QUALIFICATION HANDBOOK

Level 3 NVQ Diploma in Engineering Technical Support (Non-Destructive Testing) (1786-32)

September 2011 Version 1.0

City & Guilds

Qualification at a glance

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

Title and level	City & Guilds number	Accreditation number
Level 3 NVQ Diploma in Engineering Technical Support (Non-Destructive Testing)	1786-32	600/2085/4

Contents

1 Introduction

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

Area	Description
Who is the qualification for?	It is for candidates who work or want to work in engineering technical support - non-destructive testing 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: • Level 3 NVQ Extended Diploma in Engineering Technical Support

Structure

To achieve the **Level 3 NVQ Diploma in Engineering Technical Support (Non-Destructive Testing)**, learners must achieve **15** credits from the mandatory units and

- a minimum of **118** credits from units in either optional group 1 or 2

or

- a minimum of **117** credits from at least 2 units in optional group 3

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 group 1			

L/600/5666	324	Preparing ultrasonic flaw detection equipment for testing activities	36
H/600/5673	325	Inspecting engineering products using ultrasonic testing techniques	82
Optional group 2			
T/600/5676	326	Preparing work areas for radiographic testing activities	36
Y/600/5685	327	Carrying out radiographic testing activities	82
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T/600/5645	321	Specifying non-destructive testing instructions for inspection activities	70
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K/600/5688	328	Analysing and interpreting the results of radiographic tests	70

2 Centre requirements

Approval

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

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

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

Resource requirements

Centre staffing

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

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

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

Assessors and internal verifier

Assessor Requirements to Demonstrate Effective Assessment Practice

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

Assessor Technical Requirements

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

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

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

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

Verifier Requirements (internal and external)

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

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

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

Continuing Professional Development (CPD)

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

Candidate entry requirements

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

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

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

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

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

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

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

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

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

Age restrictions

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

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

3 Delivering the qualification

Initial assessment and induction

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

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

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

Recommended delivery strategies

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

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

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

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

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

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

Recording documents

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

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

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

Recording forms are available on the City & Guilds website.

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

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

4 Assessment

Assessment of the qualification

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

Evidence requirements

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

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

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

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

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

Performance evidence must be a combination of:

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

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

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

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

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

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

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

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

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

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

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

Recognition of Prior Learning (RPL)

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

5 Units

Availability of units

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

Structure of units

These units each have the following:

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

Unit 201 Complying with statutory regulations and organisational safety requirements

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

The learner will also be required to identify the hazards and risks that are associated with their job. Typically, these will focus on their working environment, the tools and equipment that they use, the materials and substances that they use, any working practices that do not follow laid-down procedures, and manual lifting and carrying techniques.

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

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

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

hazardous or dangerous substances
- complying with the appropriate statutory regulations at all times

1.3 present themselves in the workplace suitably prepared for the activities to be undertaken

1.4 follow organisational accident and emergency procedures

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

1.6 recognise and control hazards in the workplace

1.7 identify the hazards and risks that are associated with the following:
- their working environment
- the equipment that they use
- materials and substances (where appropriate) that they use
- working practices that do not follow laid-down procedures

1.8 use correct manual lifting and carrying techniques

1.9 demonstrate one of the following methods of manual lifting and carrying:
- lifting alone
- with assistance of others
- with mechanical assistance

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

Learning outcome
The learner will: 2. know how to comply with statutory regulations and organisational safety requirements
Assessment criteria
The learner can: 2.1 describe the roles and responsibilities of themselves and others under the Health and Safety at Work Act, and other current legislation (such as The management of health and safety at work regulations, workplace health and safety and Welfare regulations, Personal Protective equipment at work regulations, Manual Handling Operations regulations, Provision and use of work equipment regulations, Display Screen at work regulations,

reporting of Injuries, Diseases and Dangerous Occurrences regulations)

2.2 describe the specific regulations and safe working practices and procedures that apply to their work activities

2.3 describe the warning signs for the seven main groups of hazardous substances defined by Classification, Packaging and Labelling of Dangerous Substances regulations

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Unit 202 Using and interpreting engineering data and documentation

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

the work that they carry out.

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

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

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

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

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

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

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

- instructions (such as job instructions, drawing instructions, manufacturers instructions)

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

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

1.9 report any inaccuracies or discrepancies in documentation and specifications.

Learning outcome
The learner will: 2. know how to use and interpret engineering data and documentation
Assessment criteria
The learner can: 2.1 explain what information sources are used for the data and documentation that they use in their work activities 2.2 explain how documents are obtained, and how to check that they are current and valid 2.3 explain the basic principles of confidentiality (including what information should be available and to whom) 2.4 describe the different ways/formats that data and documentation can be presented (such as such as drawings, job instructions product data sheets, manufacturers' manuals, financial spreadsheets, production schedules, inspection and calibration requirements, customer information) 2.5 explain how to use other sources of information to support the data (such as electronic component pin configuration specifications, reference charts, standards, bend allowances required for material thickness, electrical conditions required for specific welding rods, mixing ratios for bonding and finishing materials, metal specifications and inspection requirements, health and safety documentation) 2.6 describe the importance of differentiating fact from opinion when reviewing data and documentation 2.7 describe the importance of analysing all available data and documentation before decisions are made 2.8 describe the different ways of storing and organising data and documentation to ensure easy access 2.9 describe the procedures for reporting discrepancies in the data or documentation, and for reporting lost or damaged documents 2.10 describe the importance of keeping all data and documentation up

to date during the work activity, and the implications of this not being done

2.11 explain the care and control procedures for the documents, and how damage or graffiti on documents can lead to scrapped work

2.12 explain the importance of returning documents to the designated location on completion of the work activities

2.13 explain what basic drawing conventions are used and why there needs to be different types of drawings (such as isometric and orthographic, first and third angle, assembly drawings, circuit and wiring diagrams, block and schematic diagrams

2.14 explain what types of documentation are used and how they interrelate (such as production drawings, assembly drawings, circuit and wiring diagrams, block and schematic diagrams)

2.15 explain the imperial and metric systems of measurement; tolerancing and fixed reference points

2.16 describe the meaning of the different symbols and abbreviations found on the documents that they use (such as surface finish, electronic components, weld symbols, linear and geometric tolerances, pressure and flow characteristics)

2.17 describe the extent of their own responsibility, when to act on their own initiative to find, clarify and evaluate information, and to whom they should report if they have problems that they cannot resolve.

Unit 303 Working efficiently and effectively in engineering

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

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

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

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

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

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

undertaken:

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

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

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

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

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

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

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

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

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

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

1.11 make recommendations for improving to two of the following:

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

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

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

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

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

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

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

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

2.11	describe the information and/or documentation required to confirm that the activity has been completed
2.12	explain what materials, equipment and tools can be reused
2.13	explain how any waste materials and/or products are transferred, stored and disposed of
2.14	explain where tools and equipment should be stored and located
2.15	describe the importance of making recommendations for improving working practices
2.16	describe the procedure and format for making suggestions for improvements
2.17	describe the benefits to organisations if improvements can be identified
2.18	describe the importance of maintaining effective working relationships within the workplace
2.19	describe the procedures to deal with and report any problems that can affect working relationships
2.20	describe the difficulties that can occur in working relationships
2.21	describe the regulations that affect how they should be treated at work (such as Equal Opportunities Act, Race and Sex Discrimination, working Time Directive)
2.22	describe the benefits of continuous personal development
2.23	describe the training opportunities that are available in the workplace
2.24	describe the importance of reviewing their training and development
2.25	explain with whom to discuss training and development issues
2.26	describe the extent of their own responsibility and to whom they should report if they have any problems that they cannot resolve.

Unit 320 Determining technical requirements for non-destructive testing

UAN:	A/600/5632
Level:	3
Credit value:	65
GLH:	168
Relationship to NOS:	This unit has been derived from National Occupational Standard engineering technical support Unit No 20: Determining technical requirements for non-destructive testing (Suite 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	This unit covers the skills and knowledge needed to prove the competences required to determine the technical requirements for Non-Destructive Testing (NDT) activities, in accordance with approved procedures. The principal objective of NDT is to generate data for the assessment of product quality achieved against prescribed acceptance criteria. This implies that the outcome of the tests will meet the testing objectives and, therefore, the first task in approaching the NDT of a product is to determine the consequent requirements for NDT sources, facilities and activities. The learner will determine these requirements from a review of relevant documentation and information, and will validate the efficiency of the tests prescribed in the NDT procedure specification. The NDT requirements will be recorded, ready for the development of the NDT instructions. The learner's responsibilities will require them to comply with organisational policy and procedures for determining and specifying the NDT technical requirements. The learner will 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 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 gathering the required information, and determining and specifying the NDT requirements. The learner will understand the prescribed method of NDT, the principles of the other common methods, and the advantages and limitations of each. The learner will appreciate how the different materials affect the feasibility of NDT, and will understand how quality required to meet design assumptions is checked against acceptance criteria. A working knowledge of relevant product technology is required, in particular that related to the incidence of defect manufacture. The learner will understand their organisation's methods of operation, in sufficient detail to enable them to make informed decisions.

