

Level 3 NVQ Diploma in Engineering Technical Support (Quality Control) (1786-31)

September 2011 Version 1.0



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 (Quality Control)	1786-31	600/2085/4



Contents

1	Introduction	4
	Structure	4
2	Centre requirements	6
	Approval	6
	Resource requirements	6
	Candidate entry requirements	8
3	Delivering the qualification	10
	Initial assessment and induction	10
	Recommended delivery strategies	10
	Recording documents	10
4	Assessment	12
	Assessment of the qualification	12
	Recognition of Prior Learning (RPL)	14
5	Units	15
Unit 201	Complying with statutory regulations and organisational safety requirements	16
Unit 202	Using and interpreting engineering data and documentation	20
Unit 303	Working efficiently and effectively in engineering	25
Unit 311	Inspecting mechanical products	30
Unit 312	Inspecting components using Co-ordinate Measuring Machines (CMM)	36
Unit 313	Inspecting fabricated components and structures	42
Unit 314	Carrying out visual inspection of welded fabrications	47
Unit 315	Inspecting and testing electrical products	52
Unit 316	Inspecting and testing electronic products	58
Unit 317	Checking and calibrating mechanical inspection equipment	64
Unit 318	Checking and calibrating electrical and electronic test equipment	69
Unit 319	Checking and calibrating process control instrumentation	74
Appendix 1	Relationships to other qualifications	79
Appendix 2	Sources of general information	80



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 - quality control 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 allow candidates to progress into employment or to the following City & Guilds qualifications: <ul style="list-style-type: none"> • Level 3 NVQ Extended Diploma in Engineering Technical Support

Structure

To achieve the **Level 3 NVQ Diploma in Engineering Technical Support (Quality Control)**, learners must achieve:

- **15** credits from the mandatory units, and
- a minimum of **139** credits from the optional unit group.

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			
Y/600/5511	311	Inspecting mechanical products	142
F/600/5535	312	Inspecting components using Co-ordinate Measuring Machines (CMM)	140

F/600/5549	313	Inspecting fabricated components and structures	142
K/600/5559	314	Carrying out visual inspection of welded fabrications	142
J/600/5570	315	Inspecting and testing electrical products	142
J/600/5603	316	Inspecting and testing electronic products	142
K/600/5612	317	Checking and calibrating mechanical inspection equipment	139
L/600/5618	318	Checking and calibrating electrical and electronic test equipment	139
H/600/5625	319	Checking and calibrating process control instrumentation	139



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.

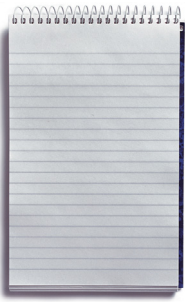
City & Guilds endorses several ePortfolio systems. Further details are available at: www.cityandguilds.com/eportfolios.

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: <ul style="list-style-type: none">• 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:<ul style="list-style-type: none">o eye protection and Personal Protective Equipment (PPE)o COSHH regulationso risk assessments

<ul style="list-style-type: none"> • identifying the warning signs and labels of the main groups of hazardous or dangerous substances • complying with the appropriate statutory regulations at all times <p>1.3 present themselves in the workplace suitably prepared for the activities to be undertaken</p> <p>1.4 follow organisational accident and emergency procedures</p> <p>1.5 comply with emergency requirements, to include:</p> <ul style="list-style-type: none"> • 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 <p>1.6 recognise and control hazards in the workplace</p> <p>1.7 identify the hazards and risks that are associated with the following:</p> <ul style="list-style-type: none"> • 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 <p>1.8 use correct manual lifting and carrying techniques</p> <p>1.9 demonstrate one of the following methods of manual lifting and carrying:</p> <ul style="list-style-type: none"> • lifting alone • with assistance of others • with mechanical assistance <p>1.10 apply safe working practices and procedures to include:</p> <ul style="list-style-type: none"> • 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:	<p>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.</p>

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: <ul style="list-style-type: none">• 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: <ul style="list-style-type: none">• 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)

<ul style="list-style-type: none"> • 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 <p>1.8 deal promptly and effectively with any problems within their control and report those which cannot be solved</p> <p>1.9 report any inaccuracies or discrepancies in documentation and specifications.</p>
--

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 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:	<p>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.</p> <p>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.</p> <p>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</p>

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

<ul style="list-style-type: none"> • supplier relationships • internal communication • customer service • training and development • teamwork • other <p>1.12 maintain effective working relationships with colleagues to include two of the following:</p> <ul style="list-style-type: none"> • colleagues within own working group • colleagues outside normal working group • line management • external contacts <p>1.13 review personal training and development as appropriate to the job role</p> <p>1.14 review personal development objectives and targets to include one of the following:</p> <ul style="list-style-type: none"> • 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 311

Inspecting mechanical products

UAN:	Y/600/5511
Level:	3
Credit value:	142
GLH:	287
Relationship to NOS:	This unit has been derived from National Occupational Standard engineering technical support Unit No 11: inspecting mechanical products (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:	<p>This unit covers the skills and knowledge needed to prove the competences required to inspect mechanical products, in accordance with approved procedures. The learner will be required to prepare the work area, ensuring that it is safe and free from hazards, to obtain all relevant and current documentation, and to obtain the tools and equipment required. The learner will be required to select the appropriate inspection equipment, based on the features to be checked and the accuracy to be measured. This will involve checking that the appropriate equipment is within current test dates and, where necessary, setting up and calibrating the equipment ready for the inspection operations to be performed. In carrying out the inspection activities, the learner will be expected to check the components for both dimensional and geometrical accuracy, and this may be required to be undertaken at various stages of manufacture, such as random sampling during production, pre-assembly, intermediate and final assembly. components to be inspected could include machined components, pressings, mouldings, castings, forgings, assemblies and sub-assemblies, treated and coated components.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for inspecting mechanical</p>

products, and to report any problems that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to ensure that all tools and equipment used to inspect the mechanical product are correctly accounted for on completion of the activities and are returned to the correct location. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the 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 inspection techniques and procedures to mechanical products including, where appropriate, British, European and International standards. The learner will understand how to use the appropriate tools and equipment to inspect mechanical products, in adequate depth to provide a sound basis for carrying out the inspection activities and identifying where features of the products do not meet the required specification tolerances.

The learner will understand the safety precautions required when carrying out the inspection 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. inspect mechanical products
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 follow the correct specification for the product or equipment being inspected 1.3 use the correct equipment to carry out the inspection 1.4 inspect mechanical products, using twelve of the following: <ul style="list-style-type: none">• rule or tape• external micrometer• internal micrometer• depth micrometer• height micrometer• specialist micrometers

- length vernier
- depth vernier
- height vernier
- straight edge
- engineer's square
- gap gauge
- feeler gauge
- hole gauge
- thread gauge
- thread wires
- slip gauge
- protractors
- sine bar or table
- dial test indicator
- radius/profile gauges
- torque wrench
- inclinometer
- surface texture comparison plates
- surface texture measuring machines
- optical equipment (such as shadowgraphs, microscopes)
- temperature gauges
- flow meters
- pressure gauges
- co-ordinate measuring machines
- electrical measuring equipment
- visual checks for appearance and completion
- other specific equipment

1.5 use the relevant equipment to measure and check twelve of the following features:

- external diameters
- internal diameters/bores
- length/linear dimensions
- shoulders and steps
- depth
- internal tapers
- external tapers
- eccentric features
- recesses
- slots
- thread fit
- thread form/profile
- internal profiles/forms/surfaces
- external profiles/forms/surfaces
- angular faces
- chamfers and radii

- grooves/undercuts
- counterbored/countersunk holes
- holes or slots on pitch circles
- holes or slots on linear/angular pitch
- special forms (such as gear, spline, serrations)
- fit/working clearance
- physical properties (such as hardness)
- bonding strength
- coating thickness
- torque
- electrical characteristics

1.6 use appropriate equipment to check eight of the following geometric features:

- flatness
- alignment
- squareness
- ovality/lobing
- straightness
- position/location
- orientation
- concentricity
- eccentricity
- level
- verticality
- parallelism
- geometry
- distortion
- surface finish

1.7 identify and confirm the inspection checks to be made and acceptance criteria to be used

1.8 carry out all required inspections as specified

1.9 carry out all of the following during the inspecting activities:

- obtain and use the correct issue of drawings, job instructions and specifications
- obtain and check the condition and calibration dates of tools, measuring instruments and equipment to be used
- follow specified or appropriate inspection procedures
- use the correct and appropriate tools and equipment at all times
- apply adjustment of inspection results for temperature correction (where applicable)
- identify and record out-of-specification features, in the appropriate format
- investigate and, where appropriate, obtain a concession for out-of-specification products
- place products in the correct location on completion of the inspection activities (in and out of specification)
- leave the work area in a safe and tidy condition on completion

of the activities

1.10 inspect one of the following types of mechanical product:

- machined components
- mechanical assemblies/sub-assemblies
- pressings
- mouldings
- castings
- forgings
- overhauled products
- treated/coated components
- extrusions
- patterns
- other

1.11 carry out two of the following inspection procedures:

- first/one-off
- in-process sample/patrol inspection
- statistical quality control
- one hundred percent final inspection of components or products
- random/selective sampling of finished components or product

1.12 identify any defects or variations from the specification

1.13 record the results of the inspection in the appropriate format

1.14 complete inspection documentation, to include one from the following, and pass to the appropriate people:

- inspection report
- concession report
- job card
- customer specific documentation

1.15 deal promptly and effectively with problems within their control and report those that cannot be solved.

