QUALIFICATION HANDBOOK

Level 3 NVQ Diploma in Engineering Technical Support (Engineering Drawing) (1786-30)

September 2011 Version 1.0

City & Guilds

Qualification at a glance

Subject area	Engineering Technical Support
City & Guilds number	1786
Age group approved	16+
Entry requirements	None
Assessment	Portfolio of evidence
Automatic approval	Available
Support materials	Centre handbook
Registration and certification	Consult the Walled Garden/Online Catalogue for last dates

Title and level	City & Guilds number	Accreditation number
Level 3 NVQ Diploma in Engineering Technical Support (Engineering Drawing)	1786-30	600/2085/4

Contents

1 Introduction

This document tells you what you need to do to deliver the qualification:

Area	Description
Who is the qualification for?	It is for candidates who work or want to work in engineering technical support - engineering drawing in the engineering sector
What does the qualification cover?	It allows candidates to learn, develop and practise the skills required for employment and/or career progression in the engineering technical support sector.
Is the qualification part of a framework or initiative?	It serves as a competence qualification, in the Engineering Apprenticeship framework.
What opportunities for progression are there?	It allows candidates to progress into employment or to the following City & Guilds qualifications: • Level 3 NVQ Extended Diploma in Engineering Technical Support

Structure

To achieve the **Level 3 NVQ Diploma in Engineering Technical Support (Engineering Drawing)**, learners must achieve **15** credits from the mandatory units and a minimum of **150** credits from the optional units available.

Unit accreditation number	City & Guilds unit number	Unit title	Credit value
Mandatory			
A/601/5013	201	Complying with statutory regulations and organisational safety requirements	5
Y/601/5102	202	Using and interpreting engineering data and documentation	5
K/601/5055	303	Working efficiently and effectively in engineering	5
Optional			
H/600/5415	304	Producing mechanical engineering drawings using computer aided techniques	150
H/600/5429	305	Producing engineering drawings/models using 3D	150

		computer aided techniques	
H/600/5463	306	Producing electrical engineering drawings using computer aided techniques	150
F/600/5471	307	Producing electronic engineering drawings using computer aided techniques	150
M/600/5482	308	Producing fabrication/structural engineering drawings using computer aided techniques	150
Y/600/5489	309	Producing fluid power engineering drawings using computer aided techniques	150
M/600/5496	310	Producing engineering systems/services drawings using computer aided techniques	150

2 Centre requirements

Approval

Centres currently offering the City & Guilds Level 3 NVQ in Engineering Technical Support (1686) will be automatically approved to run this new qualification.

To offer this qualification new centres will need to gain both centre and qualification approval. Please refer to the ***Centre Manual - Supporting Customer Excellence*** for further information.

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

Resource requirements

Centre staffing

Staff delivering this qualification must be able to demonstrate that they meet the following occupational expertise requirements. They should:

- be occupationally competent or technically knowledgeable in the areas for which they are delivering training and/or have experience of providing training; this knowledge must be to the same level as the training being delivered
- have recent relevant experience in the specific area they will be assessing
- have credible experience of providing training.

Centre staff may undertake more than one role, e.g. tutor and assessor or internal verifier, but cannot internally verify their own assessments.

Assessors and internal verifier

Assessor Requirements to Demonstrate Effective Assessment Practice

Assessment must be carried out by competent assessors that as a minimum must hold the QCF Level 3 Award in Assessing Competence in the Work Environment**.** Current and operational assessors that hold units D32 and/or D33 or A1 and/or A2 as appropriate for the assessment requirements set out in this Unit Assessment Strategy. However, they will be expected to regularly review their skills, knowledge and understanding and where applicable undertake continuing professional development to ensure that they are carrying out workplace assessment to the most up to date National Occupational Standards (NOS).

Assessor Technical Requirements

Assessors must be able to demonstrate that they have verifiable, relevant and sufficient technical competence to evaluate and judge performance

and knowledge evidence requirements as set out in the relevant QCF unit learning outcomes and associated assessment criteria.

This will be demonstrated either by holding a relevant technical qualification or by proven industrial experience of the technical areas to be assessed. The assessor's competence must, at the very least, be at the same level as that required of the learner(s) in the units being assessed.

Assessors must also be fully conversant with the awarding organisation's assessment recording documentation used for the QCF NVQ units against which the assessments and verification are to be carried out, other relevant documentation and system and procedures to support the QA process.

Verifier Requirements (internal and external)

Internal quality assurance (**Internal Verification**) must be carried out by competent Verifiers that as a minimum must hold the QCF Level 4 Award in the Internal Quality Assurance of Assessment Processes and Practices. Current and operational Internal Verifiers that hold internal verification units V1 or D34 will not be required to achieve the QCF Level 4 Award as they are still appropriate for the verification requirements set out in this Unit Assessment Strategy. Verifiers must be familiar with, and preferably hold, either the nationally recognised assessor units D32 and/or D33 or A1 and/or A2 or the QCF Level 3 Award in Assessing Competence in the Work Environment.

External quality assurance **(External Verification)** must be carried out by competent External Verifiers that as a minimum must hold the QCF Level 4 Award in the External Quality Assurance of Assessment Processes and Practices**.** Current and operational External Verifiers that hold external verification units V2 or D35 will not be required to achieve the QCF Level 4 Award as they are still appropriate for the verification requirements set out in this Unit Assessment Strategy. Verifiers must be familiar with, and preferably hold, either the nationally recognised Assessor units D32 and/or D33 or A1 and/or A2 or the QCF Level 3 Award in Assessing Competence in the Work Environment.

External and Internal Verifiers will be expected to regularly review their skills, knowledge and understanding and where applicable undertake continuing professional development to ensure that they are carrying out workplace Quality Assurance (verification) of Assessment Processes and Practices to the most up to date National Occupational Standards (NOS) Verifiers, both Internal and External, will also be expected to be fully conversant with the terminology used in the QCF NVQ units against which the assessments and verification are to be carried out, the appropriate Regulatory Body's systems and procedures and the relevant Awarding Organisation's documentation.

Continuing Professional Development (CPD)

Centres must support their staff to ensure that they have current knowledge of the occupational area, that delivery, mentoring, training, assessment and verification is in line with best practice, and that it takes account of any national or legislative developments.

Candidate entry requirements

City & Guilds does not set entry requirements for this qualification. However, centres must ensure that candidates have the potential and opportunity to gain the qualification successfully so should have the opportunity to gather work based evidence.

The SEMTA Engineering Manufacture apprenticeship framework suggests that employers would be interested in candidates that:

- Are keen and motivated to work in an engineering environment
- Are willing to undertake a course of training both on-the-job and off-the-job and apply this learning in the workplace
- Have previous work experience or employment in the sector
- Have completed a 14 to 19 Diploma in Engineering or Manufacturing
- Have completed a Young Apprenticeship in Engineering or other related area
- Have GCSEs in English, Maths and Science
- Have completed tests in basic numeracy, literacy and communication skills and have spatial awareness.

As a guide, the Engineering Manufacturing framework is suitable for applicants who have five GCSEs grades D to E in English, Maths and Science. The selection process on behalf of employers may include initial assessment where applicants will be asked if they have any qualifications or experience that can be accredited against the requirements of the apprenticeship. They may also be required to take tests in basic numeracy and literacy, communications skills and spatial awareness. There may also be an interview to ensure applicants have selected the right occupational sector and are motivated to become an apprentice, as undertaking an apprenticeship is a major commitment for both the individual and the employer.

Assessment Environment (extract from SEMTA QCF Unit Assessment Strategy 1 January 2011)

The evidence put forward for this qualification can only be regarded valid, reliable, sufficient and authentic if achieved and obtained in the working environment and be clearly attributable to the learner. However, in certain circumstances, simulation/replication of work activities may be acceptable. The use of high quality, realistic simulations/replication, which impose pressures which are consistent with workplace expectations, should only be used in relation to the assessment of the following:

- rare or dangerous occurrences, such as those associated with health, safety and the environment issues, emergency scenarios and rare operations at work;
- the response to faults and problems for which no opportunity has presented for the use of naturally occurring workplace evidence of learners competence;
- aspects of working relationships and communications for which no opportunity has presented for the use of naturally occurring workplace evidence of learners competence.

Simulations/replications will require prior approval from centres' City & Guilds external verifier/qualification consultant and should be designed in relation to the following parameters: -

- the environment in which simulations take place must be designed to match the characteristics of the working environment
- competencies achieved via simulation/replication must be transferable to the working environment
- simulations which are designed to assess competence in dealing with emergencies, accidents and incidents must be verified as complying with relevant health, safety and environmental legislation by a competent health and safety/environmental control officer before being used
- simulated activities should place learners under the same pressures of time, access to resources and access to information as would be expected if the activity was real
- simulated activities should require learners to demonstrate their competence using plant and/or equipment used in the working environment
- simulated activities which require interaction with colleagues and contacts should require the learner to use the communication media that would be expected at the workplace
- for health and safety reason simulations need not involve the use of genuine substances/materials. Any simulations which require the learner to handle or otherwise deal with materials substances/should ensure that the substitute takes the same form as in the workplace.

Age restrictions

City & Guilds cannot accept any registrations for candidates under 16 as this qualification is not approved for under 16s.

Legal restrictions apply to candidates under the age of 18 working unsupervised with children. Centres and candidates should be fully aware of minimum age requirements in their home nation and any implications for completing assessments.

3 Delivering the qualification

Initial assessment and induction

An initial assessment of each candidate should be made before the start of their programme to identify:

- if the candidate has any specific training needs
- support and guidance they may need when working towards their qualification
- any units they have already completed, or credit they have accumulated which is relevant to the qualification
- the appropriate type and level of qualification.

We recommend that centres provide an induction programme so the candidate fully understands the requirements of the qualification, their responsibilities as a candidate, and the responsibilities of the centre. This information can be recorded on a learning contract.

Recommended delivery strategies

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

Centres may design course programmes of study in any way which:

- best meets the needs and capabilities of their candidates
- satisfies the requirements of the qualifications.

When designing and delivering the course programme, centres might wish to incorporate other teaching and learning that is not assessed as part of the qualifications. This might include the following:

- literacy, language and/or numeracy
- personal learning and thinking
- personal and social development
- employability.

Where applicable, this could involve enabling the candidate to access relevant qualifications covering these skills.

Recording documents

Candidates and centres may decide to use a paper-based or electronic method of recording evidence.

City & Guilds endorses several ePortfolio systems. Further details are available at: **www.cityandguilds.com/eportfolios**.

City & Guilds has developed a set of *Recording forms* including examples of completed forms, for new and existing centres to use as appropriate.

Recording forms are available on the City & Guilds website.

Although new centres are expected to use these forms, centres may devise or customise alternative forms, which must be approved for use by the external verifier, before they are used by candidates and assessors at the centre.

Amendable (MS Word) versions of the forms are available on the City & Guilds website.

4 Assessment

Assessment of the qualification

Candidates must have a completed portfolio of evidence for each unit chosen.

Evidence requirements

Carrying Out Assessments
The NVQ units were specifically developed to cover a wide range of activities. The evidence produced for the units will, therefore, depend on the learners choice of "bulleted items" listed in the unit assessment criteria. Where the assessment criteria gives a choice of bulleted items (for example 'any three from five'), assessors should note that learners do not need to provide evidence of the other items to complete the unit (in this example, two) items, particularly where these additional items may relate to other activities or methods that are not part of the learners normal workplace activity or area of expertise.

Minimum Performance Evidence Requirements
Performance evidence must be the main form of evidence gathered. In order to demonstrate consistent, competent performance for a unit, a minimum of three different examples of performance must be provided, and must be sufficient to show that the assessment criteria have been achieved to the prescribed standards. It is possible that some of the bulleted items in the assessment criteria may be covered more than once. The assessor and learner need to devise an assessment plan to ensure that performance evidence is sufficient to cover all the specified assessment criteria and which maximises the opportunities to gather evidence. Where applicable, performance evidence may be used for more than one unit.