The learner will be aware of any health, safety and environmental requirements applicable to their area of responsibility. 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. determine technical requirements for non-destructive testing
Assessment criteria
The learner can: 1.1 obtain up-to-date, accurate and relevant information on the engineering activity 1.2 carry out all of the following activities when determining the technical requirements: • use the correct issue of company information • check that all essential information and data needed to identify the test objectives and derive the NDT instructions is available • ensure that health and safety regulations and safe working practices are taken into account • ensure that the influence of working conditions on technical performance, costs and timescales are recognised when identifying the technical requirements • record and store information in the correct formats and in the appropriate company system 1.3 make sure that all essential data are included 1.4 review and extract the NDT requirements from all of the following

sources:

- customers' orders and instructions
- product specification
- NDT procedure specification
- acceptance criteria
- relevant standards

1.5 identify accurately the technical requirements to be met and make sure they meet the needs of the customer

1.6 use the information extracted in the review to carry out all of the following:

- determine the types of test to be applied
- identify test objectives
- validate the feasibility of tests and timescales
- identify requirements for NDT activities to generate data required for assessment
- formulate risk assessment documentation

1.7 make sure that technical requirements take account of working conditions

1.8 produce NDT technical requirements for one of the following:

- penetrant flaw detection
- magnetic particle testing
- ultrasonic testing
- radiography

1.9 produce NDT technical requirements for one of the following product ranges:

- welded joints
- castings
- wrought products or materials (such as forged, rolled, extruded)
- cold formed products (such as by bending, pressing, rolling)
- heat treated components
- structures (such as airframes, lifting beams, pressure vessels)
- other specific products

1.10 confirm the technical requirements with the appropriate people

1.11 record the NDT requirements in the correct form, covering ten of the following, as appropriate to the NDT test method identified:

- specific testing method to be applied
- equipment resources and their specifications
- consumables and their specification
- test site facilities and safety requirements
- personnel resource and qualifications
- product areas to be tested
- objectives of tests
- NDT activities to generate required data
- acceptance criteria
- timescales
- post-test restoration of product/site

- applicable standards, specifications and codes
- non-routine conditions at test site which may affect NDT activities
- environmental requirements

1.12 clearly identify and deal promptly and effectively with any problems occurring with the requirements and their interpretation.

Learning outcome
The learner will: 2. know how to determine technical requirements for non-destructive testing
Assessment criteria
The learner can: 2.1 describe the relevant health and safety information and issues relating to non-destructive testing methods 2.2 explain how to access appropriate information on health and safety regulations and guidelines 2.3 describe the implications of not taking account of legislation, regulations, standards and guidelines 2.4 explain how to interpret engineering drawings and related specifications to obtain any necessary information on the NDT activities 2.5 describe the codes and conventions that are used in the drawings and specifications 2.6 describe the various methods of non-destructive testing (to include liquid penetrant testing, magnetic particle inspection, ultrasonic testing and radiographic testing 2.7 describe the advantages and limitations of each method (with respect to applications, sensitivity, flaw type location capabilities, flaw recognition, sizing and accuracy of measurements and its use for surface and volumetric testing) 2.8 explain how to obtain information on the NDT requirements, and the type of information that is available (such as customer order requirements and instructions, quality control requirements and the product specification) 2.9 describe the factors which will affect the NDT method to be used (such as material type, manufacturing process/technology used, type of flaws expected, degree of accuracy required) 2.10 describe the types of defect that are detectable by using the various detection methods 2.11 explain how to determine the level of defects that will be acceptable in the components, materials or structures 2.12 describe the influence of the defects on the service/performance of the components, materials or structures 2.13 explain how to identify the test objectives and the type of data that should be included in the technical information 2.14 describe the factors to be taken into account when determining the NDT technical requirements, especially those covering working conditions 2.15 describe the principles and practice of quality management systems, and the role of NDT within the quality system 2.16 explain how to record the NDT requirements, and the format

	required by the organisation
2.17	describe the type of information to be recorded, and where the records are kept
2.18	describe the problems that can occur when identifying NDT technical requirements, and how they can be minimised
2.19	describe the sources of technical expertise on NDT methods, if they have problems they cannot resolve
2.20	describe the extent of their own responsibility and to whom they should report if they have any problems that they cannot resolve.

Unit 321 Specifying non-destructive testing instructions for inspection activities

UAN:	T/600/5645
Level:	3
Credit value:	70
GLH:	168
Relationship to NOS:	This unit has been derived from National Occupational Standard engineering technical support Unit No 21: Specifying non-destructive testing instructions for inspection activities (Suite 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	This unit covers the skills and knowledge needed to prove the competences required to determine and specify the Non-Destructive Testing (NDT) instructions for inspection activities, in accordance with approved procedures. The non-destructive testing instructions are the chief working document, which controls the practical application of the prescribed method of testing. Using the established NDT requirements for the product to be tested, the learner will be expected to prepare the NDT instructions covering preparation for testing, testing practice, resources required, safe working practices and restorative work required. The learner's work will be validated by others, before release to the testing personnel. The learner's responsibilities will require them to comply with organisational policy and procedures for the specification of NDT instructions. The learner will 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 work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they undertake.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to determining and specifying the NDT requirements. The learner will understand the principles and practices of the prescribed method of NDT, and have knowledge of the principles of the other common methods of NDT. An appreciation of the advantages and limitations of each method, in particular flaw detection capability, will be important as will a knowledge of the influence of materials of construction on the feasibility of testing. A working knowledge of relevant product technology is required, in particular that related to the incidence of manufacturing defects. An understanding of the role of quality management, and the monitoring of quality through the application of acceptance criteria will be required.

The learner will be aware of any health, safety and environmental requirements applicable to their area of responsibility. 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. specify non-destructive testing instructions for inspection activities
Assessment criteria
The learner can: 1.1 produce specifications that are clear and accurate and contain all relevant data 1.2 carry out all of the following when specifying the NDT instructions: • use the correct issue of company information • check that all essential information and data needed to specify the NDT instructions are available • ensure that health and safety regulations and safe working practices are taken into account • ensure that the influence of working conditions on technical performance, costs and timescales are taken into account when specifying the NDT instructions • record and store the instructions in the correct formats and in the appropriate company system 1.3 produce NDT testing instructions for one of the following: • penetrant flaw detection • magnetic particle testing • ultrasonic testing • radiography

1.4 produce NDT testing instructions for one of the following product ranges:

- welded joints
- castings
- wrought products or materials (such as forged, rolled, extruded)
- cold formed products (such as by bending, pressing, rolling)
- heat treated components
- structures (such as airframes, lifting beams, pressure vessels)
- other specific products

1.5 develop the NDT instructions for the prescribed method, covering all of the following:

- objectives of the test(s)
- areas of product to be tested and their identification
- the testing plan to meet specified timescales
- equipment and consumables
- equipment settings and calibration
- testing parameters
- testing procedure(s) and technique(s)
- surface preparation of test areas
- datum and reference marking of test areas
- defect measurement techniques (where applicable)
- environmental conditions
- acceptance criteria
- personnel certification requirements
- references to applicable standards
- health and safety requirements and safe practice
- restoration of product and work area
- reporting/recording methods and procedures

1.6 produce specific instructions relating to the prescribed NDT method, covering one of the following:

- penetrant flaw detection - To include all of the following:
  - cleaning procedure for the test area
  - type and application of dye or fluorescent penetrant
  - washing and drying
  - use of specified developer
  - viewing conditions
  - temperature limitations
  - timescales for application of penetrant and developer
- magnetic particle testing - To include all of the following:
  - cleaning procedure for the test area
  - method of magnetisation
  - magnetisation parameters
  - type of magnetic ink
  - viewing conditions
- ultrasonic testing - to include all of the following:
  - scan type and procedure

- probe types, size, angle and frequency
- calibration of equipment and probes, using reference blocks
- flaw size measurement technique

- radiography - to include all of the following:
  - radiation source requirements
  - use of image quality indicators
  - source-to-film distance
  - beam/product orientation
  - exposure times
  - film type
  - use of intensifying screens
  - safety/environmental requirements

1.7 produce specifications in formats that meet organisational and customer requirements

1.8 produce the NDT instructions in one of the following forms:

- paper
- electronic

1.9 ensure that codes and other references used in the specifications follow agreed conventions

1.10 pass specifications on to the appropriate people according to the agreed schedule

1.11 store specifications securely in the approved location

1.12 make changes to specifications only within agreed control procedures.