Learning outcome

The learner will:

2. know how to inspect mechanical products

Assessment criteria

The learner can:

2.1 describe the specific safety precautions to be taken when inspecting mechanical components (such as specific legislation or regulations governing the activities or work area, safe working practices and procedures to be adopted, general workshop safety practice)

2.2 describe the health and safety requirements of the work area in which they are carrying out the inspection activities, and the responsibility these requirements place on them

2.3 describe the COSHH regulations with regard to the substances used in the inspection process

2.4 describe the hazards associated with inspecting mechanical products, and how they can be minimised

2.5 describe the appropriate Personal Protective Equipment and

- clothing to be worn during the inspection activities
- 2.6 explain how and where to obtain the required drawings and related specifications, and how to check that they are current and complete
 - 2.7 explain how to extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS or ISO standards) in relation to work undertaken
 - 2.8 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing
 - 2.9 describe the use of British, European and International standards in determining if components and products are fit for purpose
 - 2.10 describe the general principles of quality assurance systems and procedures
 - 2.11 describe the preparations to be undertaken before the product is inspected
 - 2.12 describe the effects that the environment may have on the measurements taken (such as in particular where precision measurements are concerned)
 - 2.13 describe the need to select and use set datum faces, and the effects of taking readings from different datums (such as accumulation of limits leading to errors)
 - 2.14 describe the application and uses of the tools and equipment to inspect mechanical products (such as micrometers, Verniers, gauges, special measuring equipment)
 - 2.15 explain how to determine the correct equipment for the feature to be inspected, taking into account tolerances to be achieved
 - 2.16 describe the importance of ensuring that tools and equipment are set up correctly and are in a safe and useable condition
 - 2.17 describe the procedure and methods used to check that tools and equipment are within calibration date
 - 2.18 explain why sampling is used, and when it is an effective means of quality assurance
 - 2.19 describe the typical defects and variations that can be found on mechanical products, and how to identify them
 - 2.20 describe the need to carry out the checks and to record the results on the appropriate documentation
 - 2.21 describe the procedure to be followed when inspected products are out of specification
 - 2.22 describe the importance of completing inspection documentation, what needs to be recorded and where records are kept
 - 2.23 describe the extent of their own responsibility and to whom they should report if they have any problems that they cannot resolve.

Unit 312

Inspecting components using Co-ordinate Measuring Machines (CMM)

UAN:	F/600/5535
Level:	3
Credit value:	140
GLH:	287
Relationship to NOS:	This unit has been derived from National Occupational Standard engineering technical support Unit No 12: inspecting components using Co-ordinate Measuring Machines (CMM) (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:	<p>This unit covers the skills and knowledge needed to prove the competences required to inspect components using manual and/or computer numerical control (CNC) Co-ordinate Measuring Machines (CMM), in accordance with approved procedures. The learner will be required to prepare and set up the equipment in readiness for the inspection operations. This will involve obtaining and using the correct issue of drawings, job instructions and specifications including, where appropriate, downloading the correct CNC measuring program. The learner will be expected to set up the co-ordinate measuring machine, to position and secure the component/product in a suitable location, and to select and mount the correct inspection probes. In carrying out the inspection activities, the learner will be expected to check the components/product for both dimensional and geometrical accuracy, and this may be required to be undertaken at various stages of the engineering/manufacturing process, such as first-off inspection, during production and final inspection. Components to be inspected could include machined components, pressings, mouldings, extrusions, castings, forgings, patterns, assemblies and sub-assemblies, treated and coated components.</p>

The learner's responsibilities will require them to comply with organisational policy and procedures for the setting-up and operating activities undertaken, and to report any problems with the equipment, tooling, programs or setting-up activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work 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 the quality control procedures used. The learner will understand the co-ordinate measuring equipment being used, and its application, and will know about the inspection probes, setting-up and operating procedures, in adequate depth to provide a sound basis for using the equipment effectively, identifying faults and ensuring that the inspection activities are carried out to the required specification.

The learner will understand the safety precautions required when working with the machine and its associated equipment. 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. inspect components using Co-ordinate Measuring Machines (CMM)
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 follow the correct specification for the product or equipment being inspected 1.3 use the correct equipment to carry out the inspection activities 1.4 use one of the following types of manual and/or CNC co-ordinate measuring machines: <ul style="list-style-type: none">• vertical• horizontal• gantry/bridge• other specific type 1.5 mount the workpiece in a suitable position, using two of the

following:

- directly to the machine table
- on angle plates
- in special jigs
- on parallels
- on vee blocks
- other mounting methods

1.6 identify and confirm the inspection checks to be made and acceptance criteria to be used

1.7 carry out all required inspections as specified

1.8 carry out all of the following during the inspecting activities:

- obtain and use the correct issue of drawings, job instructions and specifications
- follow specified and appropriate inspection procedures
- identify and record any out-of-tolerance dimensions/features, in the appropriate format
- investigate and obtain concessions for out-of-specification products (where appropriate)
- place products in the correct location on completion of the inspection activities (in and out of specification)
- shut down the equipment using the correct procedure
- leave the work area in a safe and tidy condition on completion of the inspection activities

1.9 inspect one of the following types of engineering components/equipment:

- machined components
- mechanical assemblies/sub-assemblies
- pressings
- mouldings
- patterns
- castings
- forgings
- overhauled components/products
- extrusions
- other specific components/products

1.10 carry out two of the following inspection procedures:

- first/one-off
- in-process sample inspection
- one hundred percent final inspection of components or products
- statistical quality control

1.11 check all of the following, as applicable to the machine type:

- check that datums for each machine axis are set in relation to equipment, components and probes selected
- where applicable, download the CNC program into the controller, safely and correctly
- select and mount suitable inspection probes for the different features to be checked

- calibrate the inspection probe (where applicable)
 - enter the probe information correctly into the machine controller/operating system
 - ensure that probe changes are carried out safely and clear from obstructions
 - check that all inspection operations and probe movements are executed safely and correctly
 - ensure that any alterations to programs are communicated fully to the appropriate personnel (where applicable)
- 1.12 inspect components/products that have a range of different features and cover twelve of the following:
- diameters
 - internal diameters/bores
 - tapered diameters
 - tapered bores
 - shoulders and steps
 - linear dimensions (lengths)
 - depths
 - threads
 - eccentric features
 - angular faces
 - internal profiles/forms/surfaces
 - external profiles/forms/surfaces
 - grooves/undercuts
 - recesses
 - slots
 - holes or slots on linear/angular pitch
 - holes or slots on pitch circles
 - counterbored/countersunk holes
 - special forms (such as gear, spline, serrations)
- 1.13 check four of the following geometric features:
- flatness
 - alignment
 - squareness
 - ovality/lobing
 - straightness
 - position/location
 - concentricity
 - eccentricity
 - parallelism
 - geometry
 - distortion
 - surface finish
- 1.14 identify any defects or variations from the specification
- 1.15 record the results of the inspection in the appropriate format
- 1.16 complete inspection documentation, to include one from the following, and pass to the appropriate people:

- inspection report
- concession report
- job card
- customer specific documentation

1.17 deal promptly and effectively with problems within their control and report those that cannot be solved.