The most effective way of assessing competence, is through direct observation of the learner. Assessors must make sure that the evidence provided reflects the learner's competence and not just the achievement of a training programme.

Evidence that has been produced from team activities, for example, maintenance or installation activities is only valid when it clearly relates to the learners specific and individual contribution to the activity, and not to the general outcome(s).

Each example of performance evidence will often contain features that apply to more than one unit, and can be used as evidence in any unit where appropriate.

Performance evidence must be a combination of:

- outputs of the learner's work, such as items that have been manufactured, installed, maintained, designed, planned or quality assured, and documents produced as part of a work activity

- evidence of the way the learner carried out the activities such as witness testimonies, assessor observations or authenticated learner reports, records or photographs of the work/activity carried out, etc.

Competent performance is more than just carrying out a series of individual set tasks. Many of the units contain statements that require the learner to provide evidence that proves they are capable of combining the various features and techniques. Where this is the case, separate fragments of evidence would not provide this combination of features and techniques and will not, therefore, be acceptable as demonstrating competent performance.

If there is any doubt as to what constitutes valid, authentic and reliable evidence, the internal and/or external verifier (qualifications consultant) should be consulted.

Assessing knowledge and understanding
Knowledge and understanding are key components of competent performance, but it is unlikely that performance evidence alone will provide enough evidence in this area. Where the learner's knowledge and understanding (and the handling of contingency situations) is not apparent from performance evidence, it must be assessed by other means and be supported by suitable evidence.

Knowledge and understanding can be demonstrated in a number of different ways. Semta (the Sector Skills Council) expects oral questioning and practical demonstrations to be used, as these are considered the most appropriate for these units. Assessors should ask enough questions to make sure that the learner has an appropriate level of knowledge and understanding, as required by the unit.

Evidence of knowledge and understanding will **not** be required for those bulleted items in the assessment criteria that have not been selected by the learner.

The achievement of the specific knowledge and understanding requirements of the units cannot simply be inferred by the results of tests or assignments from other units, qualifications or training programmes. Where evidence is submitted from these sources, the assessor must, as with any assessment, make sure the evidence is valid, reliable, authentic, directly attributable to the learner, and meets the full knowledge and understanding requirements of the unit. Where oral questioning is used the assessor must retain a record of the questions asked, together with the learner's answers.

Witness testimony
Where observation is used to obtain performance evidence, this must be carried out against the unit assessment criteria. Best practice would require that such observation is carried out by a qualified assessor. If this is not practicable, then alternative sources of evidence may be used.

For example, the observation may be carried out against the assessment criteria by someone else that is in close contact with the learner. This could be a team leader, supervisor, mentor or line manager who may be regarded as a suitable witness to the learner's competency. However, the witness must be technically competent in the process or skills that they are providing testimony for, to at least the same level of expertise as that

required of the learner. It will be the responsibility of the assessor to make sure that any witness testimonies accepted as evidence of the learner's competency are reliable, auditable and technically valid.

Recognition of Prior Learning (RPL)

Recognition of prior learning means using a person's previous experience or qualifications which have already been achieved to contribute to a new qualification. RPL is allowed and is also sector specific.

5 Units

Availability of units

The following units can also be obtained from The Register of Regulated Qualifications: **http://registerofqual.gov.uk/Unit**

Structure of units

These units each have the following:

- City & Guilds unit number
- Title
- Unit Accreditation Number (UAN)
- Level
- Credit value
- Recommended Guided Learning Hours (GLH)
- Relationship to National Occupational Standards (NOS), other qualifications and frameworks
- Endorsement by a sector or other appropriate body
- Unit aim(s)
- Learning outcomes which are comprised of a number of assessment criteria.

Unit 201 Complying with statutory regulations and organisational safety requirements

UAN:	A/601/5013
Level:	2
Credit value:	5
GLH:	35
Relationship to NOS:	This unit has been derived from national occupational standard: Complying with statutory regulations and organisational safety requirements (Suite 2).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	This unit covers the skills and knowledge needed to prove the competences required to deal with statutory regulations and organisational safety requirements. It does not deal with specific safety regulations or detailed requirements, it does, however, cover the more general health and safety requirements that apply to working in an industrial environment. The learner will be expected to comply with all relevant regulations that apply to their area of work, as well as their general responsibilities as defined in the Health and Safety at Work Act. The learner will need to be able to identify the relevant qualified first aiders and know the location of the first aid facilities. The learner will have a knowledge and understanding of the procedures to be adopted in the case of accidents involving injury and in situations where there are dangerous occurrences or hazardous malfunctions of equipment, processes or machinery. The learner will also need to be fully conversant with their organisation's procedures for fire alerts and the evacuation of premises. The learner will also be required to identify the hazards and risks that are associated with their job. Typically, these will focus on their working environment, the tools and

equipment that they use, the materials and substances that they use, any working practices that do not follow laid-down procedures, and manual lifting and carrying techniques.

The learner's responsibilities will require them to comply with all relevant statutory and organisational policy and procedures for health and safety in the workplace. The learner must act in a responsible and safe manner at all times, and present themselves in the workplace suitably prepared for the activities to be undertaken. The learner will be expected to report any problems with health and safety issues, to the relevant authority.

The learner's knowledge will provide a good understanding of the relevant statutory regulations and organisational requirements associated with their work, and will provide an informed approach to the procedures used. The learner will need to understand their organisation's health and safety requirements and their application, in adequate depth to provide a sound basis for carrying out their activities in a safe and competent manner.

Learning outcome
The learner will: 1. comply with statutory regulations and organisational safety requirements
Assessment criteria
The learner can: 1.1 comply with their duties and obligations as defined in the Health and Safety at Work Act 1.2 demonstrate their understanding of their duties and obligations to health and safety by: • applying in principle their duties and responsibilities as an individual under the Health and Safety at Work Act • identifying, within their organisation, appropriate sources of information and guidance on health and safety issues, such as: • eye protection and Personal Protective Equipment (PPE) • COSHH regulations • risk assessments • identifying the warning signs and labels of the main groups of hazardous or dangerous substances • complying with the appropriate statutory regulations at all times 1.3 present themselves in the workplace suitably prepared for the activities to be undertaken

1.4 follow organisational accident and emergency procedures

1.5 comply with emergency requirements, to include:

- identifying the appropriate qualified first aiders and the location of first aid facilities
- identifying the procedures to be followed in the event of injury to themselves or others
- following organisational procedures in the event of fire and the evacuation of premises
- identifying the procedures to be followed in the event of dangerous occurrences or hazardous malfunctions of equipment

1.6 recognise and control hazards in the workplace

1.7 identify the hazards and risks that are associated with the following:

- their working environment
- the equipment that they use
- materials and substances (where appropriate) that they use
- working practices that do not follow laid-down procedures

1.8 use correct manual lifting and carrying techniques

1.9 demonstrate one of the following methods of manual lifting and carrying:

- lifting alone
- with assistance of others
- with mechanical assistance

1.10 apply safe working practices and procedures to include:

- maintaining a tidy workplace, with exits and gangways free from obstruction
- using equipment safely and only for the purpose intended
- observing organisational safety rules, signs and hazard warnings
- taking measures to protect others from any harm resulting from the work that they are carrying out.

Learning outcome
The learner will: 2. know how to comply with statutory regulations and organisational safety requirements
Assessment criteria
The learner can: 2.1 describe the roles and responsibilities of themselves and others under the Health and Safety at Work Act, and other current legislation (such as The management of health and safety at work regulations, workplace health and safety and Welfare regulations, Personal Protective equipment at work regulations, Manual Handling Operations regulations, Provision and use of work equipment regulations, Display Screen at work regulations, reporting of Injuries, Diseases and Dangerous Occurrences regulations) 2.2 describe the specific regulations and safe working practices and procedures that apply to their work activities 2.3 describe the warning signs for the seven main groups of hazardous

substances defined by Classification, Packaging and Labelling of Dangerous Substances regulations

2.4 explain how to locate relevant health and safety information for their tasks, and the sources of expert assistance when help is needed

2.5 explain what constitutes a hazard in the workplace (such as moving parts of machinery, electricity, slippery and uneven surfaces, poorly placed equipment, dust and fumes, handling and transporting, contaminants and irritants, material ejection, fire, working at height, environment, pressure/stored energy systems, volatile, flammable or toxic materials, unshielded processes, working in confined spaces)

2.6 describe their responsibilities for identifying and dealing with hazards and reducing risks in the workplace

2.7 describe the risks associated with their working environment (such as the tools, materials and equipment that they use, spillages of oil, chemicals and other substances, not reporting accidental breakages of tools or equipment and not following laid-down working practices and procedures)

2.8 describe the processes and procedures that are used to identify and rate the level of risk (such as safety inspections, the use of hazard checklists, carrying out risk assessments, COSHH assessments)

2.9 describe the first aid facilities that exist within their work area and within the organisation in general; the procedures to be followed in the case of accidents involving injury

2.10 explain what constitute dangerous occurrences and hazardous malfunctions, and why these must be reported even if no-one is injured

2.11 describe the procedures for sounding the emergency alarms, evacuation procedures and escape routes to be used, and the need to report their presence at the appropriate assembly point

2.12 describe the organisational policy with regard to fire fighting procedures; the common causes of fire and what they can do to help prevent them

2.13 describe the protective clothing and equipment that is available for their areas of activity

2.14 explain how to safely lift and carry loads, and the manual and mechanical aids available

2.15 explain how to prepare and maintain safe working areas; the standards and procedures to ensure good housekeeping

2.16 describe the importance of safe storage of tools, equipment, materials and products

2.17 describe the extent of their own authority, and to whom they should report in the event of problems that they cannot resolve.

Unit 202 Using and interpreting engineering data and documentation

UAN:	Y/601/5102
Level:	2
Credit value:	5
GLH:	25
Relationship to NOS:	This unit has been derived from national occupational standard: Using and interpreting engineering data and documentation (Suite 2).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	This unit covers the skills and knowledge needed to prove the competences required to make effective use of text, numeric and graphical information, by interpreting and using technical information extracted from documents such as engineering drawings, technical manuals, reference tables, specifications, technical sales/marketing documentation, charts or electronic displays, in accordance with approved procedures. The learner will be required to extract the necessary information from the various documents, in order to establish and carry out the work requirements, and to make valid decisions about the work activities based on the information extracted. The learner's responsibilities will require them to comply with organisational policy and procedures for obtaining and using the documentation applicable to the activity. They will be expected to report any problems with the use and interpretation of the documents that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to work to instructions if necessary, with an appropriate level of supervision or as a member of a team, and take personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's underpinning knowledge will provide a good understanding of the types of documentation used, and will provide an informed approach to applying instructions and procedures. They will be able to read and interpret the documentation used and will know about the conventions, symbols and abbreviations, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

Learning outcome
The learner will: 1. use and interpret engineering data and documentation
Assessment criteria
The learner can: 1.1 use the approved source to obtain the required data and documentation 1.2 use the data and documentation and carry out all of the following: • check the currency and validity of the data and documentation used • exercise care and control over the documents at all times • correctly extract all necessary data in order to carry out the required tasks • seek out additional information where there are gaps or deficiencies in the information obtained • deal with or report any problems found with the data and documentation • make valid decisions based on the evaluation of the engineering information extracted from the documents • return all documents to the approved location on completion of the work • complete all necessary work related documentation such as production documentation, installation documentation, maintenance documentation, planning documentation 1.3 correctly identify, interpret and extract the required information 1.4 extract information that includes three of the following: • materials or components required • dimensions • tolerances • build quality • installation requirements • customer requirements • time scales • financial information • operating parameters • surface texture requirements • location/orientation of parts

- process or treatments required
- dismantling/assembly sequence
- inspection/testing requirements
- number/volumes required
- repair/service methods
- method of manufacture
- weld type and size
- operations required
- connections to be made
- surface finish required
- shape or profiles
- fault finding procedures
- safety/risk factors
- environmental controls
- specific data (such as component data, maintenance data, electrical data, fluid data)
- resources (such as tools, equipment, personnel)
- utility supply details (such as electricity, water, gas, air)
- location of services, including standby and emergency backup systems
- circuit characteristics (such as pressure, flow, current, voltage, speed)
- protective arrangements and equipment (such as containment, environmental controls, warning and evacuation systems and equipment)
- other specific related information

1.5 use the information obtained to ensure that work output meets the specification

1.6 use information extracted from documents to include one from the following:

- drawings (such as component drawings, assembly drawings, modification drawings, repair drawings, welding/fabrication drawings, distribution and installation drawings)
- diagrams (such as schematic, fluid power diagrams, piping, wiring/circuit diagrams)
- manufacturers manuals/drawings
- approved sketches
- technical illustrations
- photographic representations
- visual display screen information
- technical sales/marketing documentation
- contractual documentation
- other specific drawings/documents

1.7 use information extracted from related documentation, to include two from the following:

- instructions (such as job instructions, drawing instructions, manufacturers instructions)
- specifications (such as material, finish, process, contractual,

calibration)
- reference materials (such as manuals, tables, charts, guides, notes)
- schedules
- operation sheets
- service/test information
- planning documentation
- quality control documents
- company specific technical instructions
- national, international and organisational standards
- health and safety standards relating to the activity (such as COSHH)
- other specific related documentation

1.8 deal promptly and effectively with any problems within their control and report those which cannot be solved

1.9 report any inaccuracies or discrepancies in documentation and specifications.

