

Level 3 NVQ Extended Diploma in Mechanical Manufacturing Engineering (Machining) (1712-30)

November 2022 Version 2.0



Qualification at a glance

Subject area	Mechanical Manufacturing Engineering
City & Guilds number	1712
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	GLH	TQT	City & Guilds number	Accreditation number
Level 3 NVQ Extended Diploma in Mechanical Manufacturing Engineering - Machining	439	1060	1712-30	601/0081/3

Version and date	Change detail	Section
1.1 February 2018	Added TQT and GLH details Deleted QCF	Qualification at a Glance, Structure Throughout
1.2 October 2018	Changed from a seven to a nine	Unit 201 Assessment criteria 2.3
2.0 November 2022	Adjusted document to only fit extended diploma requirements, as the original diploma has expired Adjusted TQT & GLH Added PEO Requirements Links updated throughout	Structure GLH & TQT Throughout



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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 as mechanical manufacturing engineers – fitting and machining 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 mechanical manufacturing engineering sector.
Is the qualification part of a framework or initiative?	It serves as a competence qualification, in the Engineering Apprenticeship framework.
What opportunities for progression are there?	It allows candidates to progress into employment or to the following City & Guilds qualifications: <ul style="list-style-type: none">• City & Guilds level 4 Engineering Qualifications• Foundation Degree or other higher education qualifications

Structure

To achieve the **Level 3 NVQ Extended Diploma in Mechanical Manufacturing Engineering (Machining)**, Learners must achieve the minimum requirements from the Performing Engineering Operations (PEO) units, which can be found on the “1712 L2 Unit pack” document on the mechanical manufacturing engineering (1712) page (cityandguilds.com):

- A minimum of **27 credits** and **3 units** from PEO pathway A (704-761, 765-773), or:
- A minimum of **51 credits** must be achieved from PEO pathway B: this must be achieved from:
 - **11 credits** and **1 unit** from group B1 (704, 731,761)
 - **16 credits** and **2 units** from group B2 (762-764) and
 - **24 credits** and **2 units** from group B3 (765-768)
- If PEO pathway A is undertaken learners **must** note the following barred units
 - Only one unit from 704, 732 and 761 may be included in the learner’s choice of three units
 - If unit 765 is selected units 705, 706, 708, 711, 712, 715, 716, 717 cannot be included in the learner’s choice of three units
 - If unit 766 is selected units 710, 722, 723, 725, 726, 727, 728, 729, 730, 734 cannot be included in the learner’s choice of three units.
 - If unit 767 is selected units 733, 735, 736, 740 cannot be included in the learner’s choice of three units.
 - If unit 768 is selected units 719, 721, 737, 738, 739, 740, 758, 759 cannot be included in the learner’s choice of three units.

Learners must also achieve **15** credits from the mandatory units and a minimum of **111** credits from **1** of the optional groups available.

Unit accreditation number	City & Guilds unit number	Unit title	Credit value
Mandatory			
A/601/5013	Unit 201	Complying with statutory regulations and organisational safety requirements	5
Y/601/5102	Unit 202	Using and interpreting engineering data and documentation	5
K/601/5055	Unit 303	Working efficiently and effectively in engineering	5

Optional

Group 1

T/600/5385	Unit 304	Setting centre lathes for production	91
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A/600/5386	Unit 305	Machining components using centre lathes	77
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Group 2

F/600/5387	Unit 306	Setting turret lathes for production	91
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J/600/5388	Unit 307	Machining components using turret lathes	77
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Group 3

J/600/5391	Unit 308	Setting milling machines for production	91
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L/600/5392	Unit 309	Machining components using milling machines	77
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Group 4

R/600/5393	Unit 310	Setting shaping, planing or slotting machines for production	78
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Y/600/5394	Unit 311	Machining components using shaping, planing or slotting machines	69
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Group 5

D/600/5395	Unit 312	Setting gear cutting machines for production	91
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K/600/5397	Unit 313	Machining components using gear cutting machines	77
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Group 6

M/600/5398	Unit 314	Setting gear grinding machines for production	91
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D/600/5400	Unit 315	Machining components using gear grinding machines	77
Group 7			
K/600/5402	Unit 316	Setting horizontal boring machines for production	91
L/600/5411	Unit 317	Machining components using horizontal boring machines	77
Group 8			
F/600/5423	Unit 318	Setting vertical boring machines for production	91
Y/600/5430	Unit 319	Machining components using vertical boring machines	77
Group 9			
H/600/5432	Unit 320	Setting electro-discharge machines for production	91
L/600/5439	Unit 321	Machining components using electro-discharge machines	77
Group 10			
M/600/5448	Unit 322	Setting grinding machines for production	91
Y/600/5458	Unit 323	Machining components using grinding machines	77
Group 11			
L/600/5473	Unit 324	Setting honing and lapping machines for production	78
L/600/5487	Unit 325	Machining components using honing and lapping machines	33
Group 12			
L/600/5490	Unit 326	Setting broaching machines for production	78
A/600/5503	Unit 327	Machining components using broaching machines	33

Group 13

D/600/5509	Unit 328	Setting metal spinning machines for production	78
K/600/5514	Unit 329	Producing components using metal spinning machines	77

Total Qualification Time

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

Title and level	GLH	TQT
Level 3 NVQ Extended Diploma in Mechanical Manufacturing Engineering - Machining	439	1060



2 Centre requirements

Approval

Centres currently offering the City & Guilds Level 3 NVQ in Mechanical Manufacturing Engineering (1682) 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 verifiers

Assessor Requirements to Demonstrate Effective Assessment Practice

Assessment must be carried out by competent Assessors that as a minimum must hold the 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 Semta 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 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 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 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 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 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 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 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 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 Semta National Occupational Standards (NOS) Verifiers, both Internal and External, will also be expected to be fully conversant with the terminology used in the 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 qualifications, 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 3 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: **The Register of Regulated Qualifications: Home page (ofqual.gov.uk)**

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 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 Semta National Occupational standard: Complying with statutory regulations and organisational safety requirements (Suite 2).
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	This unit covers the skills and knowledge needed to prove the competences required to deal with statutory regulations and organisational safety requirements. It does not deal with specific safety regulations or detailed requirements, it does, however, cover the more general health and safety requirements that apply to working in an industrial environment.

The learner will be expected to comply with all relevant regulations that apply to their area of work, as well as their general responsibilities as defined in the Health and Safety at Work Act. The learner will need to be able to identify the relevant qualified first aiders and know the location of the first aid facilities. The learner will have a knowledge and understanding of the procedures to be adopted in the case of accidents involving injury and in situations where there are dangerous occurrences or hazardous malfunctions of equipment, processes or machinery. The learner will also need to be fully conversant with their organisation's procedures for fire alerts and the evacuation of premises.

The learner will also be required to identify the hazards and risks that are associated with their job. Typically, these will focus on

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

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

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

Learning outcome
The learner will: 1. comply with statutory regulations and organisational safety requirements
Assessment criteria
The learner can: 1.1 comply with their duties and obligations as defined in the Health and Safety at Work Act 1.2 demonstrate their understanding of their duties and obligations to health and safety by: <ul style="list-style-type: none">• applying in principle their duties and responsibilities as an individual under the Health and Safety at Work Act• identifying, within their organisation, appropriate sources of information and guidance on health and safety issues, such as:<ul style="list-style-type: none">- eye protection and Personal Protective Equipment (PPE)- COSHH regulations- risk assessments• identifying the warning signs and labels of the main groups of hazardous or dangerous substances• complying with the appropriate statutory regulations at all times 1.3 present themselves in the workplace suitably prepared for the

<p>activities to be undertaken</p> <p>1.4 follow organisational accident and emergency procedures</p> <p>1.5 comply with emergency requirements, to include:</p> <ul style="list-style-type: none"> • identifying the appropriate qualified first aiders and the location of first aid facilities • identifying the procedures to be followed in the event of injury to themselves or others • following organisational procedures in the event of fire and the evacuation of premises • identifying the procedures to be followed in the event of dangerous occurrences or hazardous malfunctions of equipment <p>1.6 recognise and control hazards in the workplace</p> <p>1.7 identify the hazards and risks that are associated with the following:</p> <ul style="list-style-type: none"> • their working environment • the equipment that they use • materials and substances (where appropriate) that they use • working practices that do not follow laid-down procedures <p>1.8 use correct manual lifting and carrying techniques</p> <p>1.9 demonstrate one of the following methods of manual lifting and carrying:</p> <ul style="list-style-type: none"> • lifting alone • with assistance of others • with mechanical assistance <p>1.10 apply safe working practices and procedures to include:</p> <ul style="list-style-type: none"> • maintaining a tidy workplace, with exits and gangways free from obstruction • using equipment safely and only for the purpose intended • observing organisational safety rules, signs and hazard warnings • taking measures to protect others from any harm resulting from the work that they are carrying out.

<p>Learning outcome</p> <p>The learner will:</p> <p>2. know how to comply with statutory regulations and organisational safety requirements</p>
<p>Assessment criteria</p> <p>The learner can:</p> <p>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)</p> <p>2.2 describe the specific regulations and safe working practices and procedures that apply to their work activities</p>

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

the work that they carry out.

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

Learning outcome
The learner will: 1. use and interpret engineering data and documentation
Assessment criteria
The learner can: 1.1 use the approved source to obtain the required data and documentation 1.2 use the data and documentation and carry out all of the following: <ul style="list-style-type: none">• check the currency and validity of the data and documentation used• exercise care and control over the documents at all times• correctly extract all necessary data in order to carry out the required tasks• seek out additional information where there are gaps or deficiencies in the information obtained• deal with or report any problems found with the data and documentation• make valid decisions based on the evaluation of the engineering information extracted from the documents• return all documents to the approved location on completion of the work• complete all necessary work related documentation such as production documentation, installation documentation, maintenance documentation, planning documentation 1.3 correctly identify, interpret and extract the required information 1.4 extract information that includes three of the following: <ul style="list-style-type: none">• materials or components required• dimensions• tolerances• build quality• installation requirements• customer requirements• time scales• financial information• operating parameters• surface texture requirements

- location/orientation of parts
 - process or treatments required
 - dismantling/assembly sequence
 - inspection/testing requirements
 - number/volumes required
 - repair/service methods
 - method of manufacture
 - weld type and size
 - operations required
 - connections to be made
 - surface finish required
 - shape or profiles
 - fault finding procedures
 - safety/risk factors
 - environmental controls
 - specific data (such as component data, maintenance data, electrical data, fluid data)
 - resources (such as tools, equipment, personnel)
 - utility supply details (such as electricity, water, gas, air)
 - location of services, including standby and emergency backup systems
 - circuit characteristics (such as pressure, flow, current, voltage, speed)
 - protective arrangements and equipment (such as containment, environmental controls, warning and evacuation systems and equipment)
 - other specific related information
- 1.5 use the information obtained to ensure that work output meets the specification
- 1.6 use information extracted from documents to include one from the following:
- drawings (such as component drawings, assembly drawings, modification drawings, repair drawings, welding/fabrication drawings, distribution and installation drawings)
 - diagrams (such as schematic, fluid power diagrams, piping, wiring/circuit diagrams)
 - manufacturers manuals/drawings
 - approved sketches
 - technical illustrations
 - photographic representations
 - visual display screen information
 - technical sales/marketing documentation
 - contractual documentation
 - other specific drawings/documents
- 1.7 use information extracted from related documentation, to include two from the following:
- instructions (such as job instructions, drawing instructions, manufacturers instructions)

	<ul style="list-style-type: none"> • specifications (such as material, finish, process, contractual, calibration) • reference materials (such as manuals, tables, charts, guides, notes) • schedules • operation sheets • service/test information • planning documentation • quality control documents • company specific technical instructions • national, international and organisational standards • health and safety standards relating to the activity (such as COSHH) • other specific related documentation
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 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 Semta National Occupational standard: Working efficiently and effectively in engineering (Suite 3).
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to work efficiently and effectively in the workplace, in accordance with approved procedures and practices. Prior to undertaking the engineering activity, the learner will be required to carry out all necessary preparations within the scope of their responsibility. This may include preparing the work area and ensuring that it is in a safe condition to carry out the intended activities, ensuring they have the appropriate job specifications and instructions and that any tools, equipment, materials and other resources required are available and in a safe and usable condition.</p> <p>On completion of the engineering activity, the learner will be required to return their immediate work area to an acceptable condition before recommencing further work requirements. This may involve placing completed work in the correct location, returning and/or storing any tools and equipment in the correct area, identifying any waste and/or scrapped materials and arranging for their disposal, and reporting any defects or damage to tools and equipment used.</p> <p>In order to be efficient and effective in the workplace, the learner will also be required to demonstrate that they can create and</p>

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.