Learning outcome

The learner will:

2. know how to inspect components using Co-ordinate Measuring Machines (CMM)

Assessment criteria

The learner can:

- 2.1 describe the specific safety precautions to be taken when inspecting components/products (such as specific legislation or regulations governing the activities or work area, safe working practices and procedures to be adopted, general workshop safety practice)
- 2.2 describe the health and safety requirements of the work area in which they are carrying out the inspection activities, and the responsibility these requirements place on them
- 2.3 describe the COSHH regulations with regard to the substances used in the inspection process
- 2.4 describe the hazards associated with inspecting components/products, and how they can be minimised
- 2.5 describe the appropriate Personal Protective Equipment and clothing to be worn during the inspection activities
- 2.6 explain how and where to obtain the required drawings and/or CNC operating program and related specifications
- 2.7 describe the importance of checking that all inspection documentation, programs and specifications are current and complete
- 2.8 explain how to extract information from engineering drawings and or CNC operating programs and related specifications (to include codes, symbols and conventions to appropriate BS or ISO standards) in relation to the inspection work being undertaken
- 2.9 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing
- 2.10 describe the use of British, European and International standards in determining if components and products are fit for purpose
- 2.11 describe the general principles of quality assurance systems and procedures
- 2.12 describe the preparations to be undertaken before the component/product is inspected
- 2.13 describe the application of different co-ordinate measuring machines (such as vertical, horizontal and gantry/bridge)
- 2.14 describe the function keys and operating system used on co-ordinate measuring machines
- 2.15 describe the application of the different types of inspection probes that are available
- 2.16 describe the importance of ensuring that equipment is set up correctly and is in a safe and useable condition

- 2.17 describe the systems of measurement that are used on co-ordinate measuring machines
- 2.18 explain how to ensure that inspection probes are correctly calibrated before undertaking the inspection activities
- 2.19 explain how to deal with equipment and/or program error messages
- 2.20 describe the effects that the environment may have on the measurements taken, particularly where precision measurements are required
- 2.21 describe the need to select and use set datum points, and the effects of taking readings from different datums (such as accumulation of limits, leading to errors)
- 2.22 explain why sampling is used, and when it is an effective means of quality assurance
- 2.23 describe the typical defects and variations that can be found on components/products, and how to identify them
- 2.24 describe the procedure to be followed when inspected products are out of specification (including obtaining concessions, where appropriate)
- 2.25 describe the importance of completing inspection documentation, what needs to be recorded and where records are kept
- 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 313

Inspecting fabricated components and structures

UAN:	F/600/5549
Level:	3
Credit value:	142
GLH:	287
Relationship to NOS:	This unit has been derived from National Occupational Standard engineering technical support Unit No 13: inspecting fabricated components and structures (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:	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out the dimensional and visual inspection of fabricated components and structures, in accordance with approved procedures. The learner will be required to select the appropriate inspection equipment, based on the features to be checked and the accuracy to be measured. This will involve checking that the appropriate equipment is within current test dates and, where necessary, setting up and calibrating the equipment ready for the inspection operations to be performed. In carrying out the inspection activities, the learner will be expected to check the components for both dimensional and geometrical accuracy, and this may be required to be undertaken at various stages of manufacture, such as pre-assembly, intermediate and final assembly. components to be inspected could include fabricated frames, tanks, pipe sections, modular components, fabricated tubular components and fabricated structures.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the inspection activities, seeking out relevant information for the activities undertaken, and to report any problems with the inspection equipment or activities that they cannot personally resolve, or that are outside their personal</p>

authority, to the relevant people. The learner will be expected to work 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 inspection procedures to fabricated components and structures. The learner will understand the inspection process and its application, and will know about the equipment and inspection techniques, 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 fabricated components, and the safeguards necessary for undertaking the activities safely and correctly. The learner will be required to demonstrate safe working practices and procedures throughout, and will understand the responsibility they owe to themselves and others in the workplace.

Learning outcome
The learner will: 1. inspect fabricated components and structures
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 follow the correct specification for the product or equipment being inspected 1.3 carry out the inspection checks to one of the following quality and accuracy standards: <ul style="list-style-type: none">• approved construction drawings• client specifications/detail drawings• applicable national and international standards 1.4 use the correct equipment to carry out the inspection activities 1.5 use six of the following types of inspection equipment: <ul style="list-style-type: none">• rules and tapes• squares• spirit levels• dividers• gauges• protractors• plumb lines• callipers

- Vernier instruments
 - torque instruments
 - rafter squares
 - templates and jigs
 - theodolites
 - laser equipment
- 1.6 identify and confirm the inspection checks to be made and acceptance criteria to be used
- 1.7 carry out all required inspections as specified
- 1.8 carry out all of the following activities during the inspection process:
- observe all the required safety procedures for the work area/activity
 - obtain and use the correct issue of drawings, job instructions and specifications
 - obtain and check the condition and calibration dates of tools, measuring instruments and equipment used
 - place and coordinate temporary survey stations, where required
 - perform the dimensional survey and determine out-of-tolerance values
 - apply adjustment of survey results for temperature correction (where applicable)
 - produce recommendations for control of final global dimensions, using intermediate data
 - report and investigate the possibility of gaining a concession for out-of-specification products
 - leave the work area in a safe and tidy condition on completion of the activities
- 1.9 carry out the inspection of two of the following types of fabrications:
- fabricated frames
 - structures
 - square/rectangular tanks
 - curved/profiled structures
 - trunking/ducting systems
 - pipe sections
 - cylindrical components
 - conical components
 - tubular structures
 - panels
 - transformers
 - reduction pieces
 - segmented bends
 - modular components
 - other specific fabrication
- 1.10 carry out twelve of the following checks:
- dimensional accuracy
 - squareness
 - angle

<ul style="list-style-type: none"> • alignment • circularity or ovality • visual appearance • straightness • position/location • freedom from distortion/damage • completeness • flatness • orientation • security of joints • weld size and profile • computation of best-fit centres • prediction of erection positions • development of cut lines • computation of allowances for weld gap tolerances and weld shrinkage for attainment of global tolerances • practical allowances for expansion and contraction <p>1.11 identify any defects or variations from the specification</p> <p>1.12 record the results of the inspection in the appropriate format</p> <p>1.13 complete inspection documentation, to include one from the following, and pass to the appropriate people:</p> <ul style="list-style-type: none"> • inspection report • concession report • job card • customer specific documentation <p>1.14 deal promptly and effectively with problems within their control and report those that cannot be solved.</p>
--

Learning outcome
The learner will: 2. know how to inspect fabricated components and structures
Assessment criteria
The learner can: 2.1 describe the specific safety precautions to be taken when inspecting fabricated components (specific legislation or regulations governing the activities or work area, safe working practices and procedures to be adopted, general workshop safety practice, relevant sections of COSHH 2.2 describe the personal protective clothing and equipment that should be worn (such as leather gloves, eye protection, ear protection, safety harness, etc) 2.3 describe the hazards associated with inspecting fabricated products (such as working at height, handling fabricated structures, slips, trips and falls), and how they can be minimised 2.4 explain how and where to obtain the required drawings and related specifications, and how to check that they are current and complete 2.5 explain how to extract information from engineering drawings and related specifications (to include symbols and conventions to

- appropriate BS or ISO standards), in relation to work undertaken
- 2.6 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing
 - 2.7 describe the use of British, European and International standards in determining if components and products are fit for purpose
 - 2.8 describe the general principles of quality assurance systems and procedures
 - 2.9 describe the preparations to be undertaken before the product is inspected
 - 2.10 describe the visual and dimensional inspection methods and techniques that are used for fabrications
 - 2.11 describe the need to select and use set datum faces, and the effects of taking readings from different datums (such as accumulation of limits leading to errors)
 - 2.12 describe the effects that the environment may have on the measurements taken (such as where precision measurements are concerned)
 - 2.13 describe the equipment that is used to carry out the various inspection checks (such as rules and tapes, precision Vernier instruments, levels and plumb lines, laser equipment and theodolite)
 - 2.14 describe the importance of ensuring that tools and equipment are set up correctly and are in a safe and useable condition
 - 2.15 describe the need to check that the equipment is approved for the inspection activities undertaken (including calibration checks and current certification dates)
 - 2.16 describe the techniques used to check for alignments, verticality and roundness/ovality
 - 2.17 describe the need to carry out the checks and to record the results on the appropriate documentation
 - 2.18 describe the calculations used to adjust survey results for temperature differences
 - 2.19 explain how to calculate and predict erection positions from the data given
 - 2.20 explain how to calculate allowances for weld gaps and weld shrinkage, in order to attain overall global tolerances
 - 2.21 describe the typical defects and variations that can be found on the fabrications, and how to identify them
 - 2.22 explain why sampling is used, and when it is an effective means of quality assurance
 - 2.23 describe the procedure to be followed when inspected products are out of specification
 - 2.24 describe the importance of completing inspection documentation, what needs to be recorded and where records are kept
 - 2.25 describe the extent of their own responsibility and to whom they should report if they have any problems that they cannot resolve.