Learning outcome
The learner will: 2. know how to specify non-destructive testing instructions for inspection activities
Assessment criteria
The learner can: 2.1 describe the relevant health and safety information and issues relating to non-destructive testing methods 2.2 explain how to access the appropriate information on health and safety regulations and guidelines 2.3 describe the implications of not taking account of legislation, regulations, standards and guidelines when specifying the NDT instructions 2.4 describe the various methods of non-destructive testing (to include liquid penetrant testing, magnetic particle inspection, ultrasonic testing and radiographic testing) 2.5 describe the advantages and limitations of each method with respect to applications, sensitivity, flaw type location capabilities, flaw recognition, sizing and accuracy of measurements, and use for surface and volumetric testing 2.6 explain how to obtain information on the NDT requirements, and the type of information that is available (such as customer order requirements and instructions, quality control requirements and the product specification) 2.7 describe the factors which will affect the NDT method to be used

(such as material type, manufacturing process/technology used, type of flaws expected, degree of accuracy required)

2.8 describe the types of defect that are detectable using the various detection methods

2.9 describe the level of defects that will be acceptable in the components, materials or structures

2.10 describe the influence of the defects on the service/performance of the components, materials or structures

2.11 explain how to identify the test objectives, and the type of data that should be included in the NDT instructions

2.12 explain how to identify the acceptance criteria, and the product quality required to meet design criteria

2.13 describe the development of the NDT procedures and instructions (to include both master documents and working instructions, along with their purpose, content and status)

2.14 explain how to prepare the NDT instructions (to include the structure, style, clarity and compliance with relevant standards)

2.15 describe the process used in the organisation to validate the NDT instructions

2.16 describe the control procedure for ensuring that the instructions are maintained up to date

2.17 explain the terminology used in NDT testing activities

2.18 describe the principles and practice of quality management systems, and the role of NDT within the quality system

2.19 explain how to record the NDT instructions

2.20 describe the type of information to be recorded

2.21 describe the problems that can occur when specifying NDT instructions

2.22 describe the sources of technical expertise on NDT methods if they have problems that they cannot resolve

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 322 Inspecting engineering products by penetrant flaw detection techniques

UAN:	L/600/5652
Level:	3
Credit value:	52
GLH:	119
Relationship to NOS:	This unit has been derived from National Occupational Standard engineering technical support Unit No 22: inspecting engineering products by penetrant flaw detection techniques (Suite 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	This unit covers the skills and knowledge needed to prove the competences required to carry out penetrant flaw detection tests on ferrous and non-ferrous engineering products, materials or structures, in accordance with approved procedures. The learner will be required to prepare the products for the penetrant flaw detection activities, and to check that the equipment complies with the specification requirements, is safe to use and fit for purpose. The learner must ensure that the ambient conditions are satisfactory for the tests to proceed, and will carry out the specified tests using the correct procedures (according to the non-destructive testing (NDT) instructions and requirements) and observe and record the test indications. The learner will complete the tests by preparing/completing a NDT test report containing the required test information and data, along with their interpretation of the test indications. The learner will be expected to mark up the products to show where there are indications of flaws. The completed inspection report will be passed to the appropriate person, in accordance with procedures. The learner's responsibilities will require them to comply with organisational policy and procedures for the penetrant flaw

detection testing activities undertaken, and to report any problems with the activities or equipment in use, 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 show a good understanding of their work, and will provide an informed approach to the inspection of engineering products by using penetrant flaw detection testing techniques. The learner will have a working knowledge of the principles of penetrant flaw detection techniques, and will understand the role of penetrant fluids, developers and ultraviolet light imaging. The learner will have a detailed knowledge of testing practice and will understand why this method has significant limitations in its flaw detecting capabilities. The learner's knowledge will include an appreciation of hazards and safe working practice, and they will understand the risks posed by material defects and the consequences of failure. The importance of compiling accurate and legible reports will also be a key issue in completing this unit.

The learner will understand the safety precautions required when carrying out the penetrant flaw detection activities, and when using the associated tools and 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 engineering products by penetrant flaw detection techniques
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 check and confirm that all of the following ambient testing conditions are satisfactory: • temperature • humidity • freedom from pollutants 1.3 follow the correct specification for the product or equipment being

inspected

1.4 prepare the products, materials or structures for testing, to include carrying out all of the following:
- identifying and marking the test areas
- removing any contaminants from the test area (such as degreasing)
- preparing the surface of the test area to the specified finish (such as grinding or polishing)

1.5 use the correct equipment to carry out the inspection

1.6 use both of the following penetrant flaw detection dispensers:
- penetrant
- developer

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 penetrant flaw detection activities:
- obtain the required penetrant flaw detection equipment and materials, and check that they are in a safe and usable condition
- use appropriate Personal Protective Equipment
- comply with job instructions, NDT testing inspection specifications, relevant COSHH sheets and risk assessment documentation
- check that penetrant flaw detection dispensers are fully operational
- follow the defined testing procedures, and apply safe working practices and procedures at all times
- leave the work area in a safe condition on completion of the activities

1.10 carry out all of the following, in accordance with instructions and procedures:
- applying penetrant to the area under inspection
- washing and drying the test area
- applying a developer (where appropriate)
- observing defect indications under correct lighting conditions (ambient light or ultraviolet (UV) light)
- recording conclusions of observations
- restoring and cleaning the product on completion of the test

1.11 carry out penetrant flaw detection on one of the following:
- welded joints
- castings
- wrought products/materials (such as forged, rolled, extruded)
- cold formed products/materials (such as by bending, pressing, rolling)
- heat treated components
- structures (such as airframes, lifting beams, pressure vessels)
- other specific products

1.12 identify any defects or variations from the specification

1.13 identify all of the following:
- defect type
- location of the defect
- dimensional size of the defect

1.14 follow the correct procedure to deal with components, materials or structures which fall into three of the following categories:
- components, materials or structures which meet the specification
- components, materials or structures with identified defects
- components, materials or structures requiring further investigation
- components, materials or structures requiring other inspection methods

1.15 record the results of the inspection in the appropriate format

1.16 complete a NDT report, to include recording all of the following:
- product identification
- material of construction
- geometry, thickness and surface condition where defect indications were found
- ambient testing conditions
- defects identified
- comparison of flaw data with acceptance criteria
- conclusions and recommendations
- personal data

1.17 complete the inspection activities, to include carrying out all of the following:
- marking up defective components, materials or structures with all relevant information
- recording all the required details of the inspection in the appropriate format
- handing over the inspection details to the appropriate people

1.18 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 engineering products by penetrant flaw detection techniques
Assessment criteria
The learner can: 2.1 describe the specific safety precautions to be taken when carrying out penetrant flaw detection activities on engineering products, materials or structures 2.2 describe the hazards associated with carrying out the penetrant flaw detection activities (such as using inflammable materials, toxic and volatile material, use of aerosol containers and safety in the use of sprays and powders), and how they can be minimised 2.3 describe the type(s) of Personal Protective Equipment (PPE) to be used, and how to obtain it

2.4 describe the COSHH regulations relating to materials used during the penetrant flaw detection process

2.5 explain how to obtain the necessary job instructions, testing specifications, and how to interpret their information

2.6 describe the reasons why some components, materials or structures require to be tested using non-destructive testing methods

2.7 explain why it is sometimes necessary to use a range of different non-destructive testing methods (such as magnetic particle, penetrant flaw detection, ultrasonic and radiography)

2.8 describe the various types of penetrant flaw detection equipment used (to include portable kits and fixed installations; containers and dispensers for penetrants, removers and developers)

2.9 describe the basic concepts of penetrant flaw detection testing (including the type and characteristics of penetrant liquids; how the liquids are absorbed by capillary flow into the surface of the product, breaking any discontinuities/flaws in the products)

2.10 explain how to develop indications of the discontinuities/flaws so that they show up clearly

2.11 describe the different types of penetrants that are used (including colour and fluorescent intensity, methods of applying them and contact time required to be effective)

2.12 describe the various types of penetrant removers (such as solvents, water-soluble and oil-soluble emulsifiers)