Learning outcome
The learner will: 2. know how to use and interpret engineering data and documentation
Assessment criteria
The learner can: 2.1 explain what information sources are used for the data and documentation that they use in their work activities 2.2 explain how documents are obtained, and how to check that they are current and valid 2.3 explain the basic principles of confidentiality (including what information should be available and to whom) 2.4 describe the different ways/formats that data and documentation can be presented (such as such as drawings, job instructions product data sheets, manufacturers' manuals, financial spreadsheets, production schedules, inspection and calibration requirements, customer information) 2.5 explain how to use other sources of information to support the data (such as electronic component pin configuration specifications, reference charts, standards, bend allowances required for material thickness, electrical conditions required for specific welding rods, mixing ratios for bonding and finishing materials, metal specifications and inspection requirements, health and safety documentation) 2.6 describe the importance of differentiating fact from opinion when reviewing data and documentation 2.7 describe the importance of analysing all available data and documentation before decisions are made 2.8 describe the different ways of storing and organising data and documentation to ensure easy access 2.9 describe the procedures for reporting discrepancies in the data or documentation, and for reporting lost or damaged documents 2.10 describe the importance of keeping all data and documentation up to date during the work activity, and the implications of this not

	being done
2.11	explain the care and control procedures for the documents, and how damage or graffiti on documents can lead to scrapped work
2.12	explain the importance of returning documents to the designated location on completion of the work activities
2.13	explain what basic drawing conventions are used and why there needs to be different types of drawings (such as isometric and orthographic, first and third angle, assembly drawings, circuit and wiring diagrams, block and schematic diagrams
2.14	explain what types of documentation are used and how they interrelate (such as production drawings, assembly drawings, circuit and wiring diagrams, block and schematic diagrams)
2.15	explain the imperial and metric systems of measurement; tolerancing and fixed reference points
2.16	describe the meaning of the different symbols and abbreviations found on the documents that they use (such as surface finish, electronic components, weld symbols, linear and geometric tolerances, pressure and flow characteristics)
2.17	describe the extent of their own responsibility, when to act on their own initiative to find, clarify and evaluate information, and to whom they should report if they have problems that they cannot resolve.

Unit 303 Working efficiently and effectively in engineering

UAN:	K/601/5055
Level:	3
Credit value:	5
GLH:	25
Relationship to NOS:	This unit has been derived from national occupational standard: Working efficiently and effectively in engineering (Suite 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	This unit covers the skills and knowledge needed to prove the competences required to work efficiently and effectively in the workplace, in accordance with approved procedures and practices. Prior to undertaking the engineering activity, the learner will be required to carry out all necessary preparations within the scope of their responsibility. This may include preparing the work area and ensuring that it is in a safe condition to carry out the intended activities, ensuring they have the appropriate job specifications and instructions and that any tools, equipment, materials and other resources required are available and in a safe and usable condition. On completion of the engineering activity, the learner will be required to return their immediate work area to an acceptable condition before recommencing further work requirements. This may involve placing completed work in the correct location, returning and/or storing any tools and equipment in the correct area, identifying any waste and/or scrapped materials and arranging for their disposal, and reporting any defects or damage to tools and equipment used. In order to be efficient and effective in the workplace, the learner will also be required to demonstrate that they can create and maintain effective working relationships with colleagues and line management. The

learner will also be expected to review objectives and targets for their personal development and make recommendations to, and communicate any opportunities for, improvements that could be made to working practices and procedures.

The learner's responsibilities will require them to comply with organisational policy and procedures for the engineering activities undertaken, and to report any problems with the activities, or the tools and equipment that are used that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to take personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to working efficiently and effectively in an engineering environment. The learner will understand the need to work efficiently and effectively, and will know about the areas they need to consider when preparing and tidying up the work area, how to contribute to improvements, deal with problems, maintain effective working relationships and agree their development objectives and targets, in adequate depth to provide a sound basis for carrying out the activities safely and correctly.

The learner will understand the safety precautions required when carrying out engineering activities. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

Learning outcome
The learner will: 1. work efficiently and effectively in engineering
Assessment criteria
The learner can: 1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 prepare the work area to carry out the engineering activity 1.3 prepare to carry out the engineering activity, taking into consideration all of the following, as applicable to the work to be

undertaken:

- the work area is free from hazards and is suitably prepared for the activities to be undertaken
- any required safety procedures are implemented
- any necessary personal protection equipment is obtained and is in a usable condition
- tools and equipment required are obtained and checked that they are in a safe and useable condition
- all necessary drawings, specifications and associated documentation is obtained
- job instructions are obtained and understood
- the correct materials or components are obtained
- storage arrangements for work are appropriate
- appropriate authorisation to carry out the work is obtained

1.4 check that there are sufficient supplies of materials and/or consumables and that they meet work requirements

1.5 ensure that completed products or resources are stored in the appropriate location on completion of the activities

1.6 complete work activities, to include all of the following:

- completing all necessary documentation accurately and legibly
- returning tools and equipment
- returning drawings and work instructions
- identifying, where appropriate, any unusable tools, equipment or components
- arranging for disposal of waste materials

1.7 tidy up the work area on completion of the engineering activity

1.8 deal promptly and effectively with problems within their control and report those that cannot be resolved

1.9 deal with problems affecting the engineering process, to include two of the following:

- materials
- tools and equipment
- drawings
- job specification
- quality
- people
- timescales
- safety
- activities or procedures

1.10 contribute to and communicate opportunities for improvement to working practices and procedures

1.11 make recommendations for improving to two of the following:

- working practices
- working methods
- quality
- safety
- tools and equipment

- supplier relationships
- internal communication
- customer service
- training and development
- teamwork
- other

1.12 maintain effective working relationships with colleagues to include two of the following:

- colleagues within own working group
- colleagues outside normal working group
- line management
- external contacts

1.13 review personal training and development as appropriate to the job role

1.14 review personal development objectives and targets to include one of the following:

- dual or multi-skilling
- training on new equipment / technology
- increased responsibility
- understanding of company working practices, procedures, plans and policies
- other specific requirements.

Learning outcome
The learner will: 2. know how to work efficiently and effectively in engineering
Assessment criteria
The learner can: 2.1 describe the safe working practices and procedures to be followed whilst preparing and tidying up their work area 2.2 describe the correct use of any equipment used to protect the health and safety of themselves and their colleagues 2.3 describe the procedure for ensuring that all documentation relating to the work being carried out is available and current, prior to starting the activity 2.4 describe the action that should be taken if documentation received is incomplete and/or incorrect 2.5 describe the procedure for ensuring that all tools and equipment are available prior to undertaking the activity 2.6 describe the checks to be carried out to ensure that tools and equipment are in full working order, prior to undertaking the activity 2.7 describe the action that should be taken if tools and equipment are not in full working order 2.8 describe the checks to be carried out to ensure that all materials required are correct and complete, prior to undertaking the activity 2.9 describe the action that should be taken if materials do not meet the requirements of the activity 2.10 explain whom to inform when the work activity has been completed 2.11 describe the information and/or documentation required to confirm

that the activity has been completed

2.12 explain what materials, equipment and tools can be reused

2.13 explain how any waste materials and/or products are transferred, stored and disposed of

2.14 explain where tools and equipment should be stored and located

2.15 describe the importance of making recommendations for improving working practices

2.16 describe the procedure and format for making suggestions for improvements

2.17 describe the benefits to organisations if improvements can be identified

2.18 describe the importance of maintaining effective working relationships within the workplace

2.19 describe the procedures to deal with and report any problems that can affect working relationships

2.20 describe the difficulties that can occur in working relationships

2.21 describe the regulations that affect how they should be treated at work (such as Equal Opportunities Act, Race and Sex Discrimination, Working Time Directive)

2.22 describe the benefits of continuous personal development

2.23 describe the training opportunities that are available in the workplace

2.24 describe the importance of reviewing their training and development

2.25 explain with whom to discuss training and development issues

2.26 describe the extent of their own responsibility and to whom they should report if they have any problems that they cannot resolve.

Unit 304 Producing mechanical engineering drawings using computer aided techniques

UAN:	H/600/5415
Level:	3
Credit value:	150
GLH:	294
Relationship to NOS:	This unit has been derived from National Occupational Standard engineering technical support Unit No 4: Producing mechanical engineering drawings using computer aided techniques (Suite 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	This unit covers the skills and knowledge needed to prove the competences required to set up and operate a Computer Aided Drawing (CAD) system to produce fully detailed drawings for mechanical engineering activities, in accordance with approved procedures. The drawings produced will include detail component drawings for manufacturing, assembly and sub-assembly drawings, installation drawings, and fault location aids such as flow diagrams and modification drawings. The learner will be given a detailed drawing brief or a request for change/modification order, and will be required to access these requirements and to extract all necessary information in order to carry out the drawing operations. The learner will need to select the appropriate equipment and drawing software to use, based on the type and complexity of the drawing functions to be carried out. The learner will be expected to use current British, European, International and company standards to produce a drawing template, for a range of paper sizes, that must include the drawing title, scale used, date of drawing, material to be used and other relevant information. The learner will then be expected to produce fully detailed drawings to enable the manufacture, assembly, installation or modification of the product to take place.

The learner's responsibilities will require them to comply with organisational policy and procedures for working in the drawing office or CAD suite. The learner will be required to report any problems with the computer hardware, software or drawing procedures that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work to verbal/written instructions and draught specifications, with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner knowledge will provide a good understanding of their work, and will provide an informed approach to applying Computer Aided Drawing procedures for mechanical engineering drawings. The learner will understand the computer system and software used, and its application, and will know about the various tools and techniques used to produce the drawings, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

The learner will understand the safety precautions required when working with the computer drawing system. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

Learning outcome
The learner will: 1. produce mechanical engineering drawings using computer aided techniques
Assessment criteria
The learner can: 1.1 prepare the CAD system for operation by carrying out all of the following: • check that all the equipment is correctly connected and is in a safe and usable condition (cables undamaged, correctly connected, safely routed) • power up the equipment and activate the drawing software • set up the drawing system to be able to produce the drawing to the appropriate scale • set up and check that all peripheral devices are connected and correctly operating (such as keyboard, mouse, light pen,

digitiser/tablet, scanner, printer, plotter)
- set the drawing datum at a convenient point (where applicable)
- set up drawing parameters to include layers, line types, colour, text styles, to company procedures or to suit the drawing produced
- create a drawing template to the required standards, which includes all necessary detail (such as title, drawing number, scale, material, date, etc.)