Unit 314

Carrying out visual inspection of welded fabrications

UAN:	K/600/5559
Level:	3
Credit value:	142
GLH:	287
Relationship to NOS:	This unit has been derived from National Occupational Standard engineering technical support Unit No 14: carrying out visual inspection of welded fabrications (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:	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out the dimensional and visual inspection of welded fabrications, in accordance with approved procedures. This includes checks during production, and post fabrication checks. The learner will be required to select the appropriate inspection equipment, based on the features to be checked and the accuracy to be measured. This will involve checking that the appropriate equipment is within current test dates and, where necessary, setting up and calibrating the equipment ready for the inspection operations to be performed. The learner will check that the materials to be fabricated are in the specified state and condition, and that the set-up arrangements for welding are correct. inspection during manufacture will check that welding activities are proceeding according to the welding procedure specification and good practice. On completion of welding and fabrication activities, the learner will visually inspect the welded joints against the acceptance criteria, and check that dimensions and distortion are within specified tolerances. The learner will mark areas where non-compliance exists and record the results of the inspection.</p>

The learner's responsibilities will require them to comply with organisational policy and procedures for the inspection activities,

seeking out relevant information for the activities undertaken, and reporting any problems with the inspection equipment or activities that they cannot personally resolve, or that are outside their personal authority, to the relevant people. The learner will be expected to work 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 visual inspection procedures to welded fabrications. The learner will understand the inspection process and its application, and will know about the equipment and inspection techniques, 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 fabricated components, and the safeguards necessary for undertaking the activities safely and correctly. The learner will be required to demonstrate safe working practices and procedures throughout, and will understand the responsibility they owe to themselves and others in the workplace.

Learning outcome
The learner will: 1. carry out visual inspection of welded fabrications
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 follow the correct specification for the product or equipment being inspected 1.3 carry out the inspection checks to one or more of the following: <ul style="list-style-type: none">• approved construction drawings• client specifications/detail drawings• applicable national and international standards• welding procedure specification 1.4 use the correct equipment to carry out the inspection activities 1.5 ensure that they have the required inspection equipment and that it is in good working order, to include six of the following, as appropriate to the operation/features being checked: <ul style="list-style-type: none">• weld measuring gauge• rule, tape or other linear measuring device

- adjustable square/protractor
 - depth gauge
 - bore scope
 - CCTV viewing system
 - magnifying glass
 - mirror
 - portable lighting
 - means of marking defective areas
- 1.6 identify and confirm the inspection checks to be made and acceptance criteria to be used
- 1.7 carry out all required inspections as specified
- 1.8 carry out all of the following activities during the inspection process:
- observe all the required safety procedures for the work area/activity
 - obtain and use the correct issue of drawings, job instructions and welding procedure specifications
 - obtain and check the condition and calibration dates of tools, measuring instruments and equipment used
 - follow specified or appropriate inspection procedures
 - identify and record out-of-specification features, in the appropriate format
 - mark and identify areas where non-compliance with specification or defect indications are found
 - leave the work area in a safe and tidy condition on completion of the activities
- 1.9 carry out specified prefabrication or sub-assembly inspection checks, to include all of the following:
- the condition of joint preparations
 - welded joint preparation dimensions
 - flatness or profile of sheets, plates, and linearity of sections
 - the set-up arrangements for welding
 - the condition of consumables
- 1.10 carry out the inspection of two of the following types of welded fabrications:
- fabricated frames
 - structures
 - square/rectangular tanks
 - curved/profiled structures
 - pipe sections
 - cylindrical components
 - conical components
 - tubular structures
 - transformers
 - segmented bends
 - modular components
 - other specific fabrications
- 1.11 carry out specified inspection during fabrication, to check all of the following:

<ul style="list-style-type: none"> • condition of the weld root zone and inter-runs • inter-run cleaning of weld faces and surfaces • distortion and shrinkage <p>1.12 carry out the specified final inspection checks, to include all of the following:</p> <ul style="list-style-type: none"> • overall dimensional tolerances • extent of distortion, shrinkage or misalignment • visual appearance of welds/weld profile • evidence of damage (requiring restoration) • defect indications manifested on weld or parent metal surface • extent of excess metal, undercut, penetration or lack of penetration <p>1.13 identify any defects or variations from the specification</p> <p>1.14 record the results of the inspection in the appropriate format</p> <p>1.15 complete the inspection documentation, to include one from the following, and pass to the appropriate people:</p> <ul style="list-style-type: none"> • weld inspection report • job card • customer specific documentation • concession report <p>1.16 deal promptly and effectively with problems within their control and report those that cannot be solved.</p>
--

Learning outcome
The learner will:
2. know how to carry out visual inspection of welded fabrications
Assessment criteria
The learner can:
2.1 describe the specific safety precautions to be taken when inspecting welded fabrications (such as specific legislation or regulations governing the activities or work area, safe working practices and procedures to be adopted, general workshop safety practice, risk assessment procedures and relevant requirements of HASAWA, COSHH and work equipment regulations)
2.2 describe the personal protective clothing and equipment that should be worn (such as leather gloves, eye protection, ear protection, safety harness, etc.)
2.3 describe the hazards associated with the inspecting welded fabrications (such as working at height, safety in enclosed/confined spaces, handling fabricated structures, slips, trips and falls), and how they can be minimised
2.4 explain how and where to obtain the required drawings and related specifications, and how to check that they are current and complete
2.5 explain how to extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS or ISO standards) in relation to work undertaken
2.6 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing

- 2.7 explain how to extract information required from drawings and welding procedure specifications (such as interpretation of welding symbols; scope, content and application of the welding procedure specification)
- 2.8 describe the types and features of welded joints in plate, tube and sections (including fillet and butt welds, single and multi-run welds, welding positions, weld quality)
- 2.9 describe the use of British, European and International standards in determining if welded fabrications are fit for purpose
- 2.10 describe the general principles of quality assurance systems and procedures
- 2.11 describe the preparations to be undertaken before the welded fabrications are inspected (such as access to test area cleanliness and physical condition of test area)
- 2.12 describe the visual and dimensional inspection methods and techniques that are used for welded fabrications
- 2.13 describe the equipment that is used to carry out the various inspection checks (such as rules and tapes, weld measuring gauge, bore scope, optical aids (such as magnifying glass and mirror), CCTV viewing system)
- 2.14 describe the things that need to be checked prior to welding the fabrications (such as joint preparation, joint set-up, parent metal condition, condition of consumables, equipment settings)
- 2.15 describe the features of the welded joints to be checked (such as linearity or profile, weld root run, inter-runs, final dimensional tolerances, distortion, shrinkage, visual appearance of welds, excess weld metal, undercut, penetration and profile)
- 2.16 explain how to calculate allowances for weld gaps and weld shrinkage, in order to attain overall global tolerances
- 2.17 describe the acceptance criteria to be used, and the influence of defects on the service performance of the fabrications (including risks and consequences of failure)
- 2.18 describe the need to carry out the checks and to record the results using the appropriate documentation
- 2.19 describe the procedure to be followed when inspected products are out of specification
- 2.20 describe the importance of completing inspection documentation, what needs to be recorded and where records are kept
- 2.21 describe the extent of their own responsibility and to whom they should report if they have any problems that they cannot resolve.

Unit 315

Inspecting and testing electrical products

UAN:	J/600/5570
Level:	3
Credit value:	142
GLH:	287
Relationship to NOS:	This unit has been derived from National Occupational Standard engineering technical support Unit No 15: inspecting and testing electrical products (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:	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out visual inspections and specific tests on electrical products, in accordance with approved procedures. The learner will be required to carry out pre-test inspections and tests of electrical products such as motors, transformers, power or control equipment, white goods, brown goods and electrical panels, to establish that they are safe and to specification. The learner will be required to use a range of electrical test instruments to carry out the necessary measurements.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the inspection and testing activities undertaken, and to report any problems with these activities, or with the tools and equipment used that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work 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.</p> <p>The learner's knowledge will provide a sound understanding of their work, and will provide an informed approach to applying test procedures to electrical products. The learner will understand the equipment being</p>

worked on, the test equipment to be used, and the various test procedures, in adequate depth to provide a sound basis for carrying out the activities to the required specification. In addition, the learner will be expected to review the outcome of the tests, to compare the results with appropriate standards, to determine the action required, and to record and report the results in the appropriate format.