2.13 describe the various types of developers that are used (such as dry powder, powder in aqueous and non-aqueous carriers, developers in solution), and the contact times required for effective development

2.14 describe the type of lighting that is required for the defects to show up clearly

2.15 describe the preparations to be carried out on the test area (such as degreasing); the effect of finish, contaminants and testing temperature on the test results achieved

2.16 explain how to carry out the testing activities (including the application of the penetrant, removal of excess penetrant, contact time, drying of products, application of developer, conditions for viewing developed indications (such as ambient light or ultraviolet (UV) light), and cleaning of the products on completion of the testing activities

2.17 describe the types of defect that are detectable using penetrant flaw detection methods

2.18 explain how to recognise the defects from the developed indications, and how to identify false indication of effects and their cause

2.19 describe the level of defects that are acceptable in the products; influence of the defects on the service/performance of the products

2.20 describe the system of quality control within the company, and who is responsible for it

2.21 explain why it is critical that records of penetrant flaw detection on the products, materials or structures are accurate, comprehensive and maintained legibly

2.22 identify the person that they need to pass the inspection records to

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 323 Inspecting engineering products by magnetic particle testing

UAN:	K/600/5660
Level:	3
Credit value:	82
GLH:	189
Relationship to NOS:	This unit has been derived from National Occupational Standard engineering technical support Unit No 23: inspecting engineering products by magnetic particle testing (Suite 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	This unit covers the skills and knowledge needed to prove the competences required to carry out magnetic particle tests on ferromagnetic components, materials or structures, in accordance with approved procedures. The learner will be required to prepare the components, materials or structures for the magnetic particle testing activities, and to check that the equipment complies with the specification requirements, is safe to use and fit for purpose. The learner must ensure that the ambient conditions are satisfactory for the tests to proceed, and will set up the equipment according to the non-destructive testing (NDT) instructions and requirements. The learner will carry out the specified tests using the correct procedures and observe and record the test indications. The learner will complete the tests by preparing/completing a NDT test report containing the required test information and data, along with their interpretation of the test indications. The learner will be expected to mark up the components, materials or structures to show where there are indications of surface defects. The completed inspection report will be passed to the appropriate person, in accordance with organisational procedures. The learner's responsibilities will require

them to comply with organisational policy and procedures for the magnetic particle testing activities undertaken, and to report any problems with the activities or equipment in use, 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 actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will show a good understanding of their work, and will provide an informed approach to the inspection of components, materials or structures by using magnetic particle testing methods. The learner will have a working knowledge of the principles of magnetic particle testing, including the methods of generating magnetic fields. The learner will understand the different types of equipment, their advantages, limitations and care, and the methods of calibration and performance checks. The learner will have a detailed knowledge of testing practice and will understand why this method has significant limitations on its flaw detecting capabilities. The learner's knowledge will include an appreciation of hazards and safe working practice, and they will understand the risks posed by material defects, and the consequences of failure. The importance of compiling accurate and legible reports will also be a key issue in completing this unit.

The learner will understand the safety precautions required when carrying out the magnetic particle testing activities, and when using the associated tools and 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 engineering products by magnetic particle testing
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 check and confirm that all of the following ambient testing conditions

are satisfactory:

- temperature
- humidity
- freedom from vibration
- freedom from pollutants

1.3 follow the correct specification for the product or equipment being inspected

1.4 prepare the products, materials or structures for testing, to include carrying out all of the following:

- identifying and marking the test areas
- removing any contaminants from the test area (such as degreasing)
- preparing the surface of the test area to the specified finish (such as grinding or polishing)

1.5 ensure that the equipment is fit for purpose and safe to use, by checking all of the following:

- the condition and security of electrical cables and connections
- the operation of all mechanical functions
- the function of powder/ink application
- the correct operation of all safety devices

1.6 follow the correct procedure to deal with components, materials or structures which fall into three of the following categories:

- components, materials or structures which meet the specification
- components, materials or structures with identified defects
- components, materials or structures requiring further investigation
- components, materials or structures requiring other inspection methods

1.7 use the correct equipment to carry out the inspection

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

1.9 carry out all required inspections as specified

1.10 carry out all of the following during the magnetic particle inspection activities:

- obtain the required magnetic particle testing equipment, and check it is in a safe and correctly calibrated condition
- use appropriate Personal Protective Equipment
- comply with job instructions, NDT testing inspection specifications, relevant COSHH sheets and risk assessment documentation
- follow the defined testing procedures, and apply safe working practices and procedures at all times
- leave the work area in a safe condition on completion of the activities

1.11 carry out all of the following tests, in accordance with instructions:

- setting the equipment parameters to the appropriate levels
- magnetising the components
- applying the detecting medium (ink or powder) correctly
- using magnetic flux indicators

- observing defect indications under correct lighting conditions (ambient light or ultraviolet (UV) light)
- recording conclusions of observations
- demagnetising and cleaning the components on completion of the test

1.12 carry out magnetic particle testing on one of the following:

- welded joints
- castings
- wrought products/materials (such as forged, rolled, extruded)
- cold formed products (such as by bending, pressing, rolling)
- heat treated components
- structures (such as airframes, lifting beams, pressure vessels)
- other specific products

1.13 identify any defects or variations from the specification

1.14 identify all of the following:

- defect type
- location of the defect
- dimensional size of the defect

1.15 record the results of the inspection in the appropriate format

1.16 complete a NDT report, to include recording all of the following:

- product identification
- material of construction
- geometry, thickness and surface condition where defect indications were found
- equipment settings (where applicable)
- ambient testing conditions
- defects identified
- comparison of flaw data with acceptance criteria
- conclusions and recommendations
- personal data

1.17 complete the inspection activities, to include carrying out all of the following:

- marking up defective components, materials or structures with all relevant information
- recording all the required details of the inspection in the appropriate format
- handing over the inspection details to the appropriate people

1.18 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 engineering products by magnetic particle testing
Assessment criteria
The learner can: 2.1 describe the specific safety precautions to be taken when carrying out magnetic particle inspection activities on components, materials or structures 2.2 describe the hazards associated with carrying out the magnetic particle inspection activities (such as electrical, mechanical, toxic and fire), and how they can be minimised 2.3 describe the type(s) of Personal Protective Equipment (PPE) to be used, and how to obtain it 2.4 describe the COSHH regulations relating to materials used during the magnetic particle inspection process 2.5 explain how to obtain the necessary job instructions, testing specifications, and how to interpret their information 2.6 describe the reasons why some components, materials or structures require to be tested using non-destructive testing methods 2.7 explain why it is sometimes necessary to use a range of different non-destructive testing methods (such as magnetic particle, penetrant flaw detection, ultrasonic and radiography) 2.8 describe the various types of magnetic particle detection equipment used (to include portable and fixed machines) 2.9 describe the various components that make up the equipment (such as contact prods and heads, rigid and flexible coils, permanent magnets, electromagnets) 2.10 describe the basic concepts of magnetic particle testing (including creating the magnetic field, magnetisation of the component, the use of a magnetic flux, disruption of the flux by discontinuities/flaws in the components and imaging of the disruption by the magnetic media) 2.11 explain how to check that the testing equipment is within current calibration dates 2.12 describe the checks that can be carried out on the equipment (such as sensitivity assessment, functional tests, operation of flux indicators and field strength meters, ammeters and quality of detecting medium) 2.13 describe the different detecting mediums that are used (to include inks and powders), methods of applying them and their removal on completion 2.14 explain how to set up the equipment parameters for the testing activities undertaken (to include selection of magnetising technique, field strength, direction of current flow, calculation of magnetising current required and flux density required) 2.15 describe the preparations to be carried out on the components, materials or structure test area (such as degreasing, grinding, filling, polishing and other mechanical operations and, where appropriate, the application of contrast aid paint) 2.16 explain how to carry out the testing activities (including the application of the magnetic field; application of the detecting media; viewing conditions required such as ambient light or

	ultraviolet (UV) light; identification of the displayed defects; defect transfer techniques (such as magnetic rubber and photographic))
2.17	describe the types of defect that are detectable using magnetic particle detection methods
2.18	explain how to recognise defects in the components, materials or structures from the displayed indications, and how to identify false indication of effects, and their cause
2.19	describe the level of defects that are acceptable in the components, materials or structures; the influence of the defects on the service/performance of the components, materials or structures
2.20	describe the system of quality control within the company, and who is responsible for it
2.21	explain why it is critical that records of magnetic particle inspections on the components are accurate, comprehensive and maintained legibly
2.22	identify the person that they need to pass the inspection records to
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 324 Preparing ultrasonic flaw detection equipment for testing activities