1.2 carry out all of the following before producing the engineering drawing:
- ensure that data and information is complete and accurate
- review the data and information to identify the drawing requirements
- recognise and deal with problems (information based and technical)

1.3 use three of the following to obtain the necessary data to produce the required drawings:
- drawing brief/request
- change order/modification request
- manuals
- calculations
- sketches
- specifications
- regulations
- sample component
- previous drawings/designs
- other available data
- standards reference documents (such as limits and fits, tapping drill charts)
- notes from meetings/discussions

1.4 produce drawings that are sufficiently and clearly detailed

1.5 take into account eight of the following design features, as appropriate to the drawing being produced:
- function
- quality
- manufacturing method
- ergonomics
- materials
- cost
- lifetime of the product
- tolerances
- clearance
- aesthetics
- physical space
- interfaces
- operating environment
- standard parts/components

- safety

1.6 produce two of the following types of drawing:
- detail drawings
- general arrangement drawings
- sub-assembly drawings

1.7 produce mechanical drawings which include ten of the following:
- straight lines
- dimensions
- angled lines
- text
- insertion of standard components
- symbols and abbreviations
- curved/contour lines
- circles or ellipses
- geometrical tolerancing
- hidden detail
- sectional detail
- parts lists
- other specific detail

1.8 produce drawings in the required formats

1.9 interpret and produce drawings using two of the following methods of projection:
- first angle orthographic projections
- isometric/oblique projections
- third angle orthographic projections

1.10 use codes and other references that follow the required conventions

1.11 produce drawings which comply with one or more of the following:
- organisational guidelines
- statutory regulations and codes of practice
- CAD software standards
- BS and ISO standards
- other international standard

1.12 make sure that drawings are checked and approved within agreed timescales by authorised people

1.13 ensure that drawings are properly registered and stored securely

1.14 save and store drawings in the appropriate locations, to include carrying out all of the following:
- ensure that their drawing has been checked and approved by the appropriate person/s
- check that the drawing is correctly titled and referenced
- save the drawing to an appropriate storage medium
- create a separate backup copy and place it in safe storage
- produce a hard copy printout of the drawing for file purposes
- register and store the drawings in the appropriate company information system
- where appropriate, record and store any changes to the drawings in the appropriate company information system

1.15 ensure that changes are completed as required by organisational procedures.

Learning outcome
The learner will: 2. know how to produce mechanical engineering drawings using computer aided techniques
Assessment criteria
The learner can: 2.1 describe the specific safety precautions to be taken when working with computer systems (to include such things as safety guidance relating to the use of Visual Display Unit (VDU) equipment and work station environment (such as lighting, seating, positioning of equipment), Repetitive Strain Injury (RSI); the dangers of trailing leads and cables; how to spot faulty or dangerous electrical leads, plugs and connections) 2.2 describe the good housekeeping arrangements (such as cleaning down work surfaces; putting disks, manuals and unwanted items of equipment into safe storage; leaving the work area in a safe and tidy condition) 2.3 describe the basic set-up and operation of the computer system, and the peripheral devices that are used (such as mouse, light pen, digitiser and tablet, printer or plotter, and scanner) 2.4 describe the correct start-up and shutdown procedures to be used for the computer system 2.5 explain how to access the specific computer drawing software to be used, and the use of software manuals and related documents to aid efficient operation of the relevant drawing system 2.6 explain how to deal with system problems (such as error messages received, peripherals which do not respond as expected, obvious faults with the equipment or connecting leads) 2.7 describe the documentation required for particular applications (such as drawing briefs, specification sheets, request for change orders) 2.8 describe the types of drawings that may be produced by the software (such as first and third angle drawings, sectional elevations, isometric or oblique drawings) 2.9 explain how to set up the viewing screen to show multiple views of the pattern to help with drawing creation (to include isometric front and side elevations) 2.10 describe the national, international and organisational standards and conventions that are used for the drawings 2.11 explain how to set up the drawing template parameters (such as layers of drawings, scale, paper size, colour set-up, line types, dimensioning system and text styles) 2.12 describe the application and use of drawing tools (such as for straight lines, curves and circles; how to create hatching and shading on drawings; how to add dimensions and text to drawings, producing layers of drawings) 2.13 explain how to access, recognise and use a wide range of standard components and symbol libraries from the CAD equipment 2.14 describe the need for document control (such as ensuring that completed drawings are approved, labelled and stored on a suitable storage medium, the need to create backup copies and to

file them in a separate and safe location away from electromagnetic sources, filing and storing hard copies for use in production)

2.15 describe the procedures for drawing change notes, trial changes, up-issuing of drawings, modifications, and miscellaneous amendments to drawings

2.16 describe the sources and methods for obtaining the required technical information relevant to the drawing being produced (such as limits and fits, contraction allowances, bearing selection, surface finish)

2.17 describe the basic principles of engineering manufacturing operations, assembly and installation methods, and limitations of the equipment/processes that are used to produce the drawn item (such as machining methods, joining processes, fabrication, casting and forging), and how these can influence the way they present the drawing

2.18 describe the functionality of the component, and its interrelationship with other components and assemblies

2.19 describe the extent of their own responsibility and to whom they should report if they have any problems that they cannot resolve when producing the drawings.

Unit 305 Producing engineering drawings/models using 3D computer aided techniques

UAN:	H/600/5429
Level:	3
Credit value:	150
GLH:	294
Relationship to NOS:	This unit has been derived from National Occupational Standard engineering technical support Unit No 5: Producing engineering drawings/models using 3D computer aided techniques (Suite 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	This unit covers the skills and knowledge needed to prove the competences required to set up and operate a Computer Aided Drawing (CAD) system to produce three-dimensional (3D) drawings, in accordance with approved procedures. The learner will be given a detailed drawing brief or a request for change/modification order, and will be required to access these requirements and to extract all necessary information, in order to carry out the drawing operations. The learner will need to select the appropriate equipment and drawing software to use, based on the type and complexity of the drawing functions to be carried out. The learner will be expected to set up co-ordinate systems in 3D space, set up the screen into split views to show true 3D views (isometric) and plan views. The learner will then be expected to produce both surface and solid models, and to understand their differences and applications. The learner will use boundary modelling techniques, as well as graphic primitives, to produce their models, and will apply Boolean operators to construct the solid models. The learner's responsibilities will require them to comply with organisational policy and procedures for working in the drawing office or CAD suite. The learner will be

required to report any problems with the computer hardware, software or drawing procedures that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work to verbal or written instructions and draught specifications, with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying Computer Aided Drawing procedures. The learner will understand the 3D CAD system and software used, and its application, and will know about the various tools and techniques used to produce the drawings, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

The learner will understand the safety precautions required when working with the CAD system. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

Learning outcome
The learner will: 1. produce engineering drawings/models using 3D computer aided techniques
Assessment criteria
The learner can: 1.1 prepare the CAD system for operation, by carrying out all of the following: • check that all the equipment is correctly connected and is in a safe and usable condition (cables undamaged, correctly connected, safely routed) • power up the equipment and activate the drawing software • set up and check that all peripheral devices are connected and correctly operating (such as keyboard, mouse, light pen, digitiser/tablet, scanner, printer, plotter) • set up the viewing screen to show multiple views of the components (this will involve isometric, front and side elevations) • set the drawing datum at a convenient point (where applicable) • set up drawing parameters to include layers, line types, colour, text styles to company procedures or to suit the

drawing produced

- create a drawing template to British Standards, European or company standards, which includes all necessary detail (such as title, drawing number, scale, material, date, etc.)

1.2 carry out all of the following before producing the engineering drawing:

- ensure that data and information is complete and accurate
- review the data and information to identify the drawing requirements
- recognise and deal with problems (information based and technical)

1.3 use three of the following to obtain the necessary data to produce the required drawings:

- drawing brief/request
- change order/modification request
- manuals
- calculations
- sketches
- notes from meetings/discussions
- specifications
- regulations
- sample component
- previous drawings/designs
- other available data

1.4 produce drawings that are sufficiently and clearly detailed

1.5 take into account eight of the following, as appropriate to the drawing being produced:

- function
- quality
- manufacturing method
- ergonomics
- materials
- cost
- lifetime of the product
- tolerances
- clearance
- aesthetics
- physical space
- operating environment
- interfaces
- standard parts/components
- safety

1.6 use two of the following drawing tools:

- surface modelling
- solid modelling
- wire frame modelling

1.7 produce and modify 3D drawings, using two of the following tools and techniques:

- graphic primitives
- boundary techniques
- surface/solid modifying tools
- Boolean operators

1.8 produce drawings which include ten of the following:

- straight lines
- dimensions
- angular surfaces
- text
- symbols and abbreviations
- insertion of standard components
- curved surfaces
- circles or ellipses
- hidden detail
- hatching and shading
- sectional detail
- parts lists
- other specific detail

1.9 produce drawings in the required formats

1.10 use two of the following co-ordinate measurements to produce 3D models:

- cartesian
- cylindrical
- spherical

1.11 produce drawings using two of the following methods of projection:

- isometric
- oblique
- orthographic
- perspective
- planometric

1.12 use codes and other references that follow the required conventions

1.13 produce drawings which comply with one or more of the following:

- organisational guidelines
- statutory regulations and codes of practice
- CAD software standards
- BS and ISO standards
- other international standard

1.14 make sure that drawings are checked and approved within agreed timescales by authorised people

1.15 ensure that drawings are properly registered and stored securely

1.16 save and store drawings in the appropriate locations, to include carrying out all of the following:

- ensure that their drawing has been checked and approved by the appropriate person/s
- check that the drawing is correctly titled and referenced

- save the drawing to an appropriate storage medium
- create a separate backup copy and place it in safe storage
- produce a hard copy printout of the drawing for file purposes
- register and store the drawings in the appropriate company information system
- record and store any changes to the drawings in the appropriate company information system

1.17 ensure that changes are completed as required by organisational procedures.

Learning outcome

The learner will:

2. know how to produce engineering drawings/models using 3D computer aided techniques

Assessment criteria

The learner can:

2.1 describe the specific safety precautions to be taken when working with computer systems (to include such things as safety guidance relating to the use of Visual Display Unit (VDU) equipment and work station environment (such as lighting, seating, positioning of equipment), Repetitive Strain Injury (RSI); the dangers of trailing leads and cables; how to spot faulty or dangerous electrical leads, plugs and connections)

2.2 describe the good housekeeping arrangements (such as cleaning down work surfaces; putting disks, manuals and unwanted items of equipment into safe storage; leaving the work area in a safe and tidy condition)

2.3 describe the basic set-up and operation of the 3D drawing system, and the peripheral devices that are used (such as mouse, light pen, digitiser and tablet, printer or plotter, and scanner)

2.4 describe the correct start-up and shutdown procedures to be used for the computer system

2.5 explain how to access the specific computer drawing software to be used, and the use of software manuals and related documents to aid efficient operation of the relevant drawing system

2.6 explain how to deal with system problems (such as error messages received, peripherals which do not respond as expected, obvious faults with the equipment or connecting leads)

2.7 describe the documentation required for particular applications (such as design briefs, specification sheets, request for change orders)

2.8 describe the types of drawings that may be produced by the software

2.9 explain how to set up the viewing screen to show multiple views of the component to help with drawing creation (to include isometric front and side elevations)

2.10 describe the national, international and organisational standards and conventions that are used for the drawings

2.11 explain how to set up the drawing template parameters (such as layers of drawings, scale, paper size, colour set-up, line types, dimensioning system and text styles)

2.12 describe the application and use of drawing tools (such as for

straight lines, curves and circles; how to create hatching and shading on drawings; producing layers of drawings)

2.13 explain how to access, recognise and use a wide range of standard components and symbol libraries from the CAD equipment

2.14 describe the applications of different 3D modelling programmes (such as surface, solid and wire frame)

2.15 describe the different projections used to create 3D drawings (such as isometric, oblique, orthographic, perspective and planometric)

2.16 describe the application of different co-ordinate measurements used to create 3D drawings (such as Cartesian, spherical and cylindrical)

2.17 describe the display views that can be used on 3D drawings (such as view co-ordinate geometry and object co-ordinate geometry

2.18 describe the application and use of drawing tools for surface or solid modelling; how to modify drawings using surface/solid modelling tools or Boolean operators; how to add dimensions and text to drawings

2.19 describe the need for document control (such as ensuring that completed drawings are approved, labelled and stored on a suitable storage medium, the need to create backup copies and to file them in a separate and safe location away from electromagnetic sources, filing and storing hard copies for use in production)

2.20 describe the procedures for drawing change notes, trial changes, up-issuing of drawings, modifications, and miscellaneous amendments to drawings

2.21 describe the sources and methods for obtaining the required technical information relevant to the drawing being produced (such as limits and fits, contraction allowances, bearing selection, surface finish)

2.22 describe the basic principles of engineering manufacturing operations, assembly and installation methods and limitations of the equipment/processes that are used to produce the drawn item (such as machining methods, joining processes, fabrication, casting and forging), and how these can influence the way they present the drawing

2.23 describe the functionality of the component and its interrelationship with other components and assemblies

2.24 describe the extent of their own responsibility and to whom they should report if they have any problems that they cannot resolve when producing the drawings.