The learner will understand the safety precautions required when carrying out the inspection and testing activities, especially those for isolating the equipment and for taking the necessary safeguards to protect themselves and others against direct and indirect electric shock. 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. inspect and test electrical products
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 follow the appropriate procedures for use of tools and equipment to carry out the required tests 1.3 carry out two of the following inspection procedures: <ul style="list-style-type: none">• first/one-off• in-process/sample• final inspection 1.4 set up and carry out the tests using the correct procedures and within agreed timescales 1.5 carry out all of the following during the testing activities: <ul style="list-style-type: none">• obtain and use the correct issue of company and/or manufacturers' drawings and testing documentation• adhere to risk assessment, COSHH and other relevant safety standards• check that test equipment is correctly calibrated and appropriate for test(s) to be carried out• provide safe access and working arrangements for the testing area• carry out the inspection and testing activities, using appropriate techniques and procedures• operate test equipment within its specification range• apply adjustment of inspection results for temperature correction (where applicable)

- identify and record out-of-specification features, in the appropriate format
- report and investigate the possibility of gaining a concession for out-of-specification products
- place products in the correct location on completion of the inspection activities (in and out of specification)
- leave the work area in a safe and tidy condition on completion of the activities

1.6 carry out tests on two of the following types of electrical equipment:

- rotating equipment (such as motors, alternators)
- power equipment (such as transformers/inductors)
- control equipment (such as switchgear, distribution equipment)
- bus bar systems
- electrical panels
- fans/blowers
- heating equipment
- portable tools/equipment
- white goods
- brown goods
- emergency power equipment
- electrical plant
- alarm equipment
- process control equipment
- communication equipment
- wiring looms/harnesses
- vehicle control equipment
- power supplies
- other specific equipment

1.7 carry out visual inspection of electrical products, to include ensuring all of the following:

- all manufacturing/assembly procedures are complete
- all components are correctly orientated, positioned and secured
- all connections are mechanically secure
- products are free from damage or obvious defects

1.8 carry out tests using four of following:

- oscilloscope
- ohmmeter
- ammeter
- voltmeter (such as 2-pole voltage detector)
- torque tester
- flash tester
- multimeter
- insulation resistance tester
- loop impedance tester
- specialist test equipment

<ul style="list-style-type: none"> • current injection tester • Residual Current Device (RCD) tester • Portable Appliance Tester (PAT) • EMC meter <p>1.9 use the relevant test equipment to measure and check five of the following:</p> <ul style="list-style-type: none"> • protective resistance values • insulation resistance values • current levels • voltage detection/levels • continuity • power rating • resistance • polarity • capacitance • frequency values • inductance • safety device trip speed • specialised tests (such as speed, sound levels, temperature, interference) <p>1.10 record the results of the tests in the appropriate format</p> <p>1.11 complete the relevant paperwork, using one of the following, and pass it to the appropriate person:</p> <ul style="list-style-type: none"> • inspection report • customer specific documentation • concession report • job card <p>1.12 review the results and carry out further tests if necessary</p> <p>1.13 check that the electrical products meet one of the following quality and accuracy standards:</p> <ul style="list-style-type: none"> • BS or ISO standards and procedures • customer standards and requirements • statutory regulations • company standards and procedures • specific system requirements.
--

Learning outcome
The learner will: 2. know how to inspect and test electrical products
Assessment criteria
The learner can: 2.1 describe the specific safety precautions to be taken when inspecting and testing electrical products (such as specific legislation or regulations governing the activities or work area, safe working practices and procedures to be adopted, general workshop safety practice, erection of protective barriers, displaying of warning notices)

- 2.2 describe the health and safety requirements of the work area where they are carrying out the testing activities, and the responsibility these requirements place on them
- 2.3 describe the hazards associated with inspecting and testing electrical products, and how they can be minimised
- 2.4 describe the importance of wearing protective clothing and other appropriate safety equipment during the electrical inspection and testing activities
- 2.5 describe the equipment isolation and lock-off procedure that applies to the testing activities
- 2.6 explain how to recognise and deal with victims of electrical shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first aid resuscitation)
- 2.7 describe the protection techniques for electrical systems (to prevent burn or fire risk)
- 2.8 explain how to obtain and interpret drawings, circuit and physical layouts, charts, specifications, manufacturers' manuals, history/maintenance reports, graphical electrical symbols, IEE wiring regulations, and other documents needed in the testing activities
- 2.9 describe the use of British, European and International standards in determining if components and products are fit for purpose
- 2.10 describe the general principles of quality assurance systems and procedures
- 2.11 describe the preparations to be undertaken before the product is inspected and tested
- 2.12 describe the types of test equipment to be used, and their selection for particular types of tests
- 2.13 explain how to ensure that the test equipment is maintained and correctly calibrated, in accordance with the appropriate organisational procedures
- 2.14 explain how to connect the appropriate test equipment for the measurement of resistance, current, voltage, power, capacitance, inductance, frequency, power factor, and protective device disconnection/trip times
- 2.15 describe the various testing methods and procedures, as recommended in approved electrical codes of practice, and how to apply them to different operating conditions
- 2.16 explain why sampling is used, and when it is an effective means of quality assurance
- 2.17 explain how to display/record test results, and the documentation to be used
- 2.18 explain how to interpret the value and significance of the test readings
- 2.19 explain how to analyse test results using tables in approved electrical codes of practice, and how to use comparison and sequential techniques
- 2.20 describe the importance of ensuring that test equipment is used only for its intended purpose and within its specified range and limits
- 2.21 describe the typical defects and variations that can be found on electrical products, and how to identify them
- 2.22 describe the problems or errors that could occur and which may

- affect the test results, and how they can be avoided
- 2.23 describe the environmental control and company operating procedures relating to the testing activities
 - 2.24 describe the importance of completing inspection documentation, what needs to be recorded and where records are kept
 - 2.25 describe the procedure to be followed when inspected products are out of specification
 - 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 316

Inspecting and testing electronic products

UAN:	J/600/5603
Level:	3
Credit value:	142
GLH:	287
Relationship to NOS:	This unit has been derived from National Occupational Standard engineering technical support Unit No 16: inspecting and testing electronic products (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:	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out visual inspection and tests on electronic products, in accordance with approved procedures. The learner will be required to satisfy all preliminary essentials, such as obtaining risk assessment/permits to work, following clean work area protocols in appropriate cases. In addition, the learner will be expected to check the currency of and review testing requirements, set up and prepare the testing facilities for use, conduct prescribed tests, consider the implications of the results obtained and record and report their findings.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the testing activities undertaken, and to report any problems with the activities or with the tools and equipment used that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking full responsibility for their own actions and for the quality and accuracy of the work that they carry out.</p> <p>The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying inspection and test procedures for electronic products. The learner will understand the basic</p>

operating principles of the items being tested, and their application, in adequate depth to provide a sound basis for carrying out the activities and recognising when circuits/components do not meet the required specification.

The learner will understand the safety precautions required when working in the electronic product and circuit-testing environment, and with the equipment that is used. 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. inspect and test electronic products
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 follow the appropriate procedures for use of tools and equipment to carry out the required tests 1.3 carry out tests which comply with one or more of the following standards: <ul style="list-style-type: none">• BS or ISO standards and procedures• customer standards and requirements• company standards and procedures• other international standards• statutory regulations• specific system requirements 1.4 carry out two of the following inspection procedures: <ul style="list-style-type: none">• first/one-off• in-process/sample• final inspection 1.5 use technical information to assist in the inspection and testing activities, by referring to three of the following: <ul style="list-style-type: none">• technical manuals• flow charts/fault algorithms• logic diagrams• fault finding/troubleshooting guides 1.6 set up and carry out the tests using the correct procedures and within agreed timescales 1.7 carry out all of the following during the testing of the electronic products: <ul style="list-style-type: none">• obtain and use the correct issue of company and/or manufacturers' drawings and testing documentation

- adhere to risk assessment, COSHH and other relevant safety standards
- follow clean work area protocols, where appropriate
- check that test equipment is correctly calibrated and appropriate for test(s) to be carried out
- use grounded wrist straps and other Electrostatic Discharge (ESD) precautions, as appropriate
- provide safe access and working arrangements for the testing area
- carry out the inspection and testing activities, using appropriate techniques and procedures
- operate test equipment within its specification range
- apply adjustment of inspection results for temperature correction (where applicable)
- identify and record out-of-specification features, in the appropriate format
- report and investigate the possibility of gaining a concession for out-of-specification products
- place products in the correct location on completion of the inspection activities (in and out of specification)
- leave the work area in a safe and tidy condition on completion of the activities