UAN:	L/600/5666
Level:	3
Credit value:	36
GLH:	91
Relationship to NOS:	This unit has been derived from National Occupational Standard engineering technical support Unit No 24: Preparing ultrasonic flaw detection equipment for testing activities (Suite 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	This unit covers the skills and knowledge needed to prove the competences required to prepare manual, semi-automatic or fully automatic ultrasonic flaw detection equipment, in readiness for the testing activities, in accordance with approved procedures. The correct outcome of ultrasonic testing demands great care in setting up the equipment, in order that the test indications may be confidently interpreted. The learner will be required to check that the flaw detector, its probes and calibration blocks are as specified in the Non-Destructive Testing (NDT) instructions. The learner will be required to check that the equipment is in a safe and usable condition, and that all electrical connections, cables and fittings are securely connected and fit for purpose. The learner will also be expected to check the performance of the equipment, and to calibrate the probe-flaw detector system for range, sensitivity and beam spread; Distance-Amplitude (DA) correction curves will be generated when required. The learner's responsibilities will require them to comply with organisational policy and procedures for the setting up of the

ultrasonic test equipment, and to report any problems with the equipment in use, or the 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 actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will show a good understanding of their work, and will provide an informed approach to the setting up of the ultrasonic equipment being used. The learner will have a good understanding of the principles of the pulse-echo system, and of the transmissions/reflection characteristics of ultrasonic waves. The learner will have an understanding of how the properties of materials will affect wave propagation, and the response of different types of reflector formed by internal features and defects. The learner will have a good knowledge of flaw detectors and their characteristics, and of the different types of probes, their application and calibration requirements. The learner's knowledge will include an appreciation of hazards and safe working practice, and they will understand the risks posed by material defects, and the consequences of failure.

The learner will understand the safety precautions required when setting up the ultrasonic flaw detection equipment, and when using the associated tools and 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. prepare ultrasonic flaw detection equipment for testing activities
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 obtain all the required equipment and ensure that it is in safe and usable condition 1.3 set up, check and adjust the equipment, to include carrying out all of the following:

- obtaining all necessary cables and fittings
- checking that all electrical connections, cables and fittings are secure and in a safe condition
- ensuring that probes are of the required type, size, frequency and angle
- ensuring that the probe is in good condition and contact faces are undamaged
- obtaining appropriate reference and calibration blocks
- obtaining the required couplant

1.4 check the performance of the ultrasonic flaw detector, using the correct reference block for both of the following: setting the equipment parameters to the appropriate levels:

- timebase linearity
- amplifier linearity

1.5 calibrate the probe-flaw detector system, using the specified calibration block(s) for all of the following:

- range
- sensitivity
- beam spread
- DA curves (where appropriate)

1.6 carry out the necessary preparations to equipment in line with work requirements

1.7 carry out all of the following during the preparation of the ultrasonic equipment:

- comply with job instructions, equipment setting up documentation, NDT testing specifications, relevant COSHH sheets and risk assessment documentation
- use appropriate Personal Protective Equipment
- follow the defined setting-up procedures, and apply safe working practices and procedures at all times
- leave the work area in a safe condition on completion of the activities

1.8 prepare ultrasonic flaw detection equipment that is either:

- analogue
- digital

1.9 prepare one of the following types of ultrasonic testing equipment in readiness for use:

- manual
- semi-automatic
- fully automatic

1.10 make sure that required safety arrangements are in place to protect other workers from activities likely to disrupt normal working

1.11 report completion of preparations in line with organisational procedures

1.12 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 prepare ultrasonic flaw detection equipment for testing activities
Assessment criteria
The learner can: 2.1 describe the specific safety precautions to be taken when setting up ultrasonic flaw detection equipment 2.2 describe the hazards associated with setting up the ultrasonic flaw detection equipment (such as electrical contact, moving mechanical parts), and how they can be minimised 2.3 describe the type(s) of Personal Protective Equipment (PPE) to be used, and how to obtain it 2.4 explain how to obtain the necessary job instructions, equipment setting-up procedures and testing specifications, and how to interpret their information 2.5 describe the basic principles of ultrasonic flaw detection testing (including sound transmission and reflection; the echo principle; ultrasound; pulse echo system; defects as reflectors and transmission time as a measuring system) 2.6 describe the basic components of the ultrasonic flaw detection equipment (such as use of pulse generators; transducers to transmit and receive ultrasound the receiver to recognise echo signals the amplifier and signal display panel) 2.7 describe the generation of ultrasonic waves (to include types of transducer; pulse length; frequency and bandwidth and the coupling of the transducer to the component/product) 2.8 describe the ultrasonic beam (to include beam diameter and spread; intensity versus radius; near field and far field; the influence of frequency, velocity and transducer size) 2.9 describe the factors which will affect the selection of suitable probes (such as type, frequency, size, angle and product to be tested, the influence of expected defects on the probe selection) 2.10 describe the manual, semi-automatic and automatic probe manipulation systems (including multiple probe systems) 2.11 explain how the properties of the materials to be tested will affect the way the equipment performs (such as size of object; surface conditions (such as, flat or curved, smooth or rough), any heat treatment or repairs to the component/product) 2.12 explain how to set up and calibrate the ultrasonic flaw detection equipment, using specified calibration blocks, setting range appropriate to component/product being inspected; the effect of different sound velocities in calibration block and material of components/products being inspected; the effect of casting shape and surface finish on range, sensitivity and signal-to-noise ratio 2.13 explain how to recognise defects (such as the various signals received from flaws; equipment response to probe manipulation and measurement of defect size) 2.14 describe the care and control of the equipment (to include checking condition of insulation 2.15 describe the extent of their own responsibility and to whom they should report if they have any problems that they cannot resolve.

Unit 325 Inspecting engineering products using ultrasonic testing techniques

UAN:	H/600/5673
Level:	3
Credit value:	82
GLH:	189
Relationship to NOS:	This unit has been derived from National Occupational Standard engineering technical support Unit No 25: inspecting engineering products using ultrasonic testing techniques (Suite 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	This unit covers the skills and knowledge needed to prove the competences required to carry out ultrasonic testing activities on engineering products, materials or structures, using manual, semi-automatic or fully automatic equipment, in accordance with approved procedures. The learner will be required to check that the ultrasonic test equipment complies with the specification requirements, is safe to use, fit for purpose and that it has been correctly calibrated. The learner will prepare the products for testing, identifying the test area for future reference, and check the material of the product for features which might interfere with the ultrasonic tests. The learner will set up and adjust the equipment, carry out the specified tests using the correct procedures, according to the non-destructive testing (NDT) instructions and requirements, and observe and record the test indications. The learner will be expected to draw conclusions about the type of defect present, its location and size. The learner will complete the tests by preparing/completing a NDT test report containing the required test information and data along with their interpretation of the test indications. The learner will be expected to mark up the products, materials or structures to show where there are indications of defects. The completed inspection report will be passed to the

appropriate person, in accordance with procedures.

The learner's responsibilities will require them to comply with organisational policy and procedures for the ultrasonic testing activities undertaken, and to report any problems with the activities or equipment in use, 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 actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will show a good understanding of their work, and will provide an informed approach to the inspection of engineering products, materials or structures by using ultrasonic flaw detection testing techniques. The learner will have a working knowledge of the principles of ultrasonic testing using the pulse-echo system, and will understand the functions and characteristics of the flaw detector, its performance requirements and the different types of probes available. The learner will have a detailed knowledge of testing practice, including the equipment calibration requirements, defect measurement techniques, equipment performance checks and routine care of the equipment. The learner's knowledge will include an appreciation of hazards and safe working practice, and they will understand the risks posed by material/structure defects, and the consequences of failure. The importance of compiling accurate and legible reports will also be a key issue in completing this unit.