Unit 306 Producing electrical engineering drawings using computer aided techniques

UAN:	H/600/5463
Level:	3
Credit value:	150
GLH:	294
Relationship to NOS:	This unit has been derived from National Occupational Standard engineering technical support Unit No 6: Producing electrical engineering drawings using computer aided techniques (Suite 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	This unit covers the skills and knowledge needed to prove the competences required to set up and operate a Computer Aided Drawing (CAD) system to produce fully detailed drawings for electrical engineering activities, in accordance with approved procedures. The types of drawing produced will include circuit and wiring diagrams, block diagrams, schematics, electrical cabling/routing, installation, assembly of panels and sub-assemblies and system design/modification. The learner will be given a detailed drawing brief or a request for change/modification order, and will be required to access these requirements and to extract all necessary information in order to carry out the drawing operations. The learner will need to select the appropriate equipment and drawing software to use, based on the type and complexity of the drawing functions to be carried out. The learner will be expected to use current British, European, International and company standards to produce a drawing template, for a range of paper sizes, that must include the drawing title, scale used, date of drawing, and other relevant information. The learner will then be expected to produce fully detailed drawings to enable the electrical circuits to be assembled, installed, maintained, commissioned or modified.

The learner's responsibilities will require them to comply with organisational policy and procedures for working in the drawing office or CAD suite. The learner will be required to report any problems with the computer hardware, software or drawing procedures that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work to verbal/written instructions and draught specifications, with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying Computer Aided Drawing procedures for electrical engineering drawings. The learner will understand the computer system and software used, and its application, and will know about the various tools and techniques used to produce the drawings, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

The learner will understand the safety precautions required when working with the computer drawing system. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

Learning outcome
The learner will: 1. produce electrical engineering drawings using computer aided techniques
Assessment criteria
The learner can: 1.1 prepare the CAD system for operation, by carrying out all of the following: • check that all the equipment is correctly connected and is in a safe and usable condition (cables undamaged, correctly connected, safely routed) • power up the equipment and activate the drawing software • set up the drawing system to be able to produce the drawing to the appropriate scale • set up and check that all peripheral devices are connected and correctly operating (such as keyboard, mouse, light pen,

digitiser/tablet, scanner, printer, plotter)
- set the drawing datum at a convenient point (where applicable)
- set up drawing parameters to include layers, line types, colour, text styles to company procedures or to suit the drawing produced
- create a drawing template to the required standards, which includes all necessary detail (such as title, drawing number, scale, material, date, etc.)

1.2 carry out all of the following before producing the engineering drawing:
- ensure that data and information is complete and accurate
- review the data and information to identify the drawing requirements
- recognise and deal with problems (information based and technical)

1.3 use three of the following to obtain the necessary data to produce the required drawings:
- drawing brief/request
- change order/modification request
- manuals
- calculations
- sketches
- specifications
- electrical regulations
- previous drawings/designs
- other available data
- standards reference documents (such as current carrying capacity of cables, component catalogues)
- notes from meetings/discussions

1.4 produce drawings that are sufficiently and clearly detailed

1.5 take into account eight of the following design features, as appropriate to the drawing being produced:
- function
- operating environment
- types of electrical components available
- position of circuit elements/components
- connections between components
- power supplies
- method of installation (such as conduit, trunking, traywork)
- type of cables (such as PVC, wire armoured, mineral insulated)
- operating voltages
- cost
- ergonomics
- lifetime of the product
- aesthetics
- physical space
- interfaces

- safety

1.6 produce electrical drawings which include ten of the following:
- straight lines
- dimensions
- angled lines
- text
- insertion of standard electrical components
- type and size of cables
- connection/termination details
- electrical symbols and abbreviations
- curved/contour lines
- circles or ellipses
- hidden detail
- colour/component coding
- fault diagnosis aids (such as fault trees, flow diagrams)
- parts lists
- other specific electrical detail

1.7 produce drawings in the required formats

1.8 produce two of the following types of electrical drawings:
- circuit diagrams
- wiring diagrams
- block diagrams
- schematics
- system/distribution drawings
- panel assembly
- installation/commissioning
- cabling and routeing
- assembly of cable looms/harnesses

1.9 use codes and other references that follow the required conventions

1.10 produce drawings which comply with one or more of the following:
- organisational guidelines
- statutory regulations and codes of practice
- CAD software standards
- BS and ISO standards
- other international standard

1.11 make sure that drawings are checked and approved within agreed timescales by authorised people

1.12 ensure that drawings are properly registered and stored securely

1.13 save and store drawings in appropriate locations, to include carrying out all of the following:
- ensure that their drawing has been checked and approved by the appropriate person/s
- check that the drawing is correctly titled and referenced
- save the drawing to an appropriate storage medium
- create a separate backup copy and place it in safe storage
- produce a hard copy printout of the drawing for file purposes
- register and store the drawings in the appropriate company

information system
- where appropriate, record and store any changes to the drawings in the appropriate company information system

1.14 ensure that changes are completed as required by organisational procedures.

Learning outcome

The learner will:

2. know how to produce electrical engineering drawings using computer aided techniques

Assessment criteria

The learner can:

2.1 describe the specific safety precautions to be taken when working with computer systems to (include such things as safety guidance relating to the use of Visual Display Unit (VDU) equipment and work station environment (such as lighting, seating, positioning of equipment), Repetitive Strain Injury (RSI); the dangers of trailing leads and cables; how to spot faulty or dangerous electrical leads, plugs and connections)

2.2 describe the good housekeeping arrangements (such as cleaning down work surfaces; putting disks, manuals and unwanted items of equipment into safe storage; leaving the work area in a safe and tidy condition)

2.3 describe the basic set-up and operation of the computer system, and the peripheral devices that are used (such as mouse, light pen, digitiser and tablet, printer or plotter, and scanner)

2.4 describe the correct start-up and shutdown procedures to be used for the computer system

2.5 explain how to access the specific computer drawing software to be used, and the use of software manuals and related documents to aid efficient operation of the relevant drawing system

2.6 explain how to deal with system problems (such as error messages received, peripherals which do not respond as expected, obvious faults with the equipment or connecting leads)

2.7 describe the documentation required for particular applications (such as drawing briefs, specification sheets, request for change orders)

2.8 describe the types of electrical drawings that may be produced by the software (such as circuit and wiring diagrams, block and schematic diagrams, assembly and installation drawings)

2.9 describe the national, international and organisational standards and conventions that are used for the drawings

2.10 explain how to set up the drawing template parameters (such as layers of drawings, scale, paper size, colour set-up, line types, dimensioning system and text styles)

2.11 describe the application and use of drawing tools (such as for straight lines, curves and circles; how to add dimensions and text to drawings, producing layers of drawings)

2.12 explain how to access, recognise and use a wide range of standard electrical component symbol libraries from the CAD equipment

2.13 describe the factors to be taken into account when producing electrical drawings (such as safety requirements, operating parameters of components, position of components in relation to

	other sources or circuits, possibility of external interference, etc)
2.14	describe the electrical equipment and circuits being drawn, and the function of the individual components within the circuits
2.15	describe the selection of the various components and cables being used, with regard to their operating ranges and current carrying capacity
2.16	describe the use of specific regulations and standard reference tables when selecting components and cables (such as IEE regulations)
2.17	explain how power cables might affect/corrupt signal transmission, and the need to consider this in siting and routeing cables
2.18	describe the calculations that may be required to verify the value/rating of components and circuits (such as Ohm's Law)
2.19	describe the constraints laid down by existing national and international legislation, statutory and non-statutory regulations, industry and national standards, industry guidelines and professional codes that regulate electrical drawing/design activities
2.20	describe the need for document control (such as ensuring that completed drawings are approved, labelled and stored on a suitable storage medium, the need to create backup copies and to file them in a separate and safe location away from electromagnetic sources, filing and storing hard copies for use in production)
2.21	describe the procedures for drawing change notes, trial changes, up-issuing of drawings, modifications, and miscellaneous amendments to drawings
2.22	describe the extent of their own responsibility and to whom they should report if they have any problems that they cannot resolve when producing the drawings.

Unit 307 Producing electronic engineering drawings using computer aided techniques

UAN:	F/600/5471
Level:	3
Credit value:	150
GLH:	294
Relationship to NOS:	This unit has been derived from National Occupational Standard engineering technical support Unit No 7: Producing electronic engineering drawings using computer aided techniques (Suite 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	This unit covers the skills and knowledge needed to prove the competences required to set up and operate a Computer Aided Drawing (CAD) system to produce fully detailed drawings for electronic engineering activities, in accordance with approved procedures. The types of drawing produced will include circuit and wiring diagrams, block diagrams, schematics, printed circuit board layouts, assembly and installation drawings, and system design/modification drawings. The learner will be given a detailed drawing brief or a request for change/modification order, and will be required to access these requirements and to extract all necessary information in order to carry out the drawing operations. The learner will need to select the appropriate equipment and drawing software to use, based on the type and complexity of the drawing functions to be carried out. The learner will be expected to use current British, European, International and company standards to produce a drawing template, for a range of paper sizes that must include the drawing title, scale used, date of drawing, and other relevant information. The learner will then be expected to produce fully detailed drawings to enable the electronic circuits to be assembled, installed, maintained, commissioned or modified.