1.8 test one of the following manufactured electronic products:

- printed circuit board assemblies
- visual display tubes/screens
- microwave components
- electronic assemblies
- electronic modules/sub-assemblies
- other specific electronic product
- power supplies (such as switched mode, series regulation, parallel regulation)
- motor control systems (such as closed loop servo and proportional control, solid state, inverter control)
- sensor/actuator equipment (such as linear, temperature, photo-optic, flow, rotational, level, pressure, mass/weight)
- digital devices (such as process control, microprocessor-based, logic devices, display devices)
- signal generating/processing equipment (such as frequency modulating/demodulating, oscillators, amplifiers, filters)
- alarms and protection devices
- ADC and DAC hybrid circuits and equipment

1.9 carry out visual inspection of electronic products, to include ensuring all of the following:

- all manufacturing/assembly procedures are complete
- all components are correctly assembled and orientated
- all connections are mechanically secure
- soldered joints are free from excess solder and flux residue
- products are free from damage or obvious defects

1.10 carry out tests using four of following tools and test equipment:

- oscilloscope
- signal generator
- multimeter
- continuity tester
- measuring instrument or gauge
- computer aided diagnostic equipment
- recording devices (such as shock, vibration, humidity, temperature)
- computer-aided diagnostic equipment
- special purpose testing equipment
- ammeter
- Q meter
- signal tracer
- automatic test equipment
- pulse sequencing analyser
- spectrum analyser
- network analyser
- logic probe/analyser
- other specific test equipment

1.11 carry out four of the following tests:

- pulse train sequencing and pulse width/rise time
- waveform shape/frequency and amplitude checks
- frequency modulation/demodulation
- signal noise/interference levels
- logic states
- dc voltage/current levels
- ac voltage/current levels
- clock/timer switching
- component value tests (such as resistance, capacitance, inductance)
- continuity, open and short circuit tests
- shock and vibration withstand tests
- humidity, temperature and damp tests
- insulation resistance
- heat dissipation
- other specific tests

1.12 record the results of the tests in the appropriate format

1.13 complete the relevant paperwork, using one of the following, and pass it to the appropriate person:

- inspection report
- customer specific documentation
- concession report
- job card

1.14 review the results and carry out further tests if necessary.

Learning outcome

The learner will:

2. know how to inspect and test electronic products

Assessment criteria

The learner can:

- 2.1 describe the specific safety precautions to be taken to protect themselves and others when conducting the prescribed tests on particular categories of electronic products (such as specific legislation or regulations governing the activities or work area, safe working practices and procedures to be adopted, general workshop safety practice, erection of protective barriers, displaying of warning notices)
- 2.2 describe the Personal Protective Equipment (PPE) to be worn whilst carrying out the testing activities concerned, both for personal protection and protection of the components or circuits (such as protective clothing, eye and hearing protection, anti-static devices)
- 2.3 describe the hazards associated with the tests being conducted (such as heat, radiation, chemicals, static electricity, high voltage points on equipment exposed to contact during tests, trapping points on equipment), and how they can be minimised
- 2.4 explain how to obtain the necessary authority to conduct testing, the relevant work areas, and any specific permit-to-work procedures that are used
- 2.5 explain how to recognise and deal effectively in the workplace with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first aid resuscitation)
- 2.6 describe the clean work area protocols that should be used (in appropriate cases)
- 2.7 explain how to obtain and use data/specifications for the post-production tests being undertaken
- 2.8 explain how to obtain and interpret drawings, circuit and physical layouts, charts, specifications, manufacturers' manuals, history/maintenance reports, graphical electrical symbols, IEE wiring regulations, and other documents needed in the testing activities
- 2.9 describe the use of British, European and International standards in determining if components and products are fit for purpose
- 2.10 describe the general principles of quality assurance systems and procedures
- 2.11 describe the preparations to be undertaken before the product is inspected and tested
- 2.12 explain how to recognise and read component values and, where appropriate, the polarity of electronic components
- 2.13 describe the types of test equipment to be used, and their selection for particular types of tests
- 2.14 explain how to ensure that the test equipment is maintained and correctly calibrated, in accordance with the appropriate organisational procedures
- 2.15 explain how to set up and use the range of test equipment items needed for the tests (such as logic and waveform analysis equipment, storage oscilloscopes, signal generators, sensing and measuring devices, current, voltage and impedance measuring instruments)
- 2.16 describe the importance of ensuring that test equipment is used

only for its intended purpose and within its specified range and limits

- 2.17 describe the importance of using the appropriate test points in the circuit, and how these are identified
- 2.18 describe the types of test used to verify the correct functioning of electronic equipment
- 2.19 explain why sampling is used, and when it is an effective means of quality assurance
- 2.20 describe the basic operating principles of the electronic components/circuits being tested
- 2.21 explain how to analyse and evaluate the results of the tests carried out
- 2.22 describe the problems or errors that could occur and which may affect the test results, and how they can be avoided
- 2.23 describe the typical defects and variations that can be found on the electronic products, and how to identify them
- 2.24 describe the importance of completing inspection documentation, what needs to be recorded and where records are kept
- 2.25 describe the procedure to be followed when inspected products are out of specification
- 2.26 describe the extent of their own responsibility and to whom they should report if they have any problems that they cannot resolve during testing of the electronic equipment.

Unit 317

Checking and calibrating mechanical inspection equipment

UAN:	K/600/5612
Level:	3
Credit value:	139
GLH:	287
Relationship to NOS:	This unit has been derived from National Occupational Standard engineering technical support Unit No 17: checking and calibrating mechanical inspection equipment (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:	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out calibration and setting activities on mechanical inspection equipment, in accordance with approved procedures. The learner will be required to prepare the equipment and the work area, ensuring that it is safe and free from hazards, to obtain all relevant and current documentation, and to obtain the necessary calibration equipment. The learner will be required to select the appropriate calibration equipment, based on the type of instruments to be calibrated and the accuracy of the measurements that will be taken. In carrying out the calibration activities, the learner will be expected to set up, calibrate and check the equipment across its full operating range (where this is appropriate). equipment to be calibrated could include measuring instruments such as micrometers and Verniers, protractors, squares and straight edges, gauges such as plug, ring, gap and length, mechanical test equipment such as torque wrenches, engineers' levels and inclinometers.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the calibration activities undertaken, and to report any problems with the activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner</p>

will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the 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 calibration techniques and procedures to mechanical measuring instruments including, where appropriate, British, European and International standards. The learner will understand how to use the tools and equipment to calibrate the instruments, in adequate depth to provide a sound basis for carrying out the calibration activities and identifying where instruments do not meet the required calibration specification.

The learner will understand the safety precautions required when carrying out the calibration 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. check and calibrate mechanical inspection equipment
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 for the calibration activities, by carrying out all of the following: <ul style="list-style-type: none">• ensure that the work area is in a safe and tidy condition• ensure that environmental conditions are suitable for the calibration checks being made (such as temperature, cleanliness, humidity)• obtain and use the correct quality control documentation (such as calibration records, equipment specifications)• obtain and check the general condition of the measuring instruments to be calibrated• obtain appropriate calibration/reference equipment for the job in hand 1.3 obtain and use the correct equipment to carry out the calibration activities 1.4 use five of the following types of calibration equipment: <ul style="list-style-type: none">• reference grade slip gauges• standard reference pieces (such as balls, blocks, wires)• angular reference gauges

- standard taper gauges
 - master cylindrical square
 - reference/master bores (such as ring/bore)
 - reference/master thread gauges
 - shadow graph
 - floating carriage micrometers
 - microscope
 - reference/master sine bars
 - reference/master sine tables
 - reference/master bench centres
- 1.5 identify and confirm the calibration checks to be made and acceptance criteria to be used
- 1.6 correctly set up, check and calibrate the equipment, using approved techniques and procedures
- 1.7 carry out the calibration of measuring instruments in both of the following systems of measurement:
- imperial units
 - metric units
- 1.8 check, and where appropriate, set and calibrate ten of the following:
- micrometers (to include external, internal and depth)
 - Verniers (to include length, height and depth)
 - specialist verniers (such as gear tooth)
 - specialist micrometers (such as thread)
 - height micrometer
 - engineers' square
 - cylindrical square
 - straight edge
 - engineers' levels
 - surface tables
 - angle plates
 - box angle plates
 - taper gauges
 - protractors
 - combination squares
 - clinometers
 - sine bars
 - sine tables
 - dial test indicators
 - surface finish equipment
 - spline gauges
 - radius/profile gauges
 - workshop gauge blocks
 - gap gauge (fixed and adjustable)
 - plug/hole gauge
 - bore gauges (fixed and telescopic)
 - groove gauges