The learner will understand the safety precautions required when carrying out the ultrasonic testing activities, and when using the associated tools and 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 engineering products using ultrasonic testing techniques
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 prepare the products, materials or structures for testing, to include carrying out all of the following: • identifying and marking the test areas • checking that the test areas are correctly prepared for testing • checking for key reference (datum) markings indicating location of product features • marking the scanning limits on the surface of the test areas • checking, when appropriate, the products for internal features which may interfere with the propagation of flaw recognition 1.4 use the correct equipment to carry out the inspection 1.5 obtain the correct type of equipment, as required by the NDT instructions, to include all of the following: • the flaw detector (such as analogue or digital) • specified probes • calibration blocks • couplant 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 ultrasonic testing activities: • obtain the required ultrasonic testing equipment, and ensure that it is in a safe and usable condition • use appropriate Personal Protective Equipment • comply with job instructions, NDT testing inspection specifications, relevant COSHH sheets and risk assessment documentation • follow the defined testing procedures, and apply safe working practices and procedures at all times • leave the work area in a safe condition on completion of the activities 1.9 carry out ultrasonic testing activities, using one of the following types of equipment: • manual • semi-automatic • fully automatic 1.10 carry out the specified tests, using all of the following: • the specified type of scan • the appropriate scanning procedure and technique • the specified probes (correct type, size and frequency)

- the correct flaw size measurement technique

1.11 carry out ultrasonic testing on one of the following:

- welded joints
- castings
- wrought products/materials (such as forged, rolled, extruded)
- cold formed products (such as by bending, pressing, rolling)
- heat treated components
- structures (such as airframes, lifting beams, pressure vessels)
- other specific products

1.12 identify any defects or variations from the specification

1.13 follow the correct procedure to deal with products which fall into three of the following categories:

- components, materials or structures which meet the specification
- components, materials or structures with identified defects
- components, materials or structures requiring further investigation
- components, materials or structures requiring other inspection methods

1.14 record the results of the inspection in the appropriate format

1.15 complete a NDT report, to include recording all of the following:

- product identification
- geometry, thickness, surface condition of identified test areas where defect indications were found
- test information (specified flaw detector, probe data, scan type and procedure, size measurement technique, sensitivity and other parameters relevant to the test)
- test indications and interpretation
- comparison of flaw data with acceptance criteria
- conclusions and recommendations
- personal data

1.16 record the test indications and conclusions including all of the following:

- defect type
- defect location
- defect size
- test area identification

1.17 complete the inspection activities, to include carrying out all of the following:

- marking up defective products, materials or structures with all relevant information
- recording all the required details of the inspection in the appropriate format
- handing over the inspection details to the appropriate people

1.18 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 engineering products using ultrasonic testing techniques
Assessment criteria
The learner can: 2.1 describe the specific safety precautions to be taken when carrying out ultrasonic flaw detection activities on engineering products, materials or structures 2.2 describe the hazards associated with carrying out the ultrasonic flaw detection activities (such as electrical contact, moving mechanical parts), and how they can be minimised 2.3 describe the type(s) of Personal Protective Equipment (PPE) to be used, and how to obtain it 2.4 explain how to obtain the necessary job instructions, NDT testing specifications, and how to interpret their information 2.5 describe the reasons why it is sometimes necessary to test products using non-destructive testing methods 2.6 explain why products may need to be tested by a range of different non-destructive testing methods (such as magnetic particle, penetrant flaw detection, ultrasonic and radiography) 2.7 describe the basic principles of ultrasonic flaw detection testing (including sound transmission and reflection; the echo principle; ultrasound; pulse echo system; defects as reflectors and transmission time as a measuring system) 2.8 describe the basic components of the ultrasonic flaw detection equipment (such as use of pulse generators; transducers to transmit and receive ultrasound the receiver to recognise echo signals the amplifier and signal display panel) 2.9 describe the generation of ultrasonic waves (to include types of transducer; pulse length; frequency and bandwidth and the coupling of the transducer to the product) 2.10 describe the different types of ultrasonic waves (to include compression, shear and surface; velocity of ultrasonic waves versus materials from which the components, materials or structures are constructed; frequency and wavelength and the relationship between the parameters) 2.11 describe the reflection and transmission of the ultrasonic waves (such as perpendicular incidence at reflectors; acoustic impedance; reflected and transmitted energy; critical angles and factors affecting angles of reflection; refraction of ultrasonic waves; calculations; echo signal amplitude and the definition of 'decibel') 2.12 describe the ultrasonic beam (to include beam diameter and spread; intensity versus radius; near field and far field; the influence of frequency, velocity and transducer size) 2.13 describe the factors which will effect the selection of suitable probes (such as type, frequency, size, angle and product to be tested, the influence of expected defects on the probe selection) 2.14 explain how the properties of the products to be tested will affect the way the equipment performs (such as size of object; surface conditions (such as, flat or curved, smooth or rough), any heat treatment or repairs to the products) 2.15 explain how to set up and calibrate the ultrasonic flaw detection

	equipment, using specified calibration blocks, setting range appropriate to the product being inspected; the effect of different sound velocities in calibration block and material of the products being inspected; the effect of product shape and surface finish on range, sensitivity and signal-to-noise ratio
2.16	explain how to carry out the ultrasonic testing activities (such as role of the couplant; the use of single and tandem probes; scanning pattern required to detect expected defects; the use of reference marks related to hidden features essential to probe positioning)
2.17	explain how to interpret the various signals from the equipment, in terms of defect identification, defect sizing and the effect of probe manipulation
2.18	describe the types of defect that are detectable using ultrasonic testing methods
2.19	describe the level of defects that are acceptable in the products; influence of the defects on the service/performance of the products, materials or structures
2.20	describe the system of quality control within the company, and who is responsible for it
2.21	explain why is it critical that records of ultrasonic flaw detection on the on the products are accurate, comprehensive and maintained legibly
2.22	identify the person that they need to pass the inspection records to
2.23	describe the care and control of the equipment (to include checking the condition of insulation, all electrical cables and connections, equipment operating controls and displays, mechanical functions and probes)
2.24	describe the extent of their own responsibility and to whom they should report if they have any problems that they cannot resolve.

Unit 326 Preparing work areas for radiographic testing activities

UAN:	T/600/5676
Level:	3
Credit value:	36
GLH:	91
Relationship to NOS:	This unit has been derived from National Occupational Standard engineering technical support Unit No 26: Preparing work areas for radiographic testing activities (Suite 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	This unit covers the skills and knowledge needed to prove the competences required to prepare work areas in readiness for radiography testing activities, in accordance with approved procedures. The work area for radiography is a controlled Test Zone, because of the emission of ionising radiation, and must be prepared in compliance with statutory regulations, local rules and instructions. The learner will ensure that the working environment is suitable for radiography, and that all essential services in the Test Zone are operating correctly. The learner will be required to establish the controlled Test Zone with a clearly identified boundary and ensure that all required safety equipment is in place and working, to protect both the testing personal and others working in the vicinity. All radioactive materials and devices must be correctly stored and transported. The learner's role will include checking that the radiographic equipment is fit for purpose and safe to use, and preparing the darkroom facility for film processing. The learner's responsibilities will require them to comply with organisational policy and procedures for the radiographic preparation activities undertaken, and to report any problems with the work area preparations, or equipment in use, 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 actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will show a good understanding of all the factors involved in establishing a safe working site for radiography. The learner will have a good understanding of the principles of X- and gamma radiography and the nature of the ionising radiation, and they will have a detailed knowledge of relevant health and safety legislation and practice. A sound knowledge of radiographic and associated equipment is essential, and the learner will be expected to have a working knowledge of radiographic practice and film processing.

The learner's knowledge will include an appreciation of hazards and safe working practice, and they will understand the safety precautions required when preparing the controlled Test Zone and radiography 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. prepare work areas for radiographic testing activities
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 ensure that the work environment is suitable for the work activities to be undertaken 1.3 check that all of the following are fit for purpose and fully functional: • the radiographic equipment, and its mounting facilities • safety devices and interlocks • control equipment 1.4 ensure that all necessary service supplies are connected and ready for use 1.5 prepare the work areas so that they are ready for the engineering activities to be carried out 1.6 carry out all of the following during the radiographic work area preparation activities: • comply with Ionising Radiation regulations, job instructions, controlled Test Zone preparation 1.7 documentation and procedures, and relevant COSHH and risk

assessment documentation

- use appropriate Personal Protective Equipment
- follow the defined preparation procedures, and apply safe working practices and procedures at all times
- leave the work area in a safe condition on completion of the activities

1.8 prepare the darkroom for film processing, to include carrying out all of the following:

- obtaining all necessary Personal Protective Equipment
- ensuring safe storage for unexposed film, film awaiting processing, and processed film
- ensuring safe storage and disposal/recirculation of developers and other chemicals
- maintaining adequate, clean facilities for processing and drying the film
- checking the correct operation of viewers for checking the image quality

1.9 make sure that required safety arrangements are in place to protect other workers from activities likely to disrupt normal working

1.10 establish the controlled test zone, in accordance with regulations, to include covering all of the following:

- take account of specified risk assessments
- set up a clearly identified boundary marking the exclusion zone
- place prepared and calibrated radiation survey meters at specified locations
- position appropriate radiation shielding screens
- obtain appropriate exposure warning devices
- prepare/maintain an emergency escape route
- ensure appropriate staging is in place and is safe and secure
- maintain an authorised secure store for gamma-ray equipment
- ensure that an approved means of transporting the gamma-ray containers is used
- ensure that essential services are connected (electricity, water/fluids, compressed air/gases)

1.11 report completion of preparations in line with organisational procedures

1.12 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 prepare work areas for radiographic testing activities
Assessment criteria
The learner can: 2.1 describe the specific safety precautions to be taken when preparing radiographic controlled Test Zones 2.2 describe the hazards associated with radiographic testing activities (such as electrical contact, moving mechanical parts, radiation,

toxic chemicals), and how they can be minimised

2.3 describe the regulations and codes of practice that are required to be followed when preparing radiographic areas for testing activities (such as Ionising Radiation regulations; COSHH regulations; local rules; the role of the Radiation Protection Supervisor; the use of the Radioactive Source Movement Register)

2.4 describe the type(s) of Personal Protective Equipment (PPE) to be used, and how to obtain it (such as protective clothing, personal dosimeters, radiation survey meters, barriers and screens)

2.5 describe the procedures to be adopted in the case of accident and emergency/incidents involving radioactive sources

2.6 describe the basic principles of radiographic testing (including the use of X- and gamma radiation as a penetrating agent; shadow effect and projection and the capture of the image on photographic type film; development, fixing, washing and drying of the film, and equipment used to view the exposed images)

2.7 describe the sources of radiation used in radiographic testing activities to include the X-ray tube (generator) and the use of radioactive isotopes

2.8 explain how to obtain the necessary job instructions, controlled Test Zone setting-up procedures and other relevant specifications and regulations, and how to interpret their information

2.9 explain how to set up a controlled Test Zone (including the identification and marking of boundary exclusion zones, the erection of physical barriers, warning lights and visual signs to restrict unauthorised entrance, the sighting of radiation survey meters, the positioning of appropriate radiation screens)

2.10 explain how to transport radioactive materials safely and correctly, and the safe storage of the radioactive source containers

2.11 describe the setting-up/maintenance of storage facilities for unexposed film, exposed film and film which has been developed

2.12 describe the preparations required for processing the film (to include providing adequate darkroom facilities/lighting conditions, ensuring essential services are connected and that sufficient supplies of processing solutions are available and stored safely)

2.13 describe the preparation requirements of the X-ray tube generator and how to set up the tube or radiation source (including equipment controls, focal spot size and safety devices)

2.14 describe the care and control of the equipment (to include checking the condition of all electrical cables and connections

2.15 describe the care of gamma-ray source containers, and storage procedures for radioactive sources

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

Unit 327 Carrying out radiographic testing activities

UAN:	Y/600/5685
Level:	3
Credit value:	82
GLH:	189
Relationship to NOS:	This unit has been derived from National Occupational Standard engineering technical support Unit No 27: carrying out radiographic testing activities (Suite 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	This unit covers the skills and knowledge needed to prove the competences required to carry out radiographic testing activities on engineering products, materials or structures, in accordance with approved procedures. Because of the presence of ionising radiation, a key requirement of radiographic testing is to ensure that the learner works in accordance with the relevant statutory regulations, local rules and instructions, and that the safety features of the controlled Test Zone are fully operational at all times. The learner will be required to check that the radiographic test equipment complies with the specification requirements, is safe to use, fit for purpose, and that it is set up correctly for the intended operations. The learner will prepare the products for testing, identifying the test area for future reference, and checking the material of the products for features that might interfere with the radiographic tests. The learner will set up and adjust the radiographic equipment, carry out the exposure, and process the exposed films in the prepared facility. following processing, the learner will be expected to check the image quality before storing the film, ready for interpretation. where radioactive sources are used, the learner will be required to keep these in the designated store, except when is use, and correctly record their movement. The learner's responsibilities will require

them to comply with organisational policy and procedures for the radiographic testing activities undertaken, and to report any problems with the equipment in use, or the testing 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 actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will show a good understanding of their work, and will provide an informed approach to the inspection of engineering products by using radiographic testing techniques. The learner will have a sound understanding of radiographic principles, the nature and characteristics of ionising radiation, and the equipment for X- and gamma radiography. The learner will understand how images are formed on the film and the factors that affect image quality. The learner will also have detailed knowledge of film processing, fixing, washing and drying requirements, along with the safe storage requirements of the film at all stages of use. The learner will have a detailed knowledge of radiographic testing practice, including the equipment calibration requirements, equipment performance checks and routine care of the equipment.

Knowledge of radiographic practice will be a key feature, with special reference to hazards and safe working practice. The learner will understand the safety precautions required when carrying out the radiographic testing activities, and when using the associated film processing materials and 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. carry out radiographic testing activities
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 radiographic testing, to include carrying out all of the following:

- checking that all features of the controlled Test Zone are in place and operating correctly (such as barriers, lights, signs, radiation survey meters)
- ensuring that the product test areas are correctly prepared and identified
- checking that all equipment and consumables are as specified and fit for purpose
- removing gamma ray source containers from the approved store and recording in the Source Movement Register

1.3 follow the appropriate procedures for use of tools and equipment to carry out the required tests

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 radiographic testing activities:

- use appropriate Personal Protective Equipment
- comply with Ionising Radiation regulations, local rules, instructions issued by the Radiation Protection Supervisor, relevant COSHH sheets and risk assessment documentation
- follow the defined radiographic testing procedures, and apply safe working practices and procedures at all times
- leave the work area in a safe condition on completion of the activities

1.6 set up the radiographic testing equipment to provide all of the following:

- correct source location, Source Focal Distance (SFD) and beam orientation
- specified exposure parameters
- specified radiographic film and intensifying screens applied to the test areas
- correctly located Image Quality Indicators (IQIs) and identification markers

1.7 carry out radiographic exposures on the engineering products, to include carrying out all of the following:

- activating exposure warning devices
- monitoring the radiation survey meters
- storing the exposed film in the designated safe place

1.8 carry out radiographic testing on one of the following:

- welded joints
- castings
- wrought products/materials (such as forged, rolled, extruded)
- cold formed products (such as by bending, pressing, rolling)
- heat treated components
- structures (such as airframes, lifting beams, pressure vessels)
- other specific products

1.9 process the exposed films in the prepared facility, according to manufacturer's instructions, to include carrying out all of the following:

- using the correct Personal Protective Equipment
- preparing the correct processing chemicals

- carrying out the processing requirements, in the correct sequence and for the correct time
- viewing the image under suitable lighting conditions
- storing processed film in a safe place
- disposing of used materials, in line with organisation and environmental safe practice

1.10 record the results of the tests in the appropriate format

1.11 complete a NDT report, to include recording all of the following:

- product identification
- test areas covered by identified radiographs
- test area geometries and thickness
- radiographic parameters
- testing conditions
- type of image quality indication (IQI)
- film type
- processing conditions
- personal data

1.12 complete the radiographic testing activities, by carrying out all of the following:

- closing down the equipment to a safe condition
- returning gamma radiation source containers to the approved store
- recording actions in the source movement register
- removing warning notices and barriers, and reinstating the work area

1.13 review the results and carry out further tests if necessary

1.14 check the quality of the developed image for all of the following features:

- processing faults
- image quality
- contrast
- sensitivity
- density

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 carry out radiographic testing activities
Assessment criteria
The learner can: 2.1 describe the specific safety precautions to be taken when carrying out radiographic testing activities on engineering products, materials or structures 2.2 describe the hazards associated with radiographic testing activities (such as electrical contact, moving mechanical parts, radiation, toxic chemicals), and how they can be minimised 2.3 describe the regulations and codes of practice to be followed when

using radiographic testing equipment (such as Ionising Radiation regulations; COSHH regulations; local rules; the role of the Radiation Protection Supervisor; the use of the Radioactive Source Movement Register)

2.4 describe the type(s) of Personal Protective Equipment (PPE) to be used, and how to obtain it (such as protective clothing, personal dosimeters, radiation survey meters, barriers and screens, warning signals, visual indicators and alarm systems)

2.5 describe the procedures to be adopted in the case of accident and emergency/incidents involving radioactive sources

2.6 explain how to check the controlled Test Zone complies with regulation requirements (such as the identification and marking of boundary exclusion zones, the erection of physical barriers, warning lights and visual signs to restrict unauthorised entrance, the sighting of radiation survey meters, the positioning of appropriate radiation screens)