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: <ul style="list-style-type: none">• 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: <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • dual or multi-skilling • training on new equipment / technology • increased responsibility • understanding of company working practices, procedures, plans and policies • other specific requirements.

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

- improving working practices
- 2.16 describe the procedure and format for making suggestions for improvements
 - 2.17 describe the benefits to organisations if improvements can be identified
 - 2.18 describe the importance of maintaining effective working relationships within the workplace
 - 2.19 describe the procedures to deal with and report any problems that can affect working relationships
 - 2.20 describe the difficulties that can occur in working relationships
 - 2.21 describe the regulations that affect how they should be treated at work (such as Equal Opportunities Act, Race and Sex Discrimination, Working Time Directive)
 - 2.22 describe the benefits of continuous personal development
 - 2.23 describe the training opportunities that are available in the workplace
 - 2.24 describe the importance of reviewing their training and development
 - 2.25 explain with whom to discuss training and development issues
 - 2.26 describe the extent of their own responsibility and to whom they should report if they have any problems that they cannot resolve.

Unit 304

Setting centre lathes for production

UAN:	T/600/5385
Level:	3
Credit value:	91
GLH:	210
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 4: Setting Centre Lathes for Production (Level 3).
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to prepare and set up centre lathes, in accordance with approved procedures. This will involve selecting the appropriate workholding devices, securing them to the machine spindle, selecting and setting suitable chuck jaws or collets, boring out soft jaws, setting workpieces mounted between centres, mounting workpieces in jigs/fixtures or setting workpieces on face plates in the correct relationship to the machine spindle. The learner will be expected to select the appropriate turning tools, check that they are in a usable condition and mount and secure them to the relevant tool holding devices.</p> <p>The learner will need to set the machine operating parameters to produce the workpiece to the required specification. This will involve setting feeds and speeds, setting roughing and finishing cuts and using accessories such as taper turning attachments, profiling attachments, offsetting the tailstock, angular setting of compound slide, and the setting and adjusting of change gears for screw cutting. The learner must produce trial cuts and prove the machine is working satisfactorily before declaring the machine ready for production. Making adjustments to settings to achieve specification, and solving</p>

machine-related problems during production, will also form part of their role.

The learner's responsibilities will require them to comply with organisational policy and procedures for the machine setting activities undertaken, and to report any problems with the machine, tooling, equipment or setting up activities that they cannot personally resolve, or 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 of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to the setting up procedures used. The learner will understand the machine used, and its application, and will know about the workholding devices, turning tools, relevant materials, consumables and setting up procedures, in adequate depth to provide a sound basis for carrying out the activities, correcting faults and ensuring the work output is to the required specification.

The learner will understand the safety precautions required when working with the machines and their 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. set centre lathes for production
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 carry out all of the following activities during setting up: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, drawings, quality control documentation)• adhere to procedures or systems in place for risk assessment, COSHH, Personal Protective Equipment and other relevant safety regulations and procedures to realise a safe system of work• follow safe practice/approved setting-up procedures at all

- times
 - ensure that correctly adjusted machine guards are in place
 - check that cutting tools are in a suitable condition
 - hold components securely without distortion
 - leave the work area and machine in a safe and appropriate condition on completion of the activities
- 1.3 follow the correct specifications for the component to be produced
- 1.4 set the machine to produce components within all of the following quality and accuracy standards, as applicable to the operations performed:
 - components to be free from false tool cuts, burrs and sharp edges
 - dimensional tolerance equivalent to BS 4500 or BS 1916 Grade 7
 - surface finish 63 μin or 1.6 μm
 - reamed and bored holes within H8
 - screw threads BS medium fit
 - angles within ± 0.5 degree
- 1.5 determine what has to be done and how the machine will be set to achieve this
- 1.6 mount and set the required workholding devices, workpiece and cutting tools
- 1.7 select, mount and secure the workpiece using four of the following workholding devices:
 - chucks with hard jaws
 - chucks with soft jaws
 - collet chucks
 - drive plate and centres
 - fixtures
 - faceplates
 - magnetic or pneumatic devices
 - fixed steadies or travelling steadies
 - four jaw chucks
- 1.8 use two of the following groups of turning tools:
 - solid high speed steel
 - brazed tungsten carbide
 - indexable tips (carbide, ceramic or diamond)
- 1.9 select and mount the following types of lathe tools to include eight of:
 - turning
 - facing
 - boring
 - knurling
 - parting off
 - forming
 - recessing
 - chamfering
 - centre drills

- twist/core drills
 - reamers
 - taps
 - thread chaser
 - single point threading
- 1.10 set the machine tool operating parameters to achieve the component specification
- 1.11 set the machine parameters in accordance with instructions/specifications, to include all of the following:
- position of workpiece
 - position of turning tools in relationship to workpiece
 - mechanisms (threading, profiles, taper)
 - workpiece revolutions per minute
 - linear feed rate
 - depth of cut for roughing and finishing
 - cutting fluid flow rate
 - machine guards and safety mechanisms
- 1.12 set up the machine to produce internal and external profiles that include ten of the following:
- flat faces
 - parallel diameters
 - stepped diameters
 - tapered diameters
 - drilled holes
 - bored holes
 - reamed holes
 - profile forms
 - internal threads
 - external threads
 - eccentric features
 - parting off
 - chamfers
 - knurls or special finishes
 - grooves
 - undercuts
- 1.13 use two of the following taper turning or profiling methods:
- taper turning attachment
 - form tools
 - profiling attachment
 - offset tailstock
 - compound slide
- 1.14 machine components made from one of the following types of material:
- ferrous
 - non-metallic
 - non-ferrous
- 1.15 check that all safety mechanisms are in place and that the

<p>equipment is set correctly for the required operations</p> <p>1.16 deal promptly and effectively with problems within their control and report those that cannot be solved.</p>
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<p>Learning outcome</p>

<p>The learner will:</p> <p>2. know how to set centre lathes for production</p>

<p>Assessment criteria</p>

<p>The learner can:</p> <p>2.1 describe the specific safety precautions to be taken when setting up workholding devices and accessories, workpiece and turning tools on lathes</p> <p>2.2 describe the hazards associated with setting lathes (such as moving parts of machinery, handling turning tools, handling cutting fluids, airborne particles, tool breakage, insecure components) and how to minimise them and reduce any risks</p> <p>2.3 explain how to stop the machine in both normal and emergency situations, and the procedure for restarting after an emergency</p> <p>2.4 describe the importance of ensuring the machine is isolated from the power supply before mounting turning tools and workholding devices</p> <p>2.5 describe the importance of wearing the appropriate protective clothing and equipment, and of keeping the work area clean and tidy</p> <p>2.6 describe the basic principles of operation of the centre lathe and its accessories, and typical operations that they can perform</p> <p>2.7 explain how to handle and store turning tools safely and correctly</p> <p>2.8 explain how to extract and use information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS, ISO or BSEN standards) in relation to work undertaken</p> <p>2.9 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing</p> <p>2.10 describe the terminology used in turning in relation to the activities undertaken</p> <p>2.11 describe the range of workholding methods and devices that are used on centre lathes (such as two, three and four jaw chucks, collet chucks, jigs and fixtures, face plates, drive plate and centres)</p> <p>2.12 describe the methods of mounting and setting the workpiece in/on the workholding devices, and the tools and equipment that can be used</p> <p>2.13 describe the different types of turning tools that are used, and how they are selected, prepared and mounted to the machine tool holding devices (such as front tool box, rear tool box, tailstock)</p> <p>2.14 describe the factors which determine speeds and feeds to be used (such as material, type of tooling, depth of cut, workpiece rigidity, machine condition, tolerance and finish required)</p> <p>2.15 explain how the various types of material will affect the feeds and speeds that can be used</p> <p>2.16 describe the types of cutting fluids that are used, and precautions to be taken when handling and using them</p> <p>2.17 explain how to set up the centre lathe and its accessories for the</p>

particular operations being performed

- 2.18 describe the need to conduct trial runs and check that the machine is set up and producing the components correctly
- 2.19 describe the problems that can occur with setting up the workholding devices, tooling and machine operating parameters, and what to do if problems occur
- 2.20 describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve.