<ul style="list-style-type: none"> • alignment gauges • thread plug gauge • thread ring gauge • thread depth gauges • pneumatic gauges • torque gauge/wrench • bench centres • roughness standards • other specific equipment <p>1.9 check and calibrate mechanical inspection equipment, to include carrying out all of the following:</p> <ul style="list-style-type: none"> • obtaining calibration parameters from data records • setting and using the correct calibration equipment • following specified or appropriate calibration procedures • calibrating the instruments to manufacturers' specifications • apply appropriate coding to calibrated equipment • recording calibration results accurately and legibly, in the appropriate format • identifying and recording out-of-specification instruments • taking appropriate action in respect of instruments that fail to meet calibration specifications • diagnosing faults during the calibration process (where appropriate) <p>1.10 record the results of the calibration checks in the appropriate format</p> <p>1.11 complete the calibration documentation, to include one from the following, and pass to the appropriate people:</p> <ul style="list-style-type: none"> • calibration report • 'equipment withdrawal from service' report • job card • customer specific documentation <p>1.12 where appropriate, apply suitable identification to the equipment, stating current date(s) of calibration</p> <p>1.13 deal promptly and effectively with problems within their control and report those that cannot be solved.</p>

Learning outcome
The learner will: 2. know how to check and calibrate mechanical inspection equipment
Assessment criteria
The learner can: 2.1 describe the specific safety precautions to be taken when checking and calibrating mechanical measuring equipment (such as specific legislation or regulations governing the activities or work area, safe working practices and procedures to be adopted, general workshop safety practice) 2.2 describe the health and safety requirements of the work area in which they are carrying out the calibration activities, and the

- responsibility these requirements place on them
- 2.3 describe the COSHH regulations with regard to the substances used in the calibration process
 - 2.4 describe the hazards associated with calibrating mechanical measuring equipment, and how they can be minimised
 - 2.5 describe the appropriate Personal Protective Equipment and clothing to be worn during the calibration activities
 - 2.6 explain how and where to obtain the required calibration specifications, and how to check that they are current and complete
 - 2.7 describe the general principles of quality assurance systems and procedures
 - 2.8 describe the preparations to be undertaken before the equipment is checked and calibrated (such as cleaned, visually inspected for damage or missing parts)
 - 2.9 describe the effects that the environment may have on the calibration activities (such as where precision measurements are concerned)
 - 2.10 describe the use of temperature controlled standards rooms for calibration activities
 - 2.11 describe the need to select and use set datum faces, and the effects of taking readings from different datums (such as accumulation of limits leading to errors)
 - 2.12 describe the application and uses of the tools and equipment to calibrate mechanical instruments (such as reference grade slip gauges, shadow graphs, cylindrical squares, optical microscopes, special measuring equipment)
 - 2.13 describe the typical defects and variations that can be found on mechanical measuring instruments, and how to identify them
 - 2.14 describe the need to carry out the calibration checks, and to record the results using the appropriate documentation
 - 2.15 describe the procedure to be followed when instruments do not meet calibration requirements
 - 2.16 describe the importance of completing calibration documentation, what needs to be recorded and where records are kept
 - 2.17 describe the extent of their own responsibility and to whom they should report if they have any problems that they cannot resolve.

Unit 318

Checking and calibrating electrical and electronic test equipment

UAN:	L/600/5618
Level:	3
Credit value:	139
GLH:	287
Relationship to NOS:	This unit has been derived from National Occupational Standard engineering technical support Unit No 18: checking and calibrating electrical and electronic test equipment (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:	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out visual inspections, calibration and setting activities on instruments used to check electrical and electronic equipment/circuits, in accordance with approved procedures. The learner will be required to prepare the instruments, ensuring that they are safe and free from hazards, to obtain all relevant and current documentation, and to obtain the necessary tools and equipment required. The learner will be required to select the appropriate calibration equipment, based on the type of equipment to be calibrated and the accuracy of the measurements that will be taken. In carrying out the calibration activities, the learner will be expected to set up, calibrate and check the equipment across its full operating range (where this is appropriate). equipment to be calibrated could include instruments such as those used to measure current, voltage, resistance, polarity, insulation values, signal waveforms, etc.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the calibration activities undertaken, and to report any problems with these activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner</p>

will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the 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 calibration techniques and procedures to electrical and electronic test instrumentation including, where appropriate, British, European and International standards. The learner will understand how to use the tools and equipment to calibrate the equipment, in adequate depth to provide a sound basis for carrying out the activities and identifying where instruments do not meet the required calibration specification.

The learner will understand the safety precautions required when carrying out the calibration 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. check and calibrate electrical and electronic test equipment
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 for the calibration activities, by carrying out all of the following: <ul style="list-style-type: none">• ensure that the work area is in a safe and tidy condition• ensure that environmental conditions are suitable for the calibration checks being made (such as temperature, cleanliness, humidity)• obtain and use the correct quality control documentation (such as calibration records, equipment specifications)• obtain and check the general condition of the instrumentation to be calibrated• obtain appropriate calibration/reference equipment for the job in hand• leave the work area in a safe and tidy condition on completion of the activities 1.3 obtain and use the correct equipment to carry out the calibration activities 1.4 use three of the following types of equipment during the calibration activities:

- reference/workshop potentiometers
 - measuring bridges
 - master/reference stabilised power supplies
 - master/reference meters
 - master/reference signal generators
 - master/reference oscilloscopes
 - spectrum analysers
 - network analysers
 - logic analysers
 - other specific calibration equipment
- 1.5 identify and confirm the calibration checks to be made and acceptance criteria to be used
- 1.6 correctly set up, check and calibrate the equipment, using approved techniques and procedures
- 1.7 carry out the calibration of electrical/electronic test instruments in both of the following types of measurement:
- analogue
 - digital
- 1.8 carry out the calibration of electrical/electronic test equipment, to include eight of the following types of instruments:
- multimeters
 - ammeter
 - voltmeter
 - watt meters
 - ohmmeters
 - oscilloscope
 - insulation tester
 - loop impedance tester
 - earth bond testers
 - current probes
 - chart recorders
 - frequency meters and counters
 - flash testers
 - resistance boxes
 - Residual Current Device (RCD) tester
 - signal generators
 - Portable Appliance (PAT) Testers
 - logic probes
 - current injection devices
 - phase testers
 - amplifiers
 - spectrum analysers
 - network analysers
 - logic analysers
 - other specific test equipment
- 1.9 test and calibrate electrical/electronic test instrumentation, to include carrying out all of the following:

<ul style="list-style-type: none"> • obtaining calibration parameters from data records • connecting up power supplies, test and calibration equipment • following specified or appropriate calibration procedures • ensure that any special operating conditions are taken into account • calibrating to manufacturer's procedures and specifications • applying appropriate coding to calibrated equipment • recording calibration results accurately and legibly, in the appropriate format • identifying and recording out-of-specification instruments • taking appropriate action in respect of instruments that fail to meet calibration specifications • diagnosing faults during the calibration process (where appropriate) <p>1.10 record the results of the calibration checks in the appropriate format</p> <p>1.11 complete the calibration documentation, to include one from the following, and pass to the appropriate people:</p> <ul style="list-style-type: none"> • calibration report • 'equipment withdrawal from service' report • job card • customer specific documentation <p>1.12 where appropriate, apply suitable identification to the equipment, stating current date(s) of calibration</p> <p>1.13 deal promptly and effectively with problems within their control and report those that cannot be solved.</p>
--

<p>Learning outcome</p> <p>The learner will:</p> <p>2. know how to check and calibrate electrical and electronic test equipment</p>
<p>Assessment criteria</p> <p>The learner can:</p> <p>2.1 describe the specific safety precautions to be taken when checking and calibrating electrical and electronic test instrumentation (such as specific legislation or regulations governing the activities or work area, safe working practices and procedures to be adopted, general workshop safety practice)</p> <p>2.2 describe the health and safety requirements of the work area in which they are carrying out the calibration activities, and the responsibility these requirements place on them</p> <p>2.3 describe the COSHH regulations with regard to the substances used in the calibration process</p> <p>2.4 describe the hazards associated with calibrating electrical and electronic test instrumentation, and how they can be minimised</p> <p>2.5 describe the appropriate Personal Protective Equipment and clothing to be worn during the calibration activities</p> <p>2.6 explain how and where to obtain the required calibration specifications, and how to check that they are current and complete</p>