The learner's responsibilities will require them to comply with organisational policy and procedures for working in the drawing office or CAD suite. The learner will be required to report any problems with the computer hardware, software or drawing procedures that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work to verbal/written instructions and draught specifications, with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying Computer Aided Drawing procedures for electronic engineering drawings. The learner will understand the computer system and software used, and its application, and will know about the various tools and techniques used to produce the drawings, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

The learner will understand the safety precautions required when working with the computer drawing system. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

Learning outcome
The learner will: 1. produce electronic engineering drawings using computer aided techniques
Assessment criteria
The learner can: 1.1 prepare the CAD system for operation, by carrying out all of the following: • check that all the equipment is correctly connected and is in a safe and usable condition (cables undamaged, correctly connected, safely routed) • power up the equipment and activate the drawing software • set up the drawing system to be able to produce the drawing to the appropriate scale • set up and check that all peripheral devices are connected and correctly operating (such as keyboard, mouse, light pen,

digitiser/tablet, scanner, printer, plotter)
- set the drawing datum at a convenient point (where applicable)
- set up drawing parameters to include layers, line types, colour, text styles to company procedures or to suit the drawing produced
- create a drawing template to the required standards, which includes all necessary detail (such as title, drawing number, scale, material, date, etc)

1.2 carry out all of the following before producing the engineering drawing:
- ensure that data and information is complete and accurate
- review the data and information to identify the drawing requirements
- recognise and deal with problems (information based and technical)

1.3 use three of the following to obtain the necessary data to produce the required drawings:
- drawing brief/request
- change order/modification request
- manuals
- calculations
- sketches
- specifications
- electrical regulations
- previous drawings/designs
- other available data
- standards reference documents (such as current carrying capacity of cables, electronic component catalogues)
- notes from meetings/discussions

1.4 produce drawings that are sufficiently and clearly detailed

1.5 take into account eight of the following design features, as appropriate to the drawing being produced:
- uses an appropriate type of circuit (such as digital, analogue, hybrid)
- physical dimensions of the circuit
- position of circuit elements/components
- function
- connectors/test points access
- connections between components
- component orientation
- special labels (such as orientation reference points)
- types of component to be used
- lifetime cost of the product
- tolerances
- aesthetics
- interfaces
- safety

- power supplies
- uses appropriate technology of circuit design (such as single sided, double sided, multi-layer, flexi-rigid)
- meets signal integrity parameters (such as capacitance, inductance, resistance, insulation voltages)
- meets specified operating conditions (such as temperature, humidity, shock and vibration)
- any assembly/manufacturing schedule constraints (such as high profile components mounted after low profile 'surface mount' ones)

1.6 produce electronic drawings which include ten of the following:

- straight lines
- dimensions
- angled lines
- text
- insertion of electronic components
- type and size of cables
- connection/termination details
- electrical/electronic symbols and abbreviations
- curved/contour lines
- circles or ellipses
- parts lists
- test points
- colour/component coding
- fault diagnosis aids (such as fault trees, flow diagrams)
- other specific electronic detail

1.7 produce drawings in the required formats

1.8 produce three of the following types of electronic drawings:

- circuit diagrams
- wiring diagrams
- block diagrams
- schematics
- system drawings
- circuit board assembly
- circuit board layout
- general assembly drawings
- assembly of cable looms/harnesses

1.9 use codes and other references that follow the required conventions

1.10 produce drawings which comply with one or more of the following:

- organisational guidelines
- statutory regulations and codes of practice
- CAD software standards
- BS and ISO standards
- other international standard

1.11 make sure that drawings are checked and approved within agreed timescales by authorised people

1.12 ensure that drawings are properly registered and stored securely

1.13 save and store drawings in appropriate locations, to include carrying out all of the following:

- ensure that their drawing has been checked and approved by the appropriate person/s
- check that the drawing is correctly titled and referenced
- save the drawing to an appropriate storage medium
- create a separate backup copy and place it in safe storage
- produce a hard copy printout of the drawing for file purposes
- register and store the drawings in the appropriate company information system
- where appropriate, record and store any changes to the drawings in the appropriate company information system

1.14 ensure that changes are completed as required by organisational procedures.

Learning outcome
The learner will: 2. know how to produce electronic engineering drawings using computer aided techniques
Assessment criteria
The learner can: 2.1 describe the specific safety precautions to be taken when working with computer systems (to include such things as safety guidance relating to the use of Visual Display Unit (VDU) equipment and work station environment (such as lighting, seating, positioning of equipment), Repetitive Strain Injury (RSI); the dangers of trailing leads and cables; how to spot faulty or dangerous electrical leads, plugs and connections) 2.2 describe the good housekeeping arrangements (such as cleaning down work surfaces; putting disks, manuals and unwanted items of equipment into safe storage; leaving the work area in a safe and tidy condition) 2.3 describe the basic set-up and operation of the computer system, and the peripheral devices that are used (such as mouse, light pen, digitiser and tablet, printer or plotter, and scanner) 2.4 describe the correct start-up and shutdown procedures to be used for the computer system 2.5 explain how to access the specific computer drawing software to be used, and the use of software manuals and related documents to aid efficient operation of the relevant drawing system 2.6 explain how to deal with system problems (such as error messages received, peripherals which do not respond as expected, obvious faults with the equipment or connecting leads) 2.7 describe the documentation required for particular applications (such as drawing briefs, specification sheets, request for change orders) 2.8 describe the types of electronic drawings that may be produced by the software (such as circuit and wiring diagrams, block and schematic diagrams, assembly and installation drawings, circuit board layouts and circuit board assembly) 2.9 describe the difficulties that can emerge in manufacturing processes because of poor drawings/design

2.10	describe the national, international and organisational standards and conventions that are used for the drawings
2.11	explain how to set up the drawing template parameters (such as layers of drawings, scale, paper size, colour set-up, line types, dimension system and text styles)
2.12	describe the application and use of drawing tools (such as for straight lines, curves and circles; how to add dimensions and text to drawings, producing layers of drawings)
2.13	explain how to access, recognise and use a wide range of standard electronic component symbol libraries from the CAD equipment
2.14	describe the factors to be taken into account when producing electronic drawings (such as safety requirements, operating parameters of components, position of components in relation to other sources or circuits, possibility of external interference, etc)
2.15	describe the electronic equipment and circuits being drawn, and the function of the individual components within the circuits
2.16	describe the selection of the various components and cables being used, with regard to their operating ranges and current carrying capacity
2.17	describe the use of specific regulations and standard reference tables when selecting components and cables (such as IEE regulations)
2.18	describe the basic calculations that may be required to be carried out to verify the value/rating of components and circuits (such as Ohm's Law)
2.19	explain how power cables might affect/corrupt electronic components, and the need to consider this when producing the drawing (such as the positioning, siting and routeing of electrical cables and wires)
2.20	describe the manufacturing processes used for populating circuits with components
2.21	describe the constraints laid down by existing national and international legislation, statutory and non-statutory regulations, industry and national standards, industry guidelines and professional codes that regulate electronic design activities
2.22	describe the need for document control (such as ensuring that completed drawings are approved, labelled and stored on a suitable storage medium, the need to create backup copies and to file them in a separate and safe location away from electromagnetic sources, filing and storing hard copies for use in production)
2.23	describe the procedures for drawing change notes, trial changes, up-issuing of drawings, modifications, and miscellaneous amendments to drawings
2.24	describe the extent of their own responsibility and to whom they should report if they have any problems that they cannot resolve when producing the drawings.

Unit 308 Producing fabrication/structural engineering drawings using computer aided techniques

UAN:	M/600/5482
Level:	3
Credit value:	150
GLH:	294
Relationship to NOS:	This unit has been derived from National Occupational Standard engineering technical support Unit No 8: Producing fabrication/structural engineering drawings using computer aided techniques (Suite 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	This unit covers the skills and knowledge needed to prove the competences required to set up and operate a Computer Aided Drawing (CAD) system to produce fully detailed drawings for fabrication or structural engineering activities, in accordance with approved procedures. The types of drawing produced will include detail component drawings for manufacturing, assembly, sub-assembly and installation drawings. The learner will be given a detailed drawing brief or a request for change/modification order, and will be required to access these requirements and to extract all necessary information in order to carry out the drawing operations. The learner will need to select the appropriate equipment and drawing software to use, based on the type and complexity of the drawing functions to be carried out. The learner will be expected to use current British, European, International and company standards to produce a drawing template, for a range of paper sizes, that must include the drawing title, scale used, date of drawing, material to be used and other relevant information. The learner will then be expected to produce fully detailed drawings to enable the manufacture, assembly, installation, commissioning,

maintenance or modification of the product to take place.

The learner's responsibilities will require them to comply with organisational policy and procedures for working in the drawing office or CAD suite. The learner will be required to report any problems with the computer hardware, software or drawing procedures that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work to verbal/written instructions and draught specifications, with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying Computer Aided Drawing procedures for fabrication or structural engineering drawings. The learner will understand the computer system and software used, and its application, and will know about the various tools and techniques used to produce the drawings, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

The learner will understand the safety precautions required when working with the computer drawing system. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

Learning outcome
The learner will: 1. produce fabrication/structural engineering drawings using computer aided techniques
Assessment criteria
The learner can: 1.1 prepare the CAD system for operation, by carrying out all of the following: • check that all the equipment is correctly connected and is in a safe and usable condition (cables undamaged, correctly connected, safely routed) • power up the equipment and activate the drawing software • set up the drawing system to be able to produce the drawing to the appropriate scale

- set up and check that all peripheral devices are connected and correctly operating (such as keyboard, mouse, light pen, digitiser/tablet, scanner, printer, plotter)
- set the drawing datum at a convenient point (where applicable)
- set up drawing parameters to include layers, line types, colour, text styles to company procedures or to suit the drawing produced
- create a drawing template to the required standards, which includes all necessary detail (such as title, drawing number, scale, material, date, etc.)

1.2 carry out all of the following before producing the engineering drawing:

- ensure that data and information is complete and accurate
- review the data and information to identify the drawing requirements
- recognise and deal with problems (information based and technical)

1.3 use three of the following to obtain the necessary data to produce the required drawings:

- drawing brief/request
- change order/modification request
- manuals
- calculations
- sketches
- specifications
- regulations
- sample component
- previous drawings/designs
- other available data
- standards reference documents
- notes from meetings/discussions

1.4 produce drawings that are sufficiently and clearly detailed

1.5 take into account eight of the following design features, as appropriate to the drawing being produced:

- function
- quality
- manufacturing method
- joining method
- ergonomics
- materials
- cost
- lifetime of the product
- tolerances
- clearance
- aesthetics
- physical size
- operating environment

- interfaces
- safety

1.6 produce fabrication/structural engineering drawings which include ten of the following:
- straight lines
- dimensions
- angled lines
- text
- insertion of standard components
- symbols and abbreviations
- weld detail
- curved/contour lines
- circles or ellipses
- geometrical tolerancing
- joint detail (such as bolting, riveting)
- installation detail
- hidden detail
- sectional detail
- parts lists
- other specific detail

1.7 produce drawings in the required formats

1.8 produce drawings using two of the following methods of projection:
- first angle orthographic projections
- isometric/oblique projections
- third angle orthographic projections

1.9 produce two of the following:
- detail drawings
- general arrangement drawings
- sub-assembly drawings
- installation/commissioning drawings

1.10 use codes and other references that follow the required conventions

1.11 produce drawings which comply with one or more of the following:
- organisational guidelines
- statutory regulations and codes of practice
- CAD software standards
- BS and ISO standards
- other international standard

1.12 make sure that drawings are checked and approved within agreed timescales by authorised people

1.13 ensure that drawings are properly registered and stored securely

1.14 save and store drawings in appropriate locations, to include carrying out all of the following:
- ensure that their drawing has been checked and approved by the appropriate person/s
- check that the drawing is correctly titled and referenced
- save the drawing to an appropriate storage medium

- create a separate backup copy and place it in safe storage
- produce a hard copy printout of the drawing for file purposes
- register and store the drawings in the appropriate company information system
- where appropriate, record and store any changes to the drawings in the appropriate company information system

1.15 ensure that changes are completed as required by organisational procedures.