Unit 305

Machining components using centre lathes

UAN:	A/600/5386
Level:	3
Credit value:	77
GLH:	161
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 5: Machining Components using Centre Lathes (Level 3).
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out turning operations on a centre lathe, in accordance with approved procedures. The learner will be required to check that the machine is ready for the operations to be performed and that all the required components/materials and consumables are available. The learner will be expected to produce a range of components that combine a number of different features, such as parallel, stepped and tapered diameters, drilled, bored and reamed holes, internal and external threads, and special forms/profiles.</p> <p>The learner will be required to operate the machine in line with safe working practices and approved procedures, and to continuously monitor the machining operations, making any necessary adjustments in order to ensure that the work output is to the required quality and accuracy. Meeting production targets will be an important issue, and their production records must show consistent and satisfactory performance.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the machining activities undertaken, and to report any problems with the machining activities that they cannot</p>

personally resolve, or 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 produce.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying machining procedures. The learner will understand the centre lathe turning process, and its application, and will know about the equipment, materials and consumables, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

The learner will understand the safety precautions required when working with the machine and its 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. machine components using centre lathes
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 they apply all of the following during the machining activities: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, drawings, quality control documentation)• adhere to procedures or systems in place for risk assessment, COSHH, Personal Protective Equipment and other relevant safety regulations and procedures to realise a safe system of work• ensure that machine guards are in place and correctly adjusted• hold components securely without distortion• maintain cutting tools in a suitable condition• apply safe working practices at all times• adjust machine settings, as required, to maintain the required accuracy• ensure that components produced meet specification• leave the work area and machine in a safe and appropriate

- condition on completion of the activities
- 1.3 confirm that the machine is set up and ready for the machining activities to be carried out
 - 1.4 manipulate the machine tool controls safely and correctly in line with operational procedures
 - 1.5 produce components to the required quality and within the specified dimensional accuracy
 - 1.6 produce machined components which combine different operations and cover ten of the following:
 - flat faces
 - parallel diameters
 - stepped diameters
 - tapered diameters
 - drilled holes
 - bored holes
 - reamed holes
 - profile forms
 - internal threads
 - external threads
 - eccentric features
 - parting off
 - chamfers
 - knurls or special finishes
 - grooves
 - undercuts
 - 1.7 machine components made from one of the following types of material:
 - ferrous
 - non-ferrous
 - non-metallic
 - 1.8 produce components within all of the following quality and accuracy standards applicable to the operations performed:
 - components to be free from false tool cuts, burrs and sharp edges
 - dimensional tolerance equivalent to BS 4500 or BS 1916 Grade 7
 - surface finish 63 μin or 1.6 μm
 - reamed and bored holes within H8
 - screw threads BS medium fit
 - angles within ± 0.5 degree
 - 1.9 carry out quality sampling checks at suitable intervals
 - 1.10 carry out the necessary checks for accuracy during production of five of the following:
 - diameters
 - hole size/fit
 - surface finish
 - angle
 - taper

<ul style="list-style-type: none"> • thread profile and fit • lengths • depths • concentricity • grooves/undercut <p>1.11 deal promptly and effectively with problems within their control and report those that cannot be solved</p> <p>1.12 shut down the equipment to a safe condition on conclusion of the machining activities.</p>

Learning outcome
The learner will: 2. know how to machine components using centre lathes
Assessment criteria
<p>The learner can:</p> <p>2.1 describe the safe working practices and procedures to be followed while operating centre lathes</p> <p>2.2 describe the safety mechanisms on the machine, and the procedure for checking that they function correctly</p> <p>2.3 describe the operation of the machine controls in both hand and power modes</p> <p>2.4 explain how to stop the machine in both normal and emergency situations, and the procedure for restarting after an emergency</p> <p>2.5 describe the Personal Protective Equipment to be worn, and where this can be obtained</p> <p>2.6 describe the hazards associated with carrying out the turning operations, and how to minimise them and reduce any risks</p> <p>2.7 describe the importance of keeping the work area clean and tidy</p> <p>2.8 explain where to obtain the component drawings, specifications and/or job instructions required for the components to be machined</p> <p>2.9 explain how to extract and use information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS, ISO or BSEN standards) in relation to work undertaken</p> <p>2.10 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing</p> <p>2.11 describe the main features of the centre lathes and the accessories that can be used (such as saddle, compound slide, tailstock, taper turning attachments, profile attachments, fixed and travelling steadies)</p> <p>2.12 describe the various turning operations that can be performed, and the shapes and types of tooling that can be used (such as solid high speed tooling, brazed tip tooling, interchangeable tipped tooling)</p> <p>2.13 describe the methods that can be used to position the tooling in relationship to the workpiece</p> <p>2.14 describe the effects of backlash in machine slides and screws, and how this can be overcome</p> <p>2.15 explain how to handle and store tools safely and correctly</p> <p>2.16 describe the factors which affect the selection of cutting feeds and speeds, and the depth of cut that can be taken</p>

- 2.17 explain how the various types of material will affect the feeds and speeds that can be used
- 2.18 describe the application of roughing and finishing cuts, and the effect on tool life, surface finish and dimensional accuracy
- 2.19 describe the application of cutting fluids with regard to a range of different materials
- 2.20 describe the effects of clamping the workpiece in a chuck/work holding device, and how this can cause distortion in the finished components
- 2.21 explain how to recognise machining faults and identify when tools need re-sharpening
- 2.22 describe the quality control procedures used, inspection checks to be carried out, and the equipment to be used
- 2.23 describe the problems that can occur with the turning activities, and how these can be overcome
- 2.24 describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve.

Unit 306

Setting turret lathes for production

UAN:	F/600/5387
Level:	3
Credit value:	91
GLH:	210
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 6: Setting turret lathes for production (Level 3).
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to prepare and set up turret lathes, in accordance with approved procedures. This will involve selecting the appropriate workholding devices, securing them to the machine spindle, selecting and setting suitable chuck jaws, boring out soft jaws and mounting workpieces in jigs or fixtures. The learner will be expected to select the appropriate turning tools, check that they are in a usable condition, and mount and secure them to the relevant tool holding devices in front and rear tool posts and turret head.</p> <p>The learner will need to set the machine operating parameters to produce the workpiece to the required specification. This will involve setting up turret and saddle feed stops, setting appropriate depths of cut for roughing and finishing operations, selecting and setting feeds and speeds, setting up multiple cutting arrangements between turret and saddle, setting up accessories such as taper turning attachments, profiling attachments, and setting up lead screws and screw cutting mechanisms. The learner must produce trial cuts, and prove the machine is working satisfactorily before declaring the machine ready for production. Making adjustments to settings to achieve specification, and solving machine-related</p>

problems during production, will also form part of their role.

The learner's responsibilities will require them to comply with organisational policy and procedures for the machine setting activities undertaken, and to report any problems with the machine, tooling, equipment or setting up activities that they cannot personally resolve, or 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 of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to the setting up procedures used. The learner will understand the machine used, and its application, and will know about the workholding devices, turning tools, relevant materials, consumables and setting-up procedures, in adequate depth to provide a sound basis for carrying out the activities, correcting faults and ensuring the work output is to the required specification.

The learner will understand the safety precautions required when working with the machines and their 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. set turret lathes for production
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 carry out all of the following activities during setting up: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, drawings, quality control documentation)• adhere to procedures or systems in place for risk assessment, COSHH, Personal Protective Equipment and other relevant safety regulations and procedures to realise a safe system of work• follow safe practice/approved setting up procedures at all

- times
 - ensure that correctly adjusted machine guards are in place
 - check that cutting tools are in a suitable condition
 - hold components securely without distortion
 - leave the work area and machine in a safe and appropriate condition on completion of the activities
- 1.3 follow the correct specifications for the component to be produced
- 1.4 set the machine to produce components within all of the following quality and accuracy standards, as applicable to the operations performed:
- components to be free from false tool cuts, burrs and sharp edges
 - dimensional tolerance equivalent to BS 4500 or BS 1916 Grade 7
 - surface finish 63µin or 1.6µm
 - reamed and bored holes within H8
 - screw threads BS medium fit
 - angles within +/- 0.5 degree
- 1.5 determine what has to be done and how the machine will be set to achieve this
- 1.6 mount and set the required workholding devices, workpiece and cutting tools
- 1.7 select, mount and secure the workpiece using four of the following workholding devices:
- hand chucks with hard jaws
 - hand chucks with soft jaws
 - power chucks with hard jaws
 - power chucks with soft jaws
 - jigs/fixtures
 - collet chucks
- 1.8 use two of the following groups of turning tools:
- solid high speed steel
 - brazed tungsten carbide
 - indexible tips (carbide, ceramic or diamond)
- 1.9 select and mount the following types of lathe tools, to include eight of:
- turning tools
 - facing tools
 - form tools
 - chamfer/radii
 - parting off tools
 - thread chaser
 - single point threading
 - boring bars
 - recessing tools
 - center drills
 - twist/core drills
 - solid reamers

- expanding reamers
 - taps
 - dies
 - knurling tool
- 1.10 mount tools in all of the following locations:
- in front tool box
 - in rear tool post
 - vertically or tangentially in turret knee box
 - in boring bars (single and multiple)
 - in chucks or floating arrangements
 - to produce multiple cutting arrangements
- 1.11 set the machine tool operating parameters to achieve the component specification
- 1.12 set up the machine in accordance with instructions and specifications, to include all of the following:
- position of workpiece
 - screw cutting mechanisms
 - linear feed rate
 - cutting fluid flow rate
 - position of turning tools in relationship to workpiece
 - workpiece revolutions per minute
 - depth of cut for roughing and finishing
 - machine guards/safety mechanisms
- 1.13 set up the machine to produce internal and external profiles that include ten of the following:
- flat faces
 - parallel diameters
 - stepped diameters
 - tapered diameters
 - drilled holes
 - bored holes
 - reamed holes
 - profile forms
 - internal threads
 - external threads
 - eccentric features
 - parting off
 - chamfers and radii
 - knurls/special finishes
 - grooves/undercuts
 - counter bores
- 1.14 machine components made from one of the following types of material:
- ferrous
 - non-metallic
 - non-ferrous
- 1.15 check that all safety mechanisms are in place and that the

<p>equipment is set correctly for the required operations</p> <p>1.16 deal promptly and effectively with problems within their control and report those that cannot be solved.</p>
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Learning outcome

<p>The learner will:</p> <p>2. know how to set turret lathes for production</p>

Assessment criteria

<p>The learner can:</p> <p>2.1 describe the specific safety precautions to be taken when setting up workholding devices and accessories, workpiece and turning tools on turret lathes</p> <p>2.2 describe the hazards associated with setting turret lathes (such as moving parts of machinery, handling turning tools, handling cutting fluids, airborne particles, tool breakage, power chucks, insecure components) lathes and how to minimise them and reduce any risks</p> <p>2.3 explain how to start and stop the machine in normal and emergency situations</p> <p>2.4 describe the importance of ensuring that the machine is isolated from the power supply before mounting turning tools and workholding devices</p> <p>2.5 describe the importance of wearing the appropriate protective clothing and equipment, and of keeping the work area clean and tidy</p> <p>2.6 describe the basic principles of operation of the turret lathe and its accessories, and typical operations that they can perform</p> <p>2.7 explain how to handle and store turning tools safely and correctly</p> <p>2.8 explain how to extract and use information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS, ISO or BSEN standards) in relation to work undertaken</p> <p>2.9 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing</p> <p>2.10 explain how to read and interpret drawings, and how to extract the relevant information</p> <p>2.11 describe the terminology used in turret lathe turning in relation to the activities undertaken</p> <p>2.12 describe the range of work holding methods and devices that are used on turret lathes (such as two, three and four jaw chucks, hand and power operated chucks, collet chucks, jigs and fixtures)</p> <p>2.13 describe the use of hard and soft jaws in chucks, and the methods of boring out soft jaws to suit the workpiece</p> <p>2.14 describe the different types of turning tools that are used, and how they are selected, prepared and mounted to the machine tool holding devices (such as front tool box, rear tool box, turret head)</p> <p>2.15 describe the use of pilot bars and shoes for the turret and, why they need to be accurately aligned</p> <p>2.16 describe the need to produce a balanced turret arrangement with tools appropriately positioned around the turret stations</p> <p>2.17 describe the factors which determine speeds and feeds to be used (material, type of tooling, depth of cut, workpiece rigidity, machine</p>
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condition, multiple cutting arrangements between turret and saddle, tolerance and finish required)