2.7 describe the basic principles of radiographic testing (including the use of X- and gamma radiation as a penetrating agent; shadow effect and projection and the capture of the image on photographic type film; development, fixing, washing and drying of the film, and equipment used to view the exposed images)

2.8 describe the sources of radiation used in radiographic testing activities (to include the X-ray tube (generator) and the use of radioactive isotopes)

2.9 describe the image formation (including rectilinear propagation; the geometry of shadow projection, inverse square law, focal spot, formation of penumbra and image quality indicators)

2.10 describe the preparation requirements of the X-ray tube generator, and how to set up the tube or radiation source (including equipment controls, establishment of testing parameters; focal spot size and safety devices; the use of exposure charts)

2.11 describe the care and control of the equipment (to include checking the condition of all electrical cables and connections, all mechanical functions and safety devices)

2.12 describe the care of gamma-ray source containers, and storage procedures for radioactive sources

2.13 explain how to transport radioactive materials safely and correctly, and the safe storage of the radioactive source containers

2.14 explain how to prepare the products, materials or structures for the radiographic testing activities (including the identification of the test area and the use of lead markers)

2.15 describe the types and selection of radiographic films (including emulsion types; intensifying screens; film development, fixing, washing and drying; the significance of temperature on the film and how it is controlled)

2.16 describe the processing faults, characteristic curves, and the effect of development conditions on the finished film quality

2.17 describe the radiographic image quality (to include sensitivity, density, contrast and definition, and the effect of scattered radiation on the image)

2.18 describe the response of defects to penetrative radiation, and the resulting images on the film

2.19 describe the setting up/maintenance of storage facilities for unexposed film, exposed film and film which has been developed

2.20 describe the extent of their own responsibility and to whom they

should report if they have any problems that they cannot resolve.

Unit 328 Analysing and interpreting the results of radiographic tests

UAN:	K/600/5688
Level:	3
Credit value:	70
GLH:	168
Relationship to NOS:	This unit has been derived from National Occupational Standard engineering technical support Unit No 28: Analysing and interpreting the results of radiographic tests (Suite 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	This unit covers the skills and knowledge needed to prove the competences required to analyse and interpret radiographs generated from radiographic testing, in accordance with approved procedures. This will require the learner to obtain all relevant information about the test areas of the products/components, the acceptance criteria and radiographic practice to be followed, to ensure a valid outcome. The learner must ensure that viewing conditions are correct, and they will be expected to check the image quality and to interpret the radiographic images against the background of the information obtained. The learner will identify the types of defect present, their location and relevant dimensions. The learner will then need to compare their findings with the acceptance criteria, and draw appropriate conclusions as to the condition of the products/components. The learner's responsibilities will require them to comply with organisational policy and procedures for the radiographic analysis and interpretation activities undertaken, and to report any problems with these activities or with the equipment in use 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

actions and for the quality and accuracy of the work that they undertake.

The learner's knowledge will show a good understanding of their work, and will provide an informed approach to the inspection of products/components using radiographic testing techniques. The learner will have a sound understanding of radiographic principles, the nature and characteristics of ionising radiation. Image formation in radiographic film and the effect of product/component geometry, radiographic practice and film processing on image form and quality will all be key issues. The learner will understand the principles and practice of the interpretation process, in particular the appearance of defects on the film and the safe storage requirements of the radiographs in use. The learner will have an understanding of the product/component manufacturing process, especially that related to the incidence of defects. The learner will know the criteria of acceptance for the products/components, the influence of the defects on the products/components in service, and the consequences of their failure.

As the learner may be required to work in controlled areas, an understanding of radiographic practice will be a key feature, with special reference to hazards and safe working practice. 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. analyse and interpret the results of radiographic tests
Assessment criteria
The learner can: 1.1 work safely in accordance with the regulations for their work environment 1.2 ensure that the viewing area has the correct conditions, to include all of the following: • absence of external light • appropriate subdued internal light • correct ambient conditions • suitable light box for viewing 1.3 ensure that the radiographic film quality meets specified IQI

requirements, to include all of the following:

- image quality
- sensitivity
- contrast
- density

1.4 ensure that they have the necessary test data on which to conduct the analysis

1.5 In obtaining the necessary information and data required for the analysis and interpretation, include obtaining all of the following:

- relevant product/component information
- material of construction
- acceptance criteria to be used
- area of product/component being examined (geometries and thickness)
- radiographic parameters and testing conditions
- type of image quality indicator (IQI) to be used
- film type
- processing conditions

1.6 resolve promptly any inconsistencies in the data

1.7 analyse the data using approved methods and procedures

1.8 interpret the radiographs from one of the following product groups:

- welded joints
- castings
- wrought products or materials (such as forged, rolled, extruded)
- cold formed products (such as by bending, pressing, rolling)
- heat treated components
- structures (such as airframes, lifting beams, pressure vessels)
- other specific products

1.9 interpret the radiographs and identify all of the following, as appropriate:

- defect type
- location of the defect
- dimensional size of the defect

1.10 check that the data analysis is accurate and thorough and takes account of the test conditions

1.11 compare the analysis against the product or asset specification and identify any faults or variations from specification

1.12 compare their findings with the acceptance criteria, and record all of the following in the NDT report:

- personal data (such as details of radiographer, date of test)
- product identification
- material of construction
- geometry, thickness and surface condition in the test area
- test area identification (where indications are found)
- test equipment settings and parameters
- film type and processing conditions
- ambient testing conditions

- the defects identified
- comparisons with acceptance criteria
- conclusions reached

1.13 follow the correct procedure to deal with products which fall into three of the following categories:

- components, materials or structures which meet the specification
- components, materials or structures with identified defects
- components, materials or structures requiring further investigation
- components, materials or structures requiring other inspection methods

1.14 record the results of the analysis in the appropriate format

1.15 complete the inspection activities, to include carrying out all of the following:

- marking up defective products/components with all relevant information
- recording all the required details of the inspection in the appropriate format
- handing over the inspection details to the appropriate people.

Learning outcome
The learner will: 2. know how to analyse and interpret the results of radiographic tests
Assessment criteria
The learner can: 2.1 describe the specific safety precautions to be taken when working in radiographic controlled zones 2.2 describe the regulations and codes of practice to be followed when working in radiographic testing areas (such as Ionising Radiation regulations; COSHH regulations; local rules; the role of the Radiation Protection Supervisor; the use of the Radioactive Source Movement Register) 2.3 describe the type(s) of Personal Protective Equipment (PPE) to be used, and how to obtain it (such as protective clothing, personal dosimeters, radiation survey meters, barriers and screens, warning signals, visual indicators and alarm systems) 2.4 describe the procedures to be adopted in the case of accident and emergency/incidents involving radioactive sources 2.5 describe the set-up and requirements of a controlled Test Zone (such as the identification and marking of boundary exclusion zones, the erection of physical barriers, warning lights and visual signs to restrict unauthorised entrance, the siting of radiation survey meters, the positioning of appropriate radiation screens) 2.6 describe the basic principles of radiographic testing (including the use of X- and gamma radiation as a penetrating agent; shadow effect and projection, and the capture of the image on photographic type film; development, fixing, washing and drying of the film, and equipment used to view the exposed images) 2.7 describe the sources of radiation used in radiographic testing activities (to include the X-ray tube (generator) and the use of

radioactive isotopes)

2.8 describe the image formation (including rectilinear propagation; the geometry of shadow projection, inverse square law, focal spot, formation of penumbra and image quality indicators)

2.9 describe the types and selection of radiographic films (including emulsion types; intensifying screens; film development, fixing, washing and drying; the significance of temperature on the film, and how it is controlled)

2.10 describe the processing faults, characteristic curves, and the effect of development conditions on the finished film quality

2.11 describe the storage facilities for the radiographs

2.12 describe the radiographic image quality (to include sensitivity, density, contrast and definition and the effect of scattered radiation on the image)

2.13 describe the response of product/component defects to penetrative radiation, and the resulting images on the film

2.14 describe the types of defect that are detectable using radiographic testing methods

2.15 explain how to interpret the radiographs and the appearance of various defects on the film; spurious images their cause and effect; assessment of defect size and location

2.16 describe the conditions in which the radiographs should be viewed (to include ambient conditions and use of appropriate light box)

2.17 describe the acceptance criteria to be used for the product/component, and the level of defects that are acceptable

2.18 describe the influence of defects on service and performance; the risks and consequences of product/component failure

2.19 explain why it is critical that records of radiographic testing on the products/components are accurate, comprehensive and maintained legibly

2.20 identify person that they need to pass the inspection records to

2.21 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

Useful contacts

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

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

About City & Guilds

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

City & Guilds Group

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

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