Learning outcome

The learner will:

2. know how to produce fabrication/structural engineering drawings using computer aided techniques

Assessment criteria

The learner can:

2.1 describe the specific safety precautions to be taken when working with computer systems (to include such things as safety guidance relating to the use of Visual Display Unit (VDU) equipment and work station environment (such as lighting, seating, positioning of equipment), Repetitive Strain Injury (RSI); the dangers of trailing leads and cables; how to spot faulty or dangerous electrical leads, plugs and connections)

2.2 describe the good housekeeping arrangements (such as cleaning down work surfaces; putting disks, manuals and unwanted items of equipment into safe storage; leaving the work area in a safe and tidy condition)

2.3 describe the basic set-up and operation of the computer system, and the peripheral devices that are used (such as mouse, light pen, digitiser and tablet, printer or plotter, and scanner)

2.4 describe the correct start-up and shutdown procedures to be used for the computer system

2.5 explain how to access the specific computer drawing software to be used, and the use of software manuals and related documents to aid efficient operation of the relevant drawing system

2.6 explain how to deal with system problems (such as error messages received, peripherals which do not respond as expected, obvious faults with the equipment or connecting leads)

2.7 describe the documentation required for particular applications (such as drawing briefs, specification sheets, request for change orders)

2.8 describe the types of drawings that may be produced by the software (such as first and third angle drawings, sectional elevations, isometric or oblique drawings)

2.9 explain how to set up the viewing screen to show multiple views of the pattern to help with drawing creation (to include isometric front and side elevations)

2.10 describe the national, international and organisational standards and conventions that are used for the drawings

2.11 explain how to set up the drawing template parameters (such as layers of drawings, scale, paper size, colour set-up, line types, dimensioning system and text styles)

2.12 describe the application and use of drawing tools (such as for straight lines, curves and circles; how to create hatching and

shading on drawings; how to add dimensions and text to drawings, producing layers of drawings)

2.13 explain how to access, recognise and use a wide range of standard components and symbol libraries from the CAD equipment

2.14 describe the need for document control (such as ensuring that completed drawings are approved, labelled and stored on a suitable storage medium, the need to create backup copies and to file them in a separate and safe location away from electromagnetic sources, filing and storing hard copies for use in production)

2.15 describe the procedures for drawing change notes, trial changes, up-issuing of drawings, modifications, and miscellaneous amendments to drawings

2.16 describe the relevant sources and methods for obtaining any required technical information relevant to the drawing being produced (such as bend allowances, weld details, locking and securing devices)

2.17 describe the basic principles of fabrication engineering manufacturing operations, assembly and installation methods relevant to the drawn item (such as bending and forming methods, joining processes, welding procedures), and how these can influence the way they prepare the drawing

2.18 describe the functionality of the component, and its interrelationship with other components and assemblies

2.19 describe the extent of their own responsibility and to whom they should report if they have any problems that they cannot resolve when producing the drawings.

Unit 309 Producing fluid power engineering drawings using computer aided techniques

UAN:	Y/600/5489
Level:	3
Credit value:	150
GLH:	294
Relationship to NOS:	This unit has been derived from National Occupational Standard engineering technical support Unit No 9: Producing fluid power engineering drawings using computer aided techniques (Suite 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	This unit covers the skills and knowledge needed to prove the competences required to set up and operate a Computer Aided Drawing (CAD) system to produce fully detailed drawings for fluid power engineering activities such as hydraulics, pneumatics or vacuum, in accordance with approved procedures. The types of drawing produced will include circuit diagrams, block diagrams, schematics, assembly and installation, and system design/modification. The learner will be given a detailed drawing brief or a request for change/modification order, and will be required to access these requirements and to extract all necessary information in order to carry out the drawing operations. The learner will need to select the appropriate equipment and drawing software to use, based on the type and complexity of the drawing functions to be carried out. The learner will be expected to use current British, European, International and company standards to produce a drawing template, for a range of paper sizes, that must include the drawing title, scale used, date of drawing, and other relevant information. The learner will then be expected to produce fully detailed drawings to enable the fluid power circuits to be assembled, installed, commissioned, maintained or modified.

The learner's responsibilities will require them to comply with organisational policy and procedures for working in the drawing office or CAD suite. The learner will be required to report any problems with the computer hardware, software or drawing procedures that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work to verbal/written instructions and draught specifications, with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying Computer Aided Drawing procedures for fluid power engineering drawings. The learner will understand the computer system and software used, and its application, and will know about the various tools and techniques used to produce the drawings, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

The learner will understand the safety precautions required when working with the computer drawing system. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

Learning outcome
The learner will: 1. produce fluid power engineering drawings using computer aided techniques
Assessment criteria
The learner can: 1.1 prepare the CAD system for operation, by carrying out all of the following: • check that all the equipment is correctly connected and is in a safe and usable condition (cables undamaged, correctly connected, safely routed) • power up the equipment and activate the drawing software • set up the drawing system to be able to produce the drawing to the appropriate scale • set up and check that all peripheral devices are connected and correctly operating (such as keyboard, mouse, light pen, digitiser/tablet, scanner, printer, plotter)

- set the drawing datum at a convenient point (where applicable)
- set up drawing parameters to include layers, line types, colour, text styles to company procedures or to suit the drawing produced
- create a drawing template to the required standards, which includes all necessary detail (such as title, drawing number, scale, material, date, etc)

1.2 carry out all of the following before producing the engineering drawing:

- ensure that data and information is complete and accurate
- review the data and information to identify the drawing requirements
- recognise and deal with problems (information based and technical)

1.3 use three of the following to obtain the necessary data to produce the required drawings:

- drawing brief/request
- change order/modification request
- manuals
- calculations
- sketches
- specifications
- fluid power regulations
- previous drawings/designs
- other available data
- standards reference documents (such as pipe and tube tables, fluid power component catalogues)
- notes from meetings/discussions

1.4 produce drawings that are sufficiently and clearly detailed

1.5 take into account eight of the following design features, as appropriate to the drawing being produced:

- function
- operating environment
- routeing of fluid power circuit
- position fluid power components
- connections between components
- operating pressures
- types of fluid power equipment (such as valves, cylinders)
- type of pipes (such as such as flexible hoses or rigid pipes)
- cost
- method of installation
- ergonomics
- lifetime of the product
- tolerances
- aesthetics
- physical space
- interfaces

- safety

1.6 produce fluid power drawings which include ten of the following:
- straight lines
- dimensions
- angled lines
- text
- insertion of standard fluid power components
- type and size of pipes and hoses
- connection/termination details
- fluid power symbols and abbreviations
- pressure characteristics of the circuit
- curved/contour lines
- circles or ellipses
- hidden detail
- installation/commissioning details
- parts lists
- fault diagnostics (such as fault trees, flow diagrams)
- other specific fluid power detail

1.7 produce drawings in the required formats

1.8 produce drawings for one of the following types of fluid power system:
- hydraulics
- pneumatics
- vacuum

1.9 produce three of the following types of fluid power drawings:
- circuit diagrams
- block diagrams
- schematics
- system drawings
- installation/commissioning
- piping and tubing layouts

1.10 use codes and other references that follow the required conventions

1.11 produce drawings which comply with one or more of the following:
- organisational guidelines
- statutory regulations and codes of practice
- CAD software standards
- BS and ISO standards
- other international standard

1.12 make sure that drawings are checked and approved within agreed timescales by authorised people

1.13 ensure that drawings are properly registered and stored securely

1.14 save and store drawings in appropriate locations, to include carrying out all of the following:
- ensure that their drawing has been checked and approved by the appropriate person/s
- check that the drawing is correctly titled and referenced

- save the drawing to an appropriate storage medium
- create a separate backup copy and place it in safe storage
- produce a hard copy printout of the drawing for file purposes
- register and store the drawings in the appropriate company information system
- where appropriate, record and store any changes to the drawings in the appropriate company information system

1.15 ensure that changes are completed as required by organisational procedures.

Learning outcome

The learner will:

2. know how to produce fluid power engineering drawings using computer aided techniques

Assessment criteria

The learner can:

2.1 describe the specific safety precautions to be taken when working with computer systems (to include such things as safety guidance relating to the use of Visual Display Unit (VDU) equipment and work station environment (such as lighting, seating, positioning of equipment), Repetitive Strain Injury (RSI); the dangers of trailing leads and cables; how to spot faulty or dangerous electrical leads, plugs and connections)

2.2 describe the good housekeeping arrangements (such as cleaning down work surfaces; putting disks, manuals and unwanted items of equipment into safe storage; leaving the work area in a safe and tidy condition)

2.3 describe the basic set-up and operation of the computer system, and the peripheral devices that are used (such as mouse, light pen, digitiser and tablet, printer or plotter, and scanner)

2.4 describe the correct start-up and shutdown procedures to be used for the computer systems

2.5 explain how to access the specific computer drawing software to be used, and the use of software manuals and related documents to aid efficient operation of the relevant drawing system

2.6 explain how to deal with system problems (such as error messages received, peripherals which do not respond as expected, obvious faults with the equipment or connecting leads)

2.7 describe the documentation required for particular applications (such as drawing briefs, specification sheets, request for change orders)

2.8 describe the types of fluid power drawings that may be produced by the software (such as circuit diagrams, block and schematic diagrams, assembly and installation drawings, fault diagnosis diagrams)

2.9 describe the national, international and organisational standards and conventions that are used for the drawings

2.10 explain how to set up the drawing template parameters (such as layers of drawings, scale, paper size, colour set-up, line types, dimension system and text styles)

2.11 describe the application and use of drawing tools (such as for straight lines, curves and circles; how to add dimensions and text to

drawings, producing layers of drawings)

2.12 explain how to access, recognise and use a wide range of standard fluid power component symbol libraries from the CAD equipment

2.13 describe the factors to be taken into account when producing fluid power drawings (such as safety requirements, operating parameters of components, position of components in relation to other sources or circuits, possibility of external interference, etc)

2.14 describe the fluid power equipment and circuits being drawn and the function of the individual components within the circuits (such as pumps, reservoirs, accumulators, pressure intensifiers, various valves for pressure, flow, and directional control, cylinders and actuating mechanisms, safety devices)

2.15 describe the selection of the various components, pipes and hoses being used with regard to their operating ranges and pressure capabilities

2.16 describe the use of specific regulations and standard reference tables when selecting fluid power components and hoses

2.17 explain how pipes and hoses might become damaged or obstruct movement, and the need to consider this in siting and routeing the pipes and hoses

2.18 describe the constraints laid down by existing national and international legislation, statutory and non-statutory regulations, industry and national standards, industry guidelines and professional codes that regulate fluid power drawing/design activities

2.19 describe the need for document control (such as ensuring completed drawings are approved, labelled and stored on a suitable storage medium, the need to create backup copies and to file them in a separate and safe location away from electromagnetic sources, filing and storing hard copies for use in production)

2.20 describe the procedures for drawing change notes, trial changes, up-issuing of drawings, modifications, and miscellaneous amendments to drawings

2.21 describe the extent of their own responsibility and to whom they should report if they have any problems that they cannot resolve when producing the drawings.

Unit 310 Producing engineering systems/services drawings using computer aided techniques

UAN:	M/600/5496
Level:	3
Credit value:	150
GLH:	294
Relationship to NOS:	This unit has been derived from National Occupational Standard engineering technical support Unit No 10: Producing engineering systems/services drawings using computer aided techniques (Suite 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	This unit covers the skills and knowledge needed to prove the competences required to set up and operate a Computer Aided Drawing (CAD) system to produce fully detailed drawings for engineering systems/services activities, such as water distribution, waste water, environmental control, refrigeration, heating and ventilation, air conditioning and ventilation, gas distribution, plant and equipment, compressed air, process control, and instrumentation and control, in accordance with approved procedures. The types of drawing produced will include circuit diagrams, block diagrams, schematics, assembly and installation, and system design/modification. The learner will be given a detailed drawing brief or a request for change/modification order and will be required to access these requirements and extract all necessary information in order to carry out the drawing operations. The learner will need to select the appropriate equipment and drawing software to use, based on the type and complexity of the drawing functions to be carried out. The learner will be expected to use current British, European, International and company standards to produce a drawing template, for a range of paper sizes, that

must include the drawing title, scale used, date of drawing, and other relevant information. The learner will then be expected to produce fully detailed drawings to enable the systems/services to be installed, commissioned, maintained or modified.