- 2.18 explain how the various types of material will affect the feeds and speeds that can be used
- 2.19 describe the types of cutting fluid that are used, and precautions to be taken when handling and using them
- 2.20 explain how to set up the turret lathe and its accessories for the particular operations being performed
- 2.21 describe the need to conduct trial runs, and to check that the machine is set up and producing the components correctly
- 2.22 describe the problems that can occur with setting up the workholding devices, tooling and machine operating parameters, and what to do if problems occur
- 2.23 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 307

Machining components using turret lathes

UAN:	J/600/5388
Level:	3
Credit value:	77
GLH:	161
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 7: Machining Components using Turret Lathes (Level 3).
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out turning operations on a turret lathe, in accordance with approved procedures. The learner will be required to check that the machine is ready for the operations to be performed and that all the required components/materials and consumables are available. The learner will be expected to produce a range of components that combine a number of different features, such as parallel, stepped and tapered diameters, drilled, bored and reamed holes, internal and external threads, and special forms/profiles.</p> <p>The learner will be required to operate the machine in line with safe working practices and approved procedures, and to continuously monitor the machining operations, making any necessary adjustments in order to ensure that the work output is to the required quality and accuracy. Meeting production targets will be an important issue, and their production records must show consistent and satisfactory performance.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the machining activities undertaken, and to report any problems with the machining activities that they cannot</p>

resolve, or 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 produce.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying machining procedures. The learner will understand the turret lathe turning process, and its application, and will know about the equipment, materials and consumables, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

The learner will understand the safety precautions required when working with the machine and its 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. machine components using turret lathes
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 they apply all of the following during the machining activities: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, drawings, quality control documentation)• adhere to procedures or systems in place for risk assessment, COSHH, Personal Protective Equipment and other relevant safety regulations and procedures to realise a safe system of work• ensure that machine guards are in place and correctly adjusted• hold components securely without distortion• maintain cutting tools in a suitable condition• apply safe working practices at all times• adjust machine settings, as required, to maintain the required accuracy• ensure that components produced meet specification• leave the work area and machine in a safe and appropriate condition on completion of the activities

- 1.3 confirm that the machine is set up and ready for the machining activities to be carried out
- 1.4 manipulate the machine tool controls safely and correctly in line with operational procedures
- 1.5 produce components to the required quality and within the specified dimensional accuracy
- 1.6 produce machined components which combine different operations and cover ten of the following:
 - flat faces
 - parallel diameters
 - stepped diameters
 - tapered diameters
 - drilled holes
 - bored holes
 - reamed holes
 - profile forms
 - internal threads
 - external threads
 - eccentric features
 - parting off
 - chamfers
 - knurls/special finishes
 - grooves/undercuts
- 1.7 machine components made from one of the following types of material:
 - ferrous
 - non-ferrous
 - non-metallic
- 1.8 produce components within all of the following quality and accuracy standards applicable to the operations performed:
 - components to be free from false tool cuts, burrs and sharp edges
 - dimensional tolerance equivalent to BS 4500 or BS 1916 Grade 7
 - surface finish $63\mu\text{in}$ or $1.6\mu\text{m}$
 - reamed and bored holes within H8
 - screw threads BS medium fit
 - angles within ± 0.5 degree
- 1.9 carry out quality sampling checks at suitable intervals
- 1.10 carry out the necessary checks during production for accuracy of five of the following:
 - diameters
 - hole size/fit
 - angle/taper
 - surface finish
 - lengths/depths
 - thread profile and fit
 - concentricity

- slot/recess width
- 1.11 deal promptly and effectively with problems within their control and report those that cannot be solved
 - 1.12 shut down the equipment to a safe condition on conclusion of the machining activities.

Learning outcome
The learner will: 2. know how to machine components using turret lathes
Assessment criteria
The learner can: 2.1 describe the safe working practices and procedures to be followed while operating turret lathes 2.2 describe the safety mechanisms on the machine, and the procedure for checking that they function correctly 2.3 describe the operation of the machine controls in both hand and power modes, including rapid power of the turret head 2.4 explain how to stop the machine in both normal and emergency situations, and the procedure for restarting after an emergency 2.5 describe the Personal Protective Equipment to be worn, and where this can be obtained 2.6 describe the hazards associated with carrying out the turning operations, and how to minimise them and reduce any risks 2.7 describe the importance of keeping the work area clean and tidy 2.8 explain where to obtain the component drawings, specifications and/or job instructions required for the components to be machined 2.9 explain how to extract and use information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS, ISO or BSEN standards) in relation to work undertaken 2.10 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing 2.11 describe the main features of the turret lathe and the accessories that can be used (such as saddle, turret head, taper turning attachments, profile attachments, lead screws for threading) 2.12 describe the various turning operations that can be performed, and the shapes and types of tooling that can be used (such as solid high speed tooling, brazed tip tooling, interchangeable tipped tooling) 2.13 describe the methods that can be used to position the tooling in relationship to the workpiece 2.14 describe the effects of backlash in machine slides and screws, and how this can be overcome 2.15 explain how to handle and store tools safely and correctly 2.16 describe the factors which affect the selection of cutting feeds and speeds, and the depth of cut that can be taken 2.17 explain how the various types of material will affect the feeds and speeds that can be used 2.18 describe the application of roughing and finishing cuts, and the effect on tool life, surface finish and dimensional accuracy 2.19 describe the application of cutting fluids with regard to a range of

different materials

- 2.20 describe the effects of clamping the workpiece in a chuck/work holding device, and how this can cause distortion in the finished components
- 2.21 explain how to recognise machining faults and identify when tools need re-sharpening
- 2.22 describe the quality control procedures used, inspection checks to be carried out, and the equipment to be used
- 2.23 describe the problems that can occur with the turning activities, and how these can be overcome
- 2.24 describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve.

Unit 308

Setting milling machines for production

UAN:	J/600/5391
Level:	3
Credit value:	91
GLH:	210
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 8: Setting milling machines for production (Level 3).
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to prepare and set up milling machines, such as horizontal, vertical, universal machines, planer/gantry milling machines and boring machines with milling attachments, in accordance with approved procedures. This involves selecting the appropriate workholding devices, and mounting and positioning them to the machine in the correct location for the type of operation being carried out.</p> <p>The learner will also be expected to select the appropriate milling cutters, check them for defects, and mount and secure them to the relevant tool holding devices and machine spindle. The learner will also be expected to set up and align the workpiece in the correct relationship to the machine spindle, and to set the machine operating parameters to produce the workpiece to the required specification. The learner must produce trial cuts, and prove the machine is working satisfactorily before declaring the installation ready for production. Making adjustments to settings to achieve specification, and solving machine-related problems during production, will also form part of their role.</p> <p>The learner's responsibilities will require them to comply with organisational policy</p>

and procedures for the machine setting activities undertaken, and to report any problems with the machine, cutters, equipment or setting up activities that they cannot resolve, or 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 of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to the setting up procedures used. The learner will understand the milling machine used, and its application, and will know about the workholding devices, milling cutters, relevant materials, consumables and setting up procedures, in adequate depth to provide a sound basis for carrying out the activities, correcting faults and ensuring the work output is to the required specification.

The learner will understand the safety precautions required when working with the milling machines and their 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. set milling machines for production
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 carry out all of the following activities during setting up: <ul style="list-style-type: none"> • obtain and use the appropriate documentation (such as job instructions, drawings, quality control documentation) • adhere to procedures or systems in place for risk assessment, COSHH, Personal Protective Equipment and other relevant safety regulations and procedures to realise a safe system of work • follow safe practice/approved setting up procedures at all times • ensure that correctly adjusted machine guards are in place • check that cutting tools are in a suitable condition • hold components securely without distortion • leave the work area and machine in a safe and appropriate

condition on completion of the activities

- 1.3 follow the correct specifications for the component to be produced
- 1.4 set the machine to produce components within all of the following quality and accuracy standards as applicable to the operations performed:
 - components to be free from false tool cuts, burrs and sharp edges
 - dimensional tolerance equivalent to BS 4500 or BS 1916 Grade 7
 - flatness & squareness within 0.001" per inch or 0.025mm per 25mm
 - surface finish 63µin or 1.6µm
 - angles within +/- 0.5 degree
 - bored holes within H8
- 1.5 determine what has to be done and how the machine will be set to achieve this
- 1.6 prepare one of the following types of milling machine for production:
 - horizontal milling machine
 - universal milling machine
 - boring machines with milling attachments
 - vertical milling machine
 - planer /gantry milling machine
- 1.7 mount and set the required workholding devices, workpiece and cutting tools
- 1.8 position, align and secure the workpiece using three of the following:
 - clamping direct to machine table
 - pneumatic or magnetic table
 - machine vice (such as plain, swivel, universal)
 - angle plate
 - vee block and clamps
 - fixtures
 - chucks (such as 3, 4 jaw)
 - indexing head/device
 - rotary table
- 1.9 select and mount milling cutters to include six of the following:
 - face mills
 - slab mills/cylindrical cutters
 - side and face cutters
 - slotting cutters
 - slitting saws
 - profile cutters
 - twist drills
 - boring tools
 - end mills
 - slot drills
 - straddle milling

<ul style="list-style-type: none"> • gang milling <p>1.10 set the machine tool operating parameters to achieve the component specification</p> <p>1.11 set up the machine in accordance with instructions and specifications, to include all of the following:</p> <ul style="list-style-type: none"> • alignment of workholding device • position of cutters in relationship to workpiece • milling cutter revs per minute • machine guards/safety mechanisms • linear/table feed rate • cutting fluid flow rate • depth of cut for roughing and finishing <p>1.12 set up the machine to produce internal and external profiles that include eight of the following:</p> <ul style="list-style-type: none"> • flat faces • square faces • parallel faces • angular faces • steps/shoulders • open ended slots • enclosed slots • recesses • tee slots • drilled holes • bored holes • profile forms (vee, concave, convex, gear forms) • serrations • indexed or rotated forms • special forms <p>1.13 machine components made from one of the following types of material:</p> <ul style="list-style-type: none"> • ferrous • non-metallic • non-ferrous <p>1.14 check that all safety mechanisms are in place and that the equipment is set correctly for the required operations</p> <p>1.15 deal promptly and effectively with problems within their control and report those that cannot be solved.</p>

Learning outcome
The learner will: 2. know how to set milling machines for production
Assessment criteria
The learner can: 2.1 describe the specific safety precautions to be taken when setting up workholding devices and milling cutters on milling machines (such as horizontal, vertical, universal, planer/gantry, boring

- machines with milling attachments)
- 2.2 describe the hazards associated with setting milling machines (such as moving parts of machinery, handling milling cutters, handling cutting fluids, airborne particles, tool breakage, insecure components), and how to minimise them and reduce any risks
 - 2.3 describe the operation of the machine controls in both hand and power modes, and how to stop the machine in an emergency
 - 2.4 describe the importance of ensuring that the machine is isolated from the power supply before mounting milling cutters and workholding devices
 - 2.5 describe the importance of wearing the appropriate protective clothing and equipment, and of keeping the work area clean and tidy
 - 2.6 describe the basic principles of operation of the various milling machines, and typical operations that they can perform
 - 2.7 explain how to handle and store milling cutters safely and correctly
 - 2.8 explain how to extract and use information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS, ISO or BSEN standards) in relation to work undertaken
 - 2.9 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing
 - 2.10 describe the terminology used in milling in relation to the activities undertaken
 - 2.11 describe the range of workholding methods and devices that are used on machines (such as direct clamping, machine vice, pneumatic and magnetic tables, jigs and fixtures, chucks, indexing devices rotary tables, angle brackets, vee blocks and clamps)
 - 2.12 describe the methods of mounting and setting the workpiece in/on the workholding devices, and the tools and equipment that can be used
 - 2.13 describe the different types of milling cutters that are used, and how they are selected, prepared and mounted to the machine tool holding devices (such as long arbors, stub arbors, collet chucks, direct mounting to machine spindle)
 - 2.14 describe the factors which determine speeds and feeds to be used (such as material, type of cutter, depth of cut, workpiece rigidity, machine condition, tolerance and finish required)
 - 2.15 explain how the various types of material will affect the feeds and speeds that can be used
 - 2.16 describe the types of cutting fluid that are used, and precautions to be taken when handling and using them
 - 2.17 explain how to set up the various machines for the particular operations being performed
 - 2.18 describe the need to conduct trial runs, and to check that the machine is set up and running safely and correctly
 - 2.19 describe the problems that can occur with setting up the milling cutters, workholding devices and machine operating parameters, and what to do if problems occur
 - 2.20 describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve.

