed and requirements which must be met for a centre to achieve ‘approved centre’ status, or to offer a particular qualification. Specifically, the document includes sections on:

- The centre and qualification approval process and forms
- Assessment, verification and examination roles at the centre
- Registration and certification of candidates
- Non-compliance
- Complaints and appeals
- Equal opportunities
- Data protection
- Frequently asked questions.

Providing City & Guilds qualifications – a guide to centre and qualification approval contains detailed information about the processes which must be followed and requirements which must be met for a centre to achieve ‘approved centre’ status, or to offer a particular qualification. Specifically, the document includes sections on:

- The centre and qualification approval process and forms
- Assessment, verification and examination roles at the centre
- Registration and certification of candidates
- Non-compliance
- Complaints and appeals
- Equal opportunities
- Data protection
- Frequently asked questions.

Ensuring quality contains updates and good practice exemplars for City & Guilds assessment and policy issues. Specifically, the document contains information on:

- Management systems
- Maintaining records
- Assessment
- Internal verification and quality assurance
- External verification.

Access to Assessment & Qualifications provides full details of the arrangements that may be made to facilitate access to assessments and qualifications for candidates who are eligible for adjustments in assessment.

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

- ***Walled Garden***

Find out how to register and certificate candidates on line

- **Qualifications and Credit Framework (QCF)**

Contains general guidance about the QCF and how qualifications will change, as well as information on the IT systems needed and FAQs

- **Events**

Contains dates and information on the latest Centre events

- **Online assessment**

Contains information on how to register for GOLLA assessments.

City & Guilds
Believe you can



www.cityandguilds.com

Useful contacts

Type	Contact	Query
UK learners	T: +44 (0)20 7294 2800 E: learnersupport@cityandguilds.com	<ul style="list-style-type: none"> • General qualification information
International learners	T: +44 (0)20 7294 2885 F: +44 (0)20 7294 2413 E: intcg@cityandguilds.com	<ul style="list-style-type: none"> • General qualification information
Centres	T: +44 (0)20 7294 2787 F: +44 (0)20 7294 2413 E: centresupport@cityandguilds.com	<ul style="list-style-type: none"> • Exam entries • Registrations/enrolment • Certificates • Invoices • Missing or late exam materials • Nominal roll reports • Results
Single subject qualifications	T: +44 (0)20 7294 8080 F: +44 (0)20 7294 2413 F: +44 (0)20 7294 2404 (BB forms) E: singlesubjects@cityandguilds.com	<ul style="list-style-type: none"> • Exam entries • Results • Certification • Missing or late exam materials • Incorrect exam papers • Forms request (BB, results entry) • Exam date and time change
International awards	T: +44 (0)20 7294 2885 F: +44 (0)20 7294 2413 E: intops@cityandguilds.com	<ul style="list-style-type: none"> • Results • Entries • Enrolments • Invoices • Missing or late exam materials • Nominal roll reports
Walled Garden	T: +44 (0)20 7294 2840 F: +44 (0)20 7294 2405 E: walledgarden@cityandguilds.com	<ul style="list-style-type: none"> • Re-issue of password or username • Technical problems • Entries • Results • GOLA • Navigation • User/menu option problems
Employer	T: +44 (0)121 503 8993 E: business_unit@cityandguilds.com	<ul style="list-style-type: none"> • Employer solutions • Mapping • Accreditation • Development Skills • Consultancy
Publications	T: +44 (0)20 7294 2850 F: +44 (0)20 7294 3387	<ul style="list-style-type: none"> • Logbooks • Centre documents • Forms • Free literature

If you have a complaint, or any suggestions for improvement about any of the services that City & Guilds provides, email: **feedbackandcomplaints@cityandguilds.com**

Published by City & Guilds
1 Giltspur Street
London
EC1A 9DD
T +44 (0)20 7294 2800
F +44 (0)20 7294 2400
www.cityandguilds.com

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