The learner's responsibilities will require them to comply with organisational policy and procedures for working in the drawing office or CAD suite. The learner will be required to report any problems with the computer hardware, software or drawing procedures that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work to verbal/written instructions and draught specifications, with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying Computer Aided Drawing procedures for engineering systems/service drawings. The learner will understand the computer system and software used, and its application, and will know about the various tools and techniques used to produce the drawings, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

The learner will understand the safety precautions required when working with the computer drawing system. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

Learning outcome
The learner will: 1. produce engineering systems/services drawings using computer aided techniques
Assessment criteria
The learner can: 1.1 prepare the CAD system for operation, by carrying out all of the following: • check that all the equipment is correctly connected and is in a

safe and usable condition (cables undamaged, correctly connected, safely routed)
- power up the equipment and activate the drawing software
- set up the drawing system to be able to produce the drawing to the appropriate scale
- set up and check that all peripheral devices are connected and correctly operating (such as keyboard, mouse, light pen, digitiser/tablet, scanner, printer, plotter)
- set the drawing datum at a convenient point (where applicable)
- set up drawing parameters to include layers, line types, colour, text styles to company procedures or to suit the drawing produced
- create a drawing template to the required standards, which includes all necessary detail (such as title, drawing number, scale, material, date, etc)

1.2 carry out all of the following before producing the engineering drawing:
- ensure that data and information is complete and accurate
- review the data and information to identify the drawing requirements
- recognise and deal with problems (information based and technical)

1.3 use three of the following to obtain the necessary data to produce the required drawings:
- drawing brief/request
- change order/modification request
- manuals
- calculations
- sketches
- specifications
- statutory regulations
- previous drawings/designs
- other available data
- standards reference documents (such as pipe and tube tables, fluid power component catalogues)
- notes from meetings/discussions

1.4 produce drawings that are sufficiently and clearly detailed

1.5 take into account eight of the following design features, as appropriate to the drawing being produced:
- function
- operating environment
- position of equipment
- connections between equipment/components
- operating conditions (such as pressure, temperature, air flow)
- type of fluid power components (such as pipework, valves)
- types of electrical components (such as cables, relays, switches)
- types of mechanical plant or components (such as pumps,

valves, machines)
- types of instrumentation/control equipment (gauges, meters, monitoring)
- cost
- ergonomics
- lifetime of the product
- tolerances
- aesthetics
- physical space
- interfaces
- safety

1.6 produce drawings for one of the following engineering systems/services:
- fresh water distribution
- waste water
- environmental control
- process control
- gas distribution
- refrigeration
- compressed air
- emergency power generation
- heating and ventilation
- air conditioning and ventilation
- instrumentation and control
- plant and equipment

1.7 produce engineering system/service drawings which include twelve of the following:
- straight lines
- dimensions
- angled lines
- text
- insertion of standard mechanical components, plant or equipment
- insertion of standard electrical components
- insertion of standard fluid power components
- insertion of standard instrumentation/process control equipment
- fault diagnostics (such as fault trees, flow diagrams)
- installation/commissioning details
- connection/termination details
- service supplies
- type and size of pipes and hoses
- symbols and abbreviations
- characteristics of the system/service
- curved/contour lines
- circles or ellipses
- hidden detail

- parts lists
- other specific service/system detail

1.8 produce drawings in the required formats

1.9 produce three of the following types of engineering system/service drawings:

- circuit diagrams
- piping and tubing layouts
- block diagrams
- schematics
- system drawings
- service drawings
- installation/commissioning

1.10 use codes and other references that follow the required conventions

1.11 produce drawings which comply with one or more of the following:

- organisational guidelines
- statutory regulations and codes of practice
- CAD software standards
- BS and ISO standards
- other international standard

1.12 make sure that drawings are checked and approved within agreed timescales by authorised people

1.13 ensure that drawings are properly registered and stored securely

1.14 save and store drawings in appropriate locations, to include carrying out all of the following:

- ensure that their drawing has been checked and approved by the appropriate person/s
- check that the drawing is correctly titled and referenced
- save the drawing to an appropriate storage medium
- create a separate backup copy and place it in safe storage
- produce a hard copy printout of the drawing for file purposes
- register and store the drawings in the appropriate company information system
- where appropriate, record and store any changes to the drawings in the appropriate company information system

1.15 ensure that changes are completed as required by organisational procedures.

Learning outcome
The learner will: 2. know how to produce engineering systems/services drawings using computer aided techniques
Assessment criteria
The learner can: 2.1 describe the specific safety precautions to be taken when working with computer systems (to include such things as safety guidance relating to the use of Visual Display Unit (VDU) equipment and work station environment (such as lighting, seating, positioning of equipment), Repetitive Strain Injury (RSI); the dangers of trailing

leads and cables; how to spot faulty or dangerous electrical leads, plugs and connections)

2.2 describe the good housekeeping arrangements (such as cleaning down work surfaces; putting disks, manuals and unwanted items of equipment into safe storage; leaving the work area in a safe and tidy condition)

2.3 describe the basic set-up and operation of the computer systems, and the peripheral devices that are used (such as mouse, light pen, digitiser and tablet, printer or plotter, and scanner)

2.4 describe the correct start-up and shutdown procedures to be used for the computer system

2.5 explain how to access the specific computer drawing software to be used, and the use of software manuals and related documents to aid efficient operation of the relevant drawing system

2.6 explain how to deal with system problems (such as error messages received, peripherals which do not respond as expected, obvious faults with the equipment or connecting leads)

2.7 describe the documentation required for particular applications (such as drawing briefs, specification sheets, request for change orders)

2.8 describe the types of engineering system/service drawings that may be produced by the software (such as circuit diagrams, block and schematic diagrams, assembly and installation drawings, fault diagnosis diagrams)

2.9 describe the national, international and organisational standards and conventions that are used for the drawings

2.10 explain how to set up the drawing template parameters (such as layers of drawings, scale, paper size, colour set up, line types, dimension system and text styles)

2.11 describe the application and use of drawing tools (such as for straight lines, curves and circles; how to add dimensions and text to drawings, producing layers of drawings)

2.12 explain how to access, recognise and use a wide range of standard component symbol libraries from the CAD equipment

2.13 describe the factors to be taken into account when producing engineering system/service drawings (such as safety requirements, operating parameters of components, position of components in relation to other sources or circuits, possibility of external interference, etc)

2.14 describe the system/service equipment and circuits being drawn, and the function of the equipment and individual components within the system/service (such as mechanical, electrical, fluid power, instrumentation and control components)

2.15 describe the selection of the various components, pipes and hoses being used, with regard to such things as pipeline contents, pressure capabilities or heat properties

2.16 describe the need to follow regulations/codes of practice with regard to colour coding/identifying the contents of the pipelines

2.17 describe the use of specific regulations and standard reference tables when selecting cables, pipes, hoses and other service/system components

2.18 explain how pipelines or cables might become damaged or obstruct movement, and the need to consider this in siting and routeing the pipes and cables

2.19 describe the selection of the various electrical components and

	cables being used, with regard to their operating ranges and current carrying capacity
2.20	describe the use of specific regulations and standard reference tables when selecting electrical components and cables (such as IEE regulations)
2.21	describe the constraints laid down by existing national and international legislation, statutory and non-statutory regulations, industry and national standards, industry guidelines and professional codes that regulate engineering system/service drawing/design activities
2.22	describe the need for document control (such as ensuring that completed drawings are approved, labelled and stored on a suitable storage medium, the need to create backup copies and to file them in a separate and safe location away from electromagnetic sources, filing and storing hard copies for use in production)
2.23	describe the procedures for drawing change notes, trial changes, up-issuing of drawings, modifications, and miscellaneous amendments to drawings
2.24	describe the extent of their own responsibility and to whom they should report if they have any problems that they cannot resolve when producing the drawings.

Appendix 1 Relationships to other qualifications

Links to other qualifications

Mapping is provided as guidance and suggests areas of commonality between the qualifications. It does not imply that candidates completing units in one qualification have automatically covered all of the content of another.

Centres are responsible for checking the different requirements of all qualifications they are delivering and ensuring that candidates meet requirements of all units/qualifications.

This qualification has connections to the Level 3 NVQ in Engineering Technical Support (1686).

Literacy, language, numeracy and ICT skills development

This qualification can develop skills that can be used in the following qualifications:

- Functional Skills (England) – see **www.cityandguilds.com/functionalskills**
- Essential Skills (Northern Ireland) – see **www.cityandguilds.com/essentialskillsni**
- Essential Skills Wales – see **www.cityandguilds.com/esw**

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 Manual - Supporting Customer Excellence 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, as well as updates and good practice exemplars for City & Guilds assessment and policy issues. Specifically, the document includes sections on:

- The centre and qualification approval process
- Assessment, internal quality assurance and examination roles at the centre
- Registration and certification of candidates
- Non-compliance
- Complaints and appeals
- Equal opportunities
- Data protection
- Management systems
- Maintaining records
- Assessment
- Internal quality assurance
- External quality assurance

Our Quality Assurance Requirements encompasses all of the relevant requirements of key regulatory documents such as:

- Regulatory Arrangements for the Qualifications and Credit Framework (2008)
- SQA Awarding Body Criteria (2007)
- NVQ Code of Practice (2006)

and sets out the criteria that centres should adhere to pre and post centre and qualification approval.

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:** how to register and certificate candidates on line
- **Qualifications and Credit Framework (QCF)**: general guidance about the QCF and how qualifications will change, as well as information on the IT systems needed and FAQs
- **Events**: dates and information on the latest Centre events
- **Online assessment**: how to register for e-assessments

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www.cityandguilds.com

Useful contacts

UK learners General qualification information	T: +44 (0)844 543 0033 E: **learnersupport@cityandguilds.com**
International learners General qualification information	T: +44 (0)844 543 0033 F: +44 (0)20 7294 2413 E: **intcg@cityandguilds.com**
Centres Exam entries, Certificates, Registrations/enrolment, Invoices, Missing or late exam materials, Nominal roll reports, Results	T: +44 (0)844 543 0000 F: +44 (0)20 7294 2413 E: **centresupport@cityandguilds.com**
Single subject qualifications Exam entries, Results, Certification, Missing or late exam materials, Incorrect exam papers, Forms request (BB, results entry), Exam date and time change	T: +44 (0)844 543 0000 F: +44 (0)20 7294 2413 F: +44 (0)20 7294 2404 (BB forms) E: **singlesubjects@cityandguilds.com**
International awards Results, Entries, Enrolments, Invoices, Missing or late exam materials, Nominal roll reports	T: +44 (0)844 543 0000 F: +44 (0)20 7294 2413 E: **intops@cityandguilds.com**
Walled Garden Re-issue of password or username, Technical problems, Entries, Results, e-assessment, Navigation, User/menu option, Problems	T: +44 (0)844 543 0000 F: +44 (0)20 7294 2413 E: **walledgarden@cityandguilds.com**
Employer Employer solutions, Mapping, Accreditation, Development Skills, Consultancy	T: +44 (0)121 503 8993 E: **business@cityandguilds.com**
Publications Logbooks, Centre documents, Forms, Free literature	T: +44 (0)844 543 0000 F: +44 (0)20 7294 2413

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

About City & Guilds

As the UK's leading vocational education organisation, City & Guilds is leading the talent revolution by inspiring people to unlock their potential and develop their skills. We offer over 500 qualifications across 28 industries through 8500 centres worldwide and award around two million certificates every year. City & Guilds is recognised and respected by employers across the world as a sign of quality and exceptional training.

City & Guilds Group

The City & Guilds Group operates from three major hubs: London (servicing Europe, the Caribbean and Americas), Johannesburg (servicing Africa), and Singapore (servicing Asia, Australia and New Zealand). The Group also includes the Institute of Leadership & Management (management and leadership qualifications), City & Guilds Land Based Services (land-based qualifications), the Centre for Skills Development (CSD works to improve the policy and practice of vocational education and training worldwide) and Learning Assistant (an online e-portfolio).

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