Unit 309

Machining components using milling machines

UAN:	L/600/5392
Level:	3
Credit value:	77
GLH:	161
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 9: Machining Components using Milling Machines (Level 3).
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out milling operations, in accordance with approved procedures, using machines such as horizontal, vertical, universal, planer milling machines and boring machines with milling attachments. The learner will be required to check that the machine is ready for the operations to be performed and that all the required components/materials and consumables are available. The learner will be expected to produce a range of components that combine a number of different features, such as flat faces, parallel faces, faces that are square to each other, angular faces, steps and slots, drilled and bored holes, and special forms.</p> <p>The learner will be required to operate the machine in line with safe working practices and approved procedures, and to continuously monitor the machining operations, making any necessary adjustments in order to ensure that the work output is to the required quality and accuracy. Meeting production targets will be an important issue, and their production records must show consistent and satisfactory performance.</p>

The learner's responsibilities will require

them to comply with organisational policy and procedures for the machining activities undertaken, and to report any problems with the machining activities that they cannot resolve, or 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 produce.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying machining procedures. The learner will understand the milling process, and its application, and will know about the equipment, materials and consumables, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

The learner will understand the safety precautions required when working with the machine and its 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. machine components using milling machines
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 they apply all of the following during the machining activities: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, drawings, quality control documentation)• adhere to procedures or systems in place for risk assessment, COSHH, Personal Protective Equipment and other relevant safety regulations and procedures to realise a safe system of work• ensure that machine guards are in place and correctly adjusted• hold components securely without distortion• maintain cutting tools in a suitable condition• apply safe working practices at all times• adjust machine settings, as required, to maintain the required accuracy• ensure that components produced meet specification

- leave the work area and machine in a safe and appropriate condition on completion of the activities
- 1.3 confirm that the machine is set up and ready for the machining activities to be carried out
- 1.4 operate one type of milling machine from the following:
- horizontal milling machine
 - universal milling machine
 - boring machines with milling attachments
 - vertical milling machine
 - planer/gantry milling machine
- 1.5 manipulate the machine tool controls safely and correctly in line with operational procedures
- 1.6 produce components to the required quality and within the specified dimensional accuracy
- 1.7 produce machined components which combine different operations and cover eight of the following:
- flat faces
 - square faces
 - parallel faces
 - angular faces
 - steps/shoulders
 - open ended slots
 - enclosed slots/recesses
 - tee slots
 - drilled holes
 - bored holes
 - profile forms (vee, concave, convex, gear forms)
 - serrations
 - indexed or rotated forms
 - special forms
- 1.8 machine components made from one type of material from the following:
- ferrous
 - non-ferrous
 - non-metallic
- 1.9 produce components within all of the relevant quality and accuracy standards as applicable to the operations performed:
- components to be free from false tool cuts, burrs and sharp edges
 - dimensional tolerance equivalent to BS 4500 or BS 1916 Grade 7
 - flatness and squareness within 0.001" per inch or 0.025mm per 25mm
 - surface finish 63µin or 1.6µm
 - angles within +/- 0.5 degree
 - bored holes within H8
- 1.10 carry out quality sampling checks at suitable intervals
- 1.11 carry out the necessary checks during production for accuracy of

five of the following:

- dimensions
- squareness
- hole size/fit
- surface finish
- angles
- flatness
- slots
- recesses

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

1.13 shut down the equipment to a safe condition on conclusion of the machining activities.

Learning outcome

The learner will:

2. know how to machine components using milling machines

Assessment criteria

The learner can:

- 2.1 describe the safe working practices and procedures to be followed while operating milling machines
- 2.2 describe the safety mechanisms on the machine, and the procedure for checking that they function correctly
- 2.3 describe the operation of the machine controls in both hand and power modes, and how to stop the machine in an emergency
- 2.4 describe the Personal Protective Equipment to be worn, and where this can be obtained
- 2.5 describe the hazards associated with carrying out the milling operations, and how to minimise them and reduce any risk
- 2.6 describe the importance of keeping the work area clean and tidy
- 2.7 explain where to obtain the component drawings, specifications and/or job instructions required for the components to be machined
- 2.8 explain how to extract and use information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS, ISO or BSEN standards) in relation to work undertaken
- 2.9 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing
- 2.10 describe the application of a range of milling machines (such as horizontal, vertical, universal, planer milling, and milling attachments for boring machines)
- 2.11 describe the various milling techniques that can be used to produce the required shapes, and the types of milling cutters required (such as face mills, slab cutters, slotting cutters, side and face cutters, end mills, slot drills)
- 2.12 describe the conventional and climb milling techniques, and when each method should be used
- 2.13 describe the methods that can be used to position the workpiece in relation to the milling cutters

- 2.14 describe the effects of backlash in machine slides and screws, and how this can be overcome
- 2.15 explain how to handle and store cutting tools safely and correctly
- 2.16 describe the factors which affect the selection of cutting feeds and speeds, and the depth of cut that can be taken (such as workpiece rigidity, machine condition, type of tooling being used, material type, finish and tolerance required)
- 2.17 explain how the various types of material will affect the feeds and speeds that can be used
- 2.18 describe the application of roughing and finishing cuts, and the effect on tool life, surface finish and dimensional accuracy
- 2.19 describe the application of cutting fluids with regard to a range of different materials
- 2.20 describe the effects of clamping the workpiece, and how this can cause distortion in the finished components
- 2.21 describe the effects of removing material, how this can cause warping/distortion of the workpiece, and how this can be overcome
- 2.22 explain how to recognise machining faults and identify when cutters need re-sharpening
- 2.23 describe the quality control procedures used, inspection checks to be carried out, and the equipment to be used
- 2.24 describe the problems that can occur with the milling activities, and how these can be overcome
- 2.25 describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve.

Unit 310

Setting shaping, planing or slotting machines for production

UAN:	R/600/5393
Level:	3
Credit value:	78
GLH:	175
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 10: Setting Shaping, Planing or Slotting Machines for Production (Level 3).
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to prepare and set up shaping, planing or slotting machines for production, in accordance with approved procedures. This will involve selecting the appropriate workholding devices and securing them to the machine table, and mounting and setting the workpiece in correct relationship to the cutting tools. The learner will be expected to select the appropriate shaping/slotting tools, check that they are in a usable condition, and mount and secure them to the relevant tool holding devices.</p> <p>The learner will need to set the machine operating parameters to produce the workpiece to the required specification. This will involve setting the appropriate stroke length, stroke position, feeds and speeds, and determining suitable roughing and finishing cuts. The learner must produce trial cuts, and prove the machine is working satisfactorily before declaring the machine ready for production. Making adjustments to settings to achieve specification, and solving machine-related problems during production, will also form part of their role.</p>

The learner's responsibilities will require

them to comply with organisational policy and procedures for the machine setting activities undertaken, and to report any problems with the machine, tooling, equipment or setting up activities that they cannot personally resolve, or 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 of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to the setting up procedures used. The learner will understand the machine used, and its application, and will know about the workholding devices, shaping/slotting tools, relevant materials, consumables and setting up procedures, in adequate depth to provide a sound basis for setting up the equipment, correcting faults and ensuring the work output meets the required specification.

The learner will understand the safety precautions required when working with the machine and its 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. set shaping, planing or slotting machines for production
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 carry out all of the following activities during setting up: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, drawings, quality control documentation)• adhere to procedures or systems in place for risk assessment, COSHH, Personal Protective Equipment and other relevant safety regulations and procedures to realise a safe system of work• follow safe practice/approved setting up procedures at all times• ensure that correctly adjusted machine guards are in place• check that cutting tools are in a suitable condition

- hold components securely without distortion
 - leave the work area and machine in a safe and appropriate condition on completion of the activities
- 1.3 follow the correct specifications for the component to be produced
- 1.4 set the machine to produce components within all of the following quality and accuracy standards as applicable to the operations performed:
- components to be free from false tool cuts, burrs and sharp edges
 - dimensional tolerance equivalent to BS 4500 or BS 1916 Grade 7
 - flatness and squareness within 0.001” per inch or 0.025mm per 25mm
 - surface finish 63 μin or 1.6 μm
 - angles within +/- 0.5 degree
- 1.5 determine what has to be done and how the machine will be set to achieve this
- 1.6 mount and set the required workholding devices, workpiece and cutting tools
- 1.7 select, mount and secure the workpiece using three of the following workholding devices:
- clamping direct to machine table
 - pneumatic or magnetic table
 - machine vice (such as plain, swivel, universal)
 - angle plate
 - vee block and clamps
 - jigs/fixtures
 - chucks (such as 3 or 4 jaw)
 - indexing head/device
 - rotary table
- 1.8 select and mount tools to include three of the following types appropriate to the machine:
- flat facing
 - vertical facing
 - forming/profiling
 - recessing
 - keyway slotting
 - spline slotting
 - serrating
 - special slotting
- 1.9 set the machine tool operating parameters to achieve the component specification
- 1.10 set up one of the following types of machine:
- shaping
 - planing
 - slotting
 - milling machine with slotting attachment
- 1.11 set up the machine in accordance with instructions and specifications, to include all of the following:

<ul style="list-style-type: none"> • position of workpiece • position of tools in relationship to workpiece • stroke position and length mechanisms • stroke speed • linear feed rate • depth of cut for roughing and finishing • cutting fluid flow rate • machine guards/safety mechanisms <p>1.12 set up machine to produce internal and external profiles that includes six of the following:</p> <ul style="list-style-type: none"> • flat faces • parallel faces • faces square to each other • steps/shoulders • angular faces • slots/grooves • key ways • splines • flat sided holes (eg. square, hexagonal) • serrations • other specific forms <p>1.13 machine components made from one of the following types of material:</p> <ul style="list-style-type: none"> • ferrous • non-metallic • non-ferrous <p>1.14 check that all safety mechanisms are in place and that the equipment is set correctly for the required operations</p> <p>1.15 deal promptly and effectively with problems within their control and report those that cannot be solved.</p>