- 2.7 describe the general principles of quality assurance systems and procedures
- 2.8 describe the basic operating principles of the test instruments that are being calibrated
- 2.9 describe the preparations to be undertaken before the equipment is checked and calibrated (such as cleaned and free from contaminants, visually inspected for damage or missing parts)
- 2.10 describe the need to take note of any special operating conditions
- 2.11 describe the effects that the environment may have on the calibration activities (such as where precision measurements are concerned)
- 2.12 describe the use of temperature-controlled standards rooms for calibration activities
- 2.13 describe the application and uses of the tools and equipment to calibrate electrical and electronic test instruments (such as stabilised power supplies, reference signal generators, measuring bridges and reference potentiometers, etc.)
- 2.14 describe the typical defects and variations that can be found on the instruments, and how to identify them
- 2.15 describe the need to carry out the calibration checks, and to record the results using the appropriate documentation
- 2.16 describe the procedure to be followed when instruments do not meet calibration requirements
- 2.17 describe the importance of completing calibration documentation, what needs to be recorded and where records are kept
- 2.18 describe the extent of their own responsibility and to whom they should report if they have any problems that they cannot resolve.

Unit 319

Checking and calibrating process control instrumentation

UAN:	H/600/5625
Level:	3
Credit value:	139
GLH:	287
Relationship to NOS:	This unit has been derived from National Occupational Standard engineering technical support Unit No 19: checking and calibrating process control instrumentation (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:	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out visual inspections, calibration and setting activities on process control instrumentation, in accordance with approved procedures. The learner will be required to prepare the instruments, ensuring that they are safe and free from hazards, to obtain all relevant and current documentation, and to obtain the necessary tools and equipment. The learner will be required to select the appropriate calibration equipment, based on the type of equipment to be calibrated and the accuracy of the measurements that will be taken. In carrying out the calibration activities, the learner will be expected to set up, calibrate and check the equipment across its full operating range (where this is appropriate). Equipment to be calibrated will include instruments such as those used to measure pressure, level, flow, temperature, load/weight, fiscal metering, gas detection and alarm, recorders and indicators, instrument controllers, analysers, fire detection and alarm, vibration monitoring, speed measurement and control.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the calibration activities undertaken, and to report any problems with the activities that they cannot personally</p>

resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the 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 calibration techniques and procedures to process control instrumentation including, where appropriate, British, European and International standards. The learner will understand how to use the tools and equipment to calibrate the instrumentation, in adequate depth to provide a sound basis for carrying out the activities and identifying where instruments do not meet the required calibration specification.

The learner will understand the safety precautions required when carrying out the calibration 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. check and calibrate process control instrumentation
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 for the calibration activities, by carrying out all of the following: <ul style="list-style-type: none">• ensure that the work area is in a safe and tidy condition• ensure that environmental conditions are suitable for the calibration checks being made (such as temperature, cleanliness, humidity)• obtain and use the correct quality control documentation (such as calibration records, equipment specifications)• obtain and check the general condition of the instrumentation to be calibrated• obtain appropriate calibration/reference equipment for the job in hand• leave the work area in a safe and tidy condition on completion of the activities 1.3 obtain and use the correct equipment to carry out the calibration activities 1.4 use six of the following types of equipment during the calibration

activities:

- standard test gauges
- dead weight tester
- manometer
- digital pressure indicators
- hydraulic/portable pressure pump
- oil/water bath
- hydrometer
- audio amplifiers/chambers
- sand bath
- electronic weight test calibrator
- speed measuring devices
- calibrated weights
- calibrated flow meter
- ultraviolet light source
- smoke canisters
- heat guns
- appropriate test gases
- reference/workshop potentiometers
- signal generators
- oscilloscope
- insulation testers
- analogue and digital meters
- phase testers
- current injection devices
- logic probes
- other specific test equipment

1.5 identify and confirm the calibration checks to be made and acceptance criteria to be used

1.6 correctly set up, check and calibrate the equipment, using approved techniques and procedures

1.7 carry out the calibration of process control equipment, to include four of the following types of instruments:

- pressure
- flow (fluid, gas or air)
- level
- temperature/humidity
- speed measurement
- vibration monitoring
- load/weighing/strain gauges
- gas detection/monitoring
- fire detection
- fiscal metering
- alarm and trip
- analysers
- recorders and indicators

<ul style="list-style-type: none"> • sound/acoustic measurement • radiation detection • instrument controllers <p>1.8 test and calibrate process control instrumentation, to include carrying out all of the following:</p> <ul style="list-style-type: none"> • obtaining calibration parameters from data records • connecting up power supplies, test and calibration equipment • following specified or appropriate calibration procedures • ensuring that any special operating conditions are taken into account (such as liquid level correction) • calibrating to manufacturer's procedures and specifications • recording calibration results accurately and legibly in the appropriate format • identifying and recording out-of-specification instruments • taking appropriate action in respect of instruments that fail to meet calibration specifications • diagnosing faults during the calibration process (where appropriate) <p>1.9 record the results of the calibration checks in the appropriate format</p> <p>1.10 complete the calibration documentation, to include one from the following, and pass to the appropriate people:</p> <ul style="list-style-type: none"> • calibration report • 'equipment withdrawal from service' report • job card • customer specific documentation <p>1.11 where appropriate, apply suitable identification to the equipment, stating current date(s) of calibration</p> <p>1.12 deal promptly and effectively with problems within their control and report those that cannot be solved.</p>
--

Learning outcome
The learner will:
2. know how to check and calibrate process control instrumentation
Assessment criteria
The learner can:
2.1 describe the specific safety precautions to be taken when checking and calibrating process control instrumentation (such as specific legislation or regulations governing the activities or work area, safe working practices and procedures to be adopted, general workshop safety practice)
2.2 describe the health and safety requirements of the work area in which they are carrying out the calibration activities, and the responsibility these requirements place on them
2.3 describe the COSHH regulations with regard to the substances used in the calibration process
2.4 describe the hazards associated with calibrating process control instrumentation, and how they can be minimised
2.5 describe the appropriate Personal Protective Equipment and clothing to be worn during the calibration activities
2.6 explain how and where to obtain the required calibration

- specifications, and how to check that they are current and complete
- 2.7 describe the general principles of quality assurance systems and procedures
 - 2.8 describe the basic operating principles of the instruments that are being calibrated
 - 2.9 describe the preparations that need to be undertaken before the equipment is checked and calibrated (such as cleaned and free from all service contaminants, visually inspected for damage or missing parts)
 - 2.10 describe the need to take note of any special operating conditions (such as liquid level correction, calibration medium)
 - 2.11 describe the effects that the environment may have on the calibration activities (such as where precision measurements are concerned)
 - 2.12 describe the use of temperature-controlled standards rooms for calibration activities
 - 2.13 describe the application and uses of the tools and equipment to calibrate process control instruments (such as standard test gauges, dead weight testers, manometers, calibrated weights, analogue and digital meters, logic probes, signal generators, etc)
 - 2.14 describe the typical defects and variations that can be found on the instruments, and how to identify them
 - 2.15 describe the need to carry out the calibration checks, and to record the results using the appropriate documentation
 - 2.16 describe the procedure to be followed when instruments do not meet calibration requirements
 - 2.17 describe the importance of completing calibration documentation, what needs to be recorded and where records are kept
 - 2.18 describe the extent of their own responsibility and to whom they should report if they have any problems that they cannot resolve.



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

City & Guilds
Believe you can



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

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

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).

Copyright

The content of this document is, unless otherwise indicated, © The City and Guilds of London Institute and may not be copied, reproduced or distributed without prior written consent. However, approved City & Guilds centres and candidates studying for City & Guilds qualifications may photocopy this document free of charge and/or include a PDF version of it on centre intranets on the following conditions:

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

The *Standard Copying Conditions* (see the City & Guilds website) also apply.

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

Published by City & Guilds, a registered charity established to promote education and training.

City & Guilds
1 Giltspur Street
London EC1A 9DD
T +44 (0)844 543 0000
F +44 (0)20 7294 2413
www.cityandguilds.com

WW-02-1786