Learning outcome
The learner will:
2. know how to set shaping, planing or slotting machines for production
Assessment criteria
The learner can:
2.1 describe the specific safety precautions to be taken when setting up workholding devices and accessories, workpiece and shaping/slotting tools
2.2 describe the hazards associated with setting shaping, planing and slotting machines (such as moving parts of machinery, handling cutting tools, handling cutting fluids, tool breakage, insecure components), and how to minimise them and reduce any risks
2.3 explain how to start and stop the machine in normal and emergency situations
2.4 describe the importance of ensuring that the machine is isolated from the power supply before mounting tools and workholding devices

- 2.5 describe the importance of wearing the appropriate protective clothing and equipment, and of keeping the work area clean and tidy
- 2.6 describe the basic principles of operation of the shaping, planing or slotting machine and its accessories, and typical operations that they can perform
- 2.7 explain how to handle and store shaping, planing and slotting tools safely and correctly
- 2.8 explain how to extract and use information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS, ISO or BSEN standards) in relation to work undertaken
- 2.9 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing
- 2.10 describe the terminology used in shaping, planing or slotting in relation to the activities undertaken
- 2.11 describe the range of work holding methods and devices that are used on shaping, planing and slotting machines (such as plain, swivel and universal machine vice, three and four jaw chucks, jigs and fixtures, direct clamping to machine table, rotary and indexing devices)
- 2.12 describe the methods of mounting and setting the workpiece in/on the workholding devices, and the tools and equipment that can be used
- 2.13 describe the different types of shaping, planing and slotting tools that are used, and how they are selected, prepared and mounted to the machine tool holding devices (such as clapper box, slotting or planing head)
- 2.14 describe the factors which determine stroke speeds and feeds to be used (such as material, type of tooling, depth of cut, workpiece rigidity, machine condition, tolerance and finish required)
- 2.15 explain how the various types of materials used will affect the feeds and speeds that can be used
- 2.16 describe the types of cutting fluid that are used, and precautions to be taken when handling and using them
- 2.17 explain how to set up the shaping, planing or slotting machine, and its accessories, for the particular operations being performed (such as setting stroke length, stroke position, angle of tool head)
- 2.18 describe the need to conduct trial runs, and to check that the machine is set up and producing the components correctly
- 2.19 describe the problems that can occur with setting up the workholding devices, tooling and machine operating parameters, and what to do if problems occur
- 2.20 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 311

Machining components using shaping, planing or slotting machines

UAN:	Y/600/5394
Level:	3
Credit value:	69
GLH:	126
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 11: Machining Components using Shaping, Planing or Slotting Machines (Level 3).
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out shaping, planing or slotting operations, in accordance with approved procedures. The learner will be required to check that the machine is ready for the operations to be performed and that all the required components/materials and consumables are available. The learner will be expected to produce a range of components that combine a number of different features, such as flat faces, parallel faces, faces that are square to each other, angular faces, steps, slots, keyways, flat sided holes, splines and serrations.</p> <p>The learner will be required to operate the machine in line with safe working practices and approved procedures, and to continuously monitor the machining operations, making any necessary adjustments in order to ensure that the work output is to the required quality and accuracy. Meeting production targets will be an important issue, and their production records must show consistent and satisfactory performance.</p> <p>The learner's responsibilities will require them to comply with organisational policy</p>

and procedures for the machining activities undertaken, and to report any problems with the machining activities that they cannot personally resolve, or 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 produce.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying machining procedures. The learner will understand the shaping, planing or slotting process, and its application, and will know about the equipment, materials and consumables, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

The learner will understand the safety precautions required when working with the machine and its 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. machine components using shaping, planing or slotting machines
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 they apply all of the following during the machining activities: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, drawings, quality control documentation)• adhere to procedures or systems in place for risk assessment, COSHH, Personal Protective Equipment and other relevant safety regulations and procedures to realise a safe system of work• ensure that machine guards are in place and correctly adjusted• hold components securely without distortion• maintain cutting tools in a suitable condition• apply safe working practices at all times• adjust machine settings, as required, to maintain the required accuracy

- ensure that components produced meet specification
 - leave the work area and machine in a safe and appropriate condition on completion of the activities
- 1.3 confirm that the machine is set up and ready for the machining activities to be carried out
- 1.4 operate one type of machine from the following:
- shaping
 - planing
 - slotting
 - milling machine with slotting attachment
- 1.5 manipulate the machine tool controls safely and correctly in line with operational procedures
- 1.6 produce components to the required quality and within the specified dimensional accuracy
- 1.7 produce machined components which combine different operations and cover six of the following:
- flat faces
 - faces that are square to each other
 - parallel faces
 - steps/shoulders
 - angular faces
 - slots and grooves
 - special forms
 - keyways
 - flat sided holes (square, hexagonal)
 - splines
 - serrations
 - special forms
- 1.8 machine components made from one type of material from the following:
- ferrous
 - non-ferrous
 - non-metallic
- 1.9 produce components within all the relevant quality and accuracy standards, as applicable to the operations performed:
- components to be free from false tool cuts, burrs and sharp edges
 - dimensional tolerance equivalent to BS 4500 or BS 1916 Grade 7
 - flatness and squareness within 0.001" per inch or 0.025mm per 25mm
 - surface finish 63 μin or 1.6 μm
 - angles within +/- 0.5 degree
- 1.10 carry out quality sampling checks at suitable intervals
- 1.11 carry out the necessary checks during production for accuracy of five of the following:
- dimensions
 - squareness

- angles
- flatness
- spline/serration fit
- surface finish
- slot/recess width
- keyway position

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

1.13 shut down the equipment to a safe condition on conclusion of the machining activities.

Learning outcome

The learner will:

2. know how to machine components using shaping, planing or slotting machines

Assessment criteria

The learner can:

2.1 describe the safe working practices and procedures to be followed while operating shaping, planing or slotting machines

2.2 describe the safety mechanisms on the machine, and the procedure for checking that they function correctly

2.3 describe the operation of the machine controls in both hand and power modes, and how to stop the machine in an emergency

2.4 describe the Personal Protective Equipment to be worn, and where this can be obtained

2.5 describe the hazards associated with the carrying out shaping, planing or slotting operations, and how to minimise them and reduce any risks

2.6 describe the importance of keeping the work area clean and tidy

2.7 explain where to obtain the component drawings, specifications and/or job instructions required for the components to be machined

2.8 explain how to extract and use information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS, ISO or BSEN standards) in relation to work undertaken

2.9 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing

2.10 describe the various shaping, planing and slotting techniques that can be used to produce the required shapes, and the types of tooling used (such as solid high speed steel, brazed tip, interchangeable tipped)

2.11 describe the methods that can be used to position the workpiece in relation to the cutting tools

2.12 describe the effects of backlash in machine slides and screws, and how this can be overcome

2.13 explain how to handle and store cutting tools safely and correctly

2.14 describe the factors which affect the selection of cutting feeds and speeds, and the depth of cut that can be taken (such as workpiece rigidity, machine condition, type of tooling being used, material type, finish and tolerance required)

- 2.15 explain how the various types of material will affect the feeds and speeds that can be used
- 2.16 describe the application of roughing and finishing cuts, and the effect on tool life, surface finish and dimensional accuracy
- 2.17 describe the application of cutting fluids with regard to a range of different materials
- 2.18 describe the effects of clamping the workpiece, and how this can cause distortion in the finished components
- 2.19 describe the effects of removing material, how this can cause warping/distortion of the workpiece, and how this can be overcome
- 2.20 explain how to recognise machining faults and identify when tools need re-sharpening
- 2.21 describe the quality control procedures used, inspection checks to be carried out, and the equipment to be used
- 2.22 describe the problems that can occur with the shaping, planing or slotting activities, and how these can be overcome
- 2.23 describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve.

Unit 312

Setting gear cutting machines for production

UAN:	D/600/5395
Level:	3
Credit value:	91
GLH:	210
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 12: Setting Gear Cutting Machines for Production (Level 3).
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to prepare and set up gear cutting machines, such as gear hobbing, gear shaping, gear shaving, gear planning and bevel gear cutting machines, in accordance with approved procedures. This involves selecting the appropriate workholding devices, and mounting and positioning them to the machine in the correct location for the type of operation being carried out. The learner will also be expected to select the appropriate cutters to use, and to mount and secure them to the appropriate tool holding devices.</p> <p>The learner will be expected to check that the components and cutting tools are running true and concentric before starting the cutting operations. The learner will be expected to set up hob slides to the required angle, select and fit appropriate index change gears and differential gears, feed cams, determine and set parameters for axial or conventional shaving, tangential or underpass methods, diagonal or plunge methods, push or pull methods, and the appropriate feeds and speeds for the particular gears and gear cutting methods being used.</p> <p>The learner's responsibilities will require</p>

them to comply with organisational policy and procedures for the machine setting activities undertaken, and to report any problems with the setting up activities that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to the setting up procedures used. The learner will understand the machine used, and its application, and will know about the workholding devices, gear cutting tools, relevant materials, consumables and setting-up procedures, in adequate depth to provide a sound basis for carrying out the activities, correcting faults and ensuring the work output is to the required specification.

The learner will understand the safety precautions required when working with the machines and their 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. set gear cutting machines for production
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 carry out all of the following activities during setting up: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, drawings, quality control documentation)• adhere to procedures or systems in place for risk assessment, COSHH, Personal Protective Equipment and other relevant safety regulations and procedures to realise a safe system of work• follow safe practice/approved setting up procedures at all times• ensure that correctly adjusted machine guards are in place• check that cutting tools are in a suitable condition• hold components securely without distortion

- leave the work area and machine in a safe and appropriate condition on completion of the activities
- 1.3 follow the correct specifications for the component to be produced
- 1.4 set the machine to produce components within all of the following quality and accuracy standards, as applicable to the operations performed:
- components to be free from false tool cuts, burrs and sharp edges
 - straight splines and serrations to BS 2059 or BS1953 Class 1
 - spur and helical gears to BS 436 Pt 1 or BS1967
 - involute splines to BS 3550 1963 Class 1
 - tolerance to BS 4500 or BS1916 Grade 9
 - surface texture 63 μin or 1.6 μm
- 1.5 determine what has to be done and how the machine will be set to achieve this
- 1.6 set up two of the following types of machine:
- gear hobbing
 - gear shaping
 - bevel gear cutting
 - gear planing
 - gear shaving
- 1.7 mount and set the required workholding devices, workpiece and cutting tools
- 1.8 select, mount and secure the workpiece using two of the following workholding devices:
- arbors
 - mandrels
 - chucks
 - pots
 - collets
 - fixtures
 - centres
 - clamps
 - face plates
- 1.9 select and mount to the appropriate tool holding device, four of the following types of gear cutting tools:
- shank type hobs
 - protuberance hobs
 - skiving hobs
 - inserted blade hobs
 - tapered hobs
 - single or multi-start straight hobs
 - bevel gear roughing cutters
 - bevel gear finishing cutters
 - disc type shaping/shaving cutters
 - shank type shaping/shaving cutters
 - extended hub type shaving cutters
 - screwed hub type shaping/shaving cutters

<ul style="list-style-type: none"> • special cutters • rack type gear planing roughing cutters • single tooth gear planing roughing cutters • rack type full fillet planing finishing cutters • single tooth full fillet planing finishing cutters <p>1.10 set the machine tool operating parameters to achieve the component specification</p> <p>1.11 prepare the machine by carrying out all the following activities applicable to the machine type:</p> <ul style="list-style-type: none"> • set the slide angles • set the speed and feed rates • fitting differential/index change gears • select and set climb or conventional hobbing • set other machine operating parameters • select and fit appropriate index change gears and differential gears • select/set shaving method (axial or conventional, tangential or underpass, diagonal or plunge) <p>1.12 set up the machine to produce machined components that include two of the following:</p> <ul style="list-style-type: none"> • external spur gear • internal spur gear • single helical gear • double helical gear • chain sprockets • serrations • splines • straight bevel gears <p>1.13 machine components made from one of the following types of material:</p> <ul style="list-style-type: none"> • ferrous • non-metallic • non-ferrous <p>1.14 check that all safety mechanisms are in place and that the equipment is set correctly for the required operations</p> <p>1.15 deal promptly and effectively with problems within their control and report those that cannot be solved.</p>
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Learning outcome
The learner will: 2. know how to set gear cutting machines for production
Assessment criteria
The learner can: 2.1 describe the specific safety precautions to be taken when setting up workholding devices and tooling on gear cutting machines 2.2 describe the hazards associated with setting gear cutting machines (such as moving parts of machinery, handling gear cutters, handling cutting fluids, airborne particles, tool breakage, insecure

- components) and how to minimise them and reduce any risks
- 2.3 explain how to start and stop the machine in normal and emergency situations
 - 2.4 describe the importance of ensuring that the machine is isolated from the power supply before mounting cutters and workholding devices
 - 2.5 describe the importance of wearing the appropriate protective clothing and equipment, and of keeping the work area clean and tidy
 - 2.6 explain how to handle and store gear cutting tools safely and correctly
 - 2.7 explain how to extract and use information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS, ISO or BSEN standards) in relation to work undertaken
 - 2.8 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing
 - 2.9 describe the terminology used in gear cutting in relation to the activities undertaken
 - 2.10 describe the range of workholding methods and devices that are used on gear cutting machines
 - 2.11 describe the methods of mounting and setting the workpiece in/on the workholding devices, and the tools and equipment that can be used
 - 2.12 describe the various gear cutting operations that are used to produce the required gear forms, and the types of tooling used (such as straight hobs having single and multi start, tapered hobs, shank type hobs, protuberance hobs, inserted blade hobs, skiving hobs, disc and shank type gear shaping and shaving cutters, gear planing cutters and bevel gear cutters)
 - 2.13 explain how to check that the gear cutting tools are in a safe and serviceable condition
 - 2.14 describe the various tool holding devices that are used, and the methods of mounting and securing the gear cutting tools to the tool holders and machine spindles
 - 2.15 explain how to set up the various machines for the particular gears being machined
 - 2.16 explain how the various types of material will affect the feeds and speeds that can be used
 - 2.17 describe the application of cutting fluids with regard to a range of different materials, and why some materials do not require the use of cutting fluids
 - 2.18 describe the need to conduct trial runs, and to check that the machine is set up and running safely and correctly
 - 2.19 describe the problems that can occur with setting up of the tooling, workholding devices and machine operating parameters, and what to do if problems occur
 - 2.20 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 313

Machining components using gear cutting machines

UAN:	K/600/5397
Level:	3
Credit value:	77
GLH:	161
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 13: Machining Components using Gear Cutting Machines (Level 3).
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out gear cutting operations, in accordance with approved procedures, using machines such as gear hobbing, gear shaping, gear shaving, gear planing, bevel gear cutting. The learner will be required to check that the machine is ready for the operations to be performed and that all the required components/materials and consumables are available. The learner will be expected to produce a range of gears, such as external spur gears, internal spur gears, helical and double helical gears, bevel gears, chain sprockets, external splines and serrations.</p> <p>The learner will be required to operate the machine in line with safe working practices and approved procedures, and to continuously monitor the machining operations, making any necessary adjustments in order to ensure that the work output is to the required quality and accuracy. Meeting production targets will be an important issue, and their production records must show consistent and satisfactory performance.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the machining activities</p>

undertaken, and to report any problems with the machining activities that they cannot personally resolve, or 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 produce.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying machining procedures. The learner will understand the gear cutting process undertaken, and its application, and will know about the equipment, materials and consumables, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

The learner will understand the safety precautions required when working with the machine and its 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. machine components using gear cutting machines
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 they apply all of the following during the machining activities: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, drawings, quality control documentation)• adhere to procedures or systems in place for risk assessment, COSHH, Personal Protective Equipment and other relevant safety regulations and procedures to realise a safe system of work• ensure that machine guards are in place and correctly adjusted• hold components securely without distortion• maintain cutting tools in a suitable condition• apply safe working practices at all times• adjust machine settings, as required, to maintain the required accuracy• ensure that components produced meet specification

- leave the work area and machine in a safe and appropriate condition on completion of the activities
- 1.3 confirm that the machine is set up and ready for the machining activities to be carried out
- 1.4 operate two types of gear cutting machine from the following:
 - gear hobbing
 - gear shaping
 - bevel gear cutting
 - gear planing
 - gear shaving
- 1.5 manipulate the machine tool controls safely and correctly in line with operational procedures
- 1.6 produce components to the required quality and within the specified dimensional accuracy
- 1.7 produce two of the following types of machined components:
 - external spur gear
 - internal spur gear
 - single helical gear
 - double helical gear
 - chain sprockets
 - serrations
 - splines
 - straight bevel gears
- 1.8 machine gears made from one of the following types of material:
 - ferrous
 - non-ferrous
 - non-metallic
- 1.9 produce components within all of the following quality and accuracy standards as is applicable to the operations performed:
 - components to be free from false tool cuts, burrs and sharp edges
 - straight splines and serrations to BS 2059 or BS1953 Class 1
 - spur and helical gears to BS 436 Pt 1 or BS1967
 - involute splines to BS 3550 1963 Class 1
 - tolerance to BS 4500 or BS1916 Grade 9
 - surface texture 63 μin or 1.6 μm
- 1.10 carry out quality sampling checks at suitable intervals
- 1.11 carry out the necessary checks during production for accuracy of five of the following:
 - gear blanks
 - lead and helix angle
 - gear tooth thickness
 - composite error rolling test
 - surface texture
 - involute form
- 1.12 deal promptly and effectively with problems within their control and report those that cannot be solved
- 1.13 shut down the equipment to a safe condition on conclusion of the

machining activities.

Learning outcome

The learner will:

2. know how to machine components using gear cutting machines

Assessment criteria

The learner can:

- 2.1 describe the safe working practices and procedures to be followed while operating gear hobbing, shaping, shaving and planing machines
- 2.2 describe the safety mechanisms on the machine, and the procedure for checking that they function correctly
- 2.3 describe the operation of the machine controls in both hand and power modes, and how to stop the machine in an emergency
- 2.4 describe the Personal Protective Equipment to be worn, and where this can be obtained
- 2.5 describe the hazards associated with carrying out the gear cutting operations, and how to minimise them and reduce any risks
- 2.6 describe the importance of keeping the work area clean and tidy
- 2.7 explain where to obtain the component drawings, specifications and/or job instructions required for the components to be machined
- 2.8 explain how to extract and use information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS, ISO or BSEN standards) in relation to work undertaken
- 2.9 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing
- 2.10 describe the terminology used in gear cutting in relation to the activities undertaken
- 2.11 describe the various gear cutting operations that are used to produce the required gear forms, and the types of tooling used (such as straight hobs having single and multi start, tapered hobs, shank type hobs, protuberance hobs, inserted blade hobs, skiving hobs, disc and shank type gear shaping and shaving cutters, gear planing cutters and bevel gear cutters)
- 2.12 describe the methods that can be used to position the workpiece in relation to the cutting tools
- 2.13 describe the importance of checking blank and cutter concentricity, and the tools and equipment that are used
- 2.14 describe the effects of backlash in machine slides and screws, and how this can be overcome
- 2.15 explain how to handle and store cutting tools safely and correctly
- 2.16 describe the factors which affect the selection of cutting feeds and speeds, and the depth of cut that can be taken (such as workpiece rigidity, machine condition, type of tooling being used, material type, finish and tolerance required)
- 2.17 explain how the various types of material will affect the feeds and speeds that can be used
- 2.18 describe the application of roughing and finishing cuts, and the effect on tool life, surface finish and dimensional accuracy
- 2.19 describe the application of cutting fluids with regard to a range of

different materials

- 2.20 describe the effects of clamping the workpiece, and how this can cause distortion in the finished components
- 2.21 explain how to recognise machining faults and identify when tools need re-sharpening
- 2.22 describe the quality control procedures used, inspection checks to be carried out, and the equipment to be used
- 2.23 describe the problems that can occur with the gear cutting activities, and how these can be overcome
- 2.24 describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve.

Unit 314

Setting gear grinding machines for production

UAN:	M/600/5398
Level:	3
Credit value:	91
GLH:	210
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 14: Setting Gear Grinding Machines for Production (Level 3).
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to prepare and set up gear grinding machines, which cover gear grinding using formed wheels and gear grinding using generation methods, and will include the grinding of spur gears, helical, bevel gears and splines, in accordance with approved procedures. This involves selecting the appropriate workholding devices, and mounting and positioning them to the machine in the correct location for the type of operation being carried out. The learner will also be expected to select the appropriate grinding wheels to use, check them for defects, balance them when appropriate, and mount and secure them to the machine spindle. The learner will also be expected to mount the gears to be ground, and to check that they are running true and concentric before starting the grinding operations.</p> <p>The learner will be expected to prepare the grinding wheels for operation, by mounting the correct templates and dressing the wheels to the correct form, or mounting the correct crushing rolls and forming the wheels to the correct profiles. The learner must set up the appropriate mechanisms and controls for indexing, selecting and fitting appropriate change gears or roll gears</p>

for generation, workspeed, setting the angle of the wheelhead and workhead, feeds and speeds, as applicable for the particular gears and gear grinding methods being used. Making adjustments to settings to achieve specification, and solving machine-related problems during production, will also form part of their role.

The learner's responsibilities will require them to comply with organisational policy and procedures for the machine setting activities undertaken, and to report any problems with the grinding machines, equipment or setting up activities that they cannot resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to the setting up procedures used. The learner will understand the gear grinding machines used, and their application, and will know about the workholding devices, grinding wheels, wheel forming and setting up procedures, in adequate depth to provide a sound basis for carrying out the activities, correcting faults and ensuring the work produced is to the required specification.

The learner will understand the safety precautions required when working with the machines and their 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. set gear grinding machines for production
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 carry out all of the following activities during setting up: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job

- instructions, drawings, quality control documentation)
- adhere to procedures or systems in place for risk assessment, COSHH, Personal Protective Equipment and other relevant safety regulations and procedures to realise a safe system of work
 - follow safe practice/approved setting up procedures at all times
 - ensure that correctly adjusted machine guards are in place
 - check that grinding wheels are in a safe and usable condition
 - hold components securely without distortion
 - leave the work area and machine in a safe and appropriate condition on completion of the activities
- 1.3 follow the correct specifications for the component to be produced
- 1.4 set the machine to produce components within all of the following quality and accuracy standards, as applicable to the operations performed:
- dimensional tolerance equivalent to BS 4500 Grade 5 or BS1916
 - surface texture 8 μin or 0.2 μm
 - components to be free from false grinding cuts, burrs and sharp edges
- 1.5 determine what has to be done and how the machine will be set to achieve this
- 1.6 prepare one of the following gear grinding machines in readiness for production:
- gear grinding using formed wheels
 - gear grinding using generation
- 1.7 mount and set the required workholding devices, workpiece and cutting tools
- 1.8 position and secure workpieces using two of the following workholding arrangements:
- mandrels
 - arbors
 - pots
 - centres
 - chucks
 - collets
 - clamps
 - face plates
 - jigs/fixtures
- 1.9 select and mount grinding wheels to include all of the following:
- selecting gear grinding wheels for specific materials and gear pitch (grain size, grade, structure, bond) mounting wheels (paper washers, flanges, locking pressure)
 - testing wheels for cracks
 - balancing wheels, where appropriate
- 1.10 set the machine tool operating parameters to achieve the component specification
- 1.11 set up gear grinding machines, to include four of the following as appropriate to machine type:

<ul style="list-style-type: none"> • setting up diamond tools for use in pantograph and wheel dressing units • selecting and mounting correct templates for the specific gear tooth form • selecting and mounting correct crushing rolls for the specific gear tooth form • dressing and 'trueing up' single and multi-ribbed grinding wheels • setting index plates or change gears for number of teeth to be ground • selecting and fitting of pitch block and tapes for diameter of pitch circle to be ground • selecting and fitting workspeed gears • setting wheelhead and workhead angle for helical gears <p>1.12 set up a machine to grind two of the following gear forms applicable to the machine type:</p> <ul style="list-style-type: none"> • external spur gear • internal spur gear • single helical gear • double helical gear • bevel gears • straight splines • involute splines • tip and root relief <p>1.13 grind gears made from one of the following types of material:</p> <ul style="list-style-type: none"> • ferrous • non-ferrous • non-metallic <p>1.14 check that all safety mechanisms are in place and that the equipment is set correctly for the required operations</p> <p>1.15 deal promptly and effectively with problems within their control and report those that cannot be solved.</p>
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Learning outcome
The learner will: 2. know how to set gear grinding machines for production
Assessment criteria
The learner can: 2.1 describe the specific safety precautions to be taken when setting up workholding devices and grinding wheels on gear grinding machines 2.2 describe their duties and responsibilities under The Abrasive Wheels Regulations, with particular reference to the mounting of abrasive wheels 2.3 describe the hazards associated with setting gear grinding machines (such as moving parts of machinery, sparks/airborne particles, bursting grinding wheels) and how to minimise them and reduce any risks 2.4 explain how to start and stop the machine in normal and

- emergency situations
- 2.5 describe the importance of ensuring that the machine is isolated from the power supply before mounting grinding wheels and workholding devices
 - 2.6 describe the importance of wearing the appropriate protective clothing and equipment, and of keeping the work area clean and tidy
 - 2.7 explain how to handle and store gear grinding wheels safely and correctly
 - 2.8 explain how to extract and use information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS, ISO or BSEN standards) in relation to work undertaken
 - 2.9 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing
 - 2.10 describe the terminology used in gear grinding in relation to the activities undertaken
 - 2.11 describe the range of workholding methods and devices that are used on gear grinding machines
 - 2.12 describe the methods of mounting and setting the workpiece in/on the workholding devices, and the tools and equipment that can be used
 - 2.13 describe the various gear grinding operations that are used to produce the required gear forms, and the types of wheels that are used
 - 2.14 explain how to check that the grinding wheels are in a safe and serviceable condition (such as free from damage, cracks, correctly balanced)
 - 2.15 describe the methods of mounting and securing the grinding wheels to the machine spindles
 - 2.16 describe the methods of forming the wheels to the required gear profile (such as use of pantograph and wheel dressing units, use of crushing rolls)
 - 2.17 describe the need for 'trueing up' and dressing of wheels to prevent glazing and burning of workpiece
 - 2.18 explain how to set up the various machines for the particular gears being ground
 - 2.19 explain how the various types of material will affect the feeds and speeds that can be used
 - 2.20 describe the application of cutting fluids with regard to a range of different materials
 - 2.21 describe the need to conduct trial runs, and to check that the machine is set up and running safely and correctly
 - 2.22 describe the problems that can occur with setting up of the grinding wheels, workholding devices and machine operating parameters, and what to do if problems occur
 - 2.23 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 315

Machining components using gear grinding machines

UAN:	D/600/5400
Level:	3
Credit value:	77
GLH:	161
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 15: Machining Components using Gear Grinding Machines (Level 3).
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out gear grinding operations, in accordance with approved procedures. The learner will be required to check that the machine is ready for the operations to be performed, and that all the required components, consumables and gear measuring equipment is available. The learner will be expected to grind a range of gears, such as spur gears, helical and double helical gears, bevel gears, and splines.</p> <p>The learner must operate the machine in line with safe working practices and approved procedures, and continuously monitor the machining operations, making any necessary adjustments to settings in order to ensure that the work output is to the required quality and accuracy. Meeting production targets will be an important issue, and their production records must show consistent and satisfactory performance.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the grinding activities undertaken, and to report any problems with the grinding activities that they cannot resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with minimum</p>

supervision, taking personal responsibility for their actions and for the quality and accuracy of the work that they produce.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying gear grinding procedures. The learner will understand the gear grinding process undertaken, and its application, and will know about the equipment, materials and consumables, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

The learner will understand the safety precautions required when working with the machine and its 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. machine components using gear grinding machines
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 they apply all of the following during the machining activities: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, drawings, quality control documentation)• adhere to procedures or systems in place for risk assessment, COSHH, Personal Protective Equipment and other relevant safety regulations and procedures to realise a safe system of work• ensure that machine guards are in place and correctly adjusted• hold components securely without distortion• maintain grinding wheels in a safe and usable condition• apply safe working practices at all times• adjust machine settings, as required, to maintain the required accuracy• ensure that components produced meet specification• leave the work area and machine in a safe and appropriate condition on completion of the activities 1.3 confirm that the machine is set up and ready for the machining activities to be carried out 1.4 operate one of the following types of gear grinding machine:

<ul style="list-style-type: none"> • gear grinding using formed wheels • gear grinding by generation
1.5 manipulate the machine tool controls safely and correctly in line with operational procedures
1.6 produce components to the required quality and within the specified dimensional accuracy
1.7 finish grind two of the following types of gears applicable to the machine type: <ul style="list-style-type: none"> • external spur gear • internal spur gear • single helical gear • double helical gear • bevel gears • straight splines • involute splines • tip and root relief
1.8 grind gears made from one of the following types of material: <ul style="list-style-type: none"> • ferrous • non-ferrous • non-metallic
1.9 produce components within all the relevant quality and accuracy standards, as applicable to the operations performed: <ul style="list-style-type: none"> • dimensional tolerance equivalent to BS 4500 Grade 5 or BS1916 • surface texture 8 µin or 0.2µm • components to be free from false grinding cuts, burrs and sharp edges
1.10 carry out quality sampling checks at suitable intervals
1.11 carry out the necessary checks during production for accuracy of four of the following: <ul style="list-style-type: none"> • gear tooth profile • lead and pitch • gear tooth thickness • involute form • concentricity • surface texture
1.12 deal promptly and effectively with problems within their control and report those that cannot be solved
1.13 shut down the equipment to a safe condition on conclusion of the machining activities.

Learning outcome
The learner will: 2. know how to machine components using gear grinding machines
Assessment criteria
The learner can: 2.1 describe the safe working practices and procedures to be followed while operating gear grinding machines

- 2.2 describe their duties and responsibilities under The Abrasive Wheels Regulations, with particular reference to the mounting of abrasive wheels
- 2.3 describe the safety mechanisms on the machine, and the procedure for checking that they function correctly
- 2.4 describe the operation of the machine controls in both hand and power modes, and how to stop the machine in an emergency
- 2.5 describe the Personal Protective Equipment to be worn, and where this can be obtained
- 2.6 describe the hazards associated with carrying out gear grinding operations, and how to minimise them and reduce any risks
- 2.7 describe the importance of keeping the work area clean and tidy
- 2.8 explain where to obtain the component drawings, specifications and/or job instructions required for the components to be machined
- 2.9 explain how to extract and use information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS, ISO or BSEN standards) in relation to work undertaken
- 2.10 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing
- 2.11 describe the terminology used in gear grinding in relation to the activities undertaken
- 2.12 describe the various gear grinding operations that are used to produce the required gear forms, and the types of grinding wheels used
- 2.13 explain how to dress and reshape single and multi-ribbed grinding wheels, and the equipment to be used
- 2.14 describe the methods that can be used to position the gear in relation to the grinding wheel
- 2.15 describe the importance of checking the gear concentricity before grinding, and tools and equipment that are used
- 2.16 describe the effects of backlash in machine slides and screws, and how this can be overcome
- 2.17 explain how to handle and store grinding wheels safely and correctly
- 2.18 describe the factors which affect the selection of grinding wheel feeds and speeds, and the depth of cut that can be taken (such as wheel size, material type, finish and tolerance required)
- 2.19 describe the application of roughing and finishing cuts, and the effect on wheel life, surface finish and dimensional accuracy
- 2.20 describe the reason for using cutting fluids, and the type of fluid used
- 2.21 describe the effects of clamping the workpiece, and how this can cause distortion in the finished components
- 2.22 explain how to recognise grinding faults and identify when grinding wheels need re-dressing/forming
- 2.23 describe the quality control procedures used, inspection checks to be carried out, and the equipment to be used
- 2.24 describe the problems that can occur with the gear grinding activities, and how these can be overcome
- 2.25 describe the extent of their own authority, and to whom they should report if they have problems that they cannot resolve.

Unit 316

Setting horizontal boring machines for production

UAN:	K/600/5402
Level:	3
Credit value:	91
GLH:	210
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 16: Setting Horizontal Boring Machines for Production (Level 3).
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to prepare and set up horizontal boring machines, and horizontal boring attachments, in accordance with approved procedures. This involves selecting the appropriate workholding devices, and mounting and positioning them to the machine in the correct location for the type of operation being carried out. The learner will also be expected to select the appropriate horizontal boring tools and cutters, check them for defects, and mount and secure them to the relevant tool holding devices and machine spindle.</p> <p>The learner will be expected to set up and align the workpiece in the correct relationship to the machine spindle, and to set the machine operating parameters to produce the workpiece to the required specification. The learner must produce trial cuts, and prove the machine is working satisfactorily before declaring the installation ready for production. Making adjustments to settings to achieve specification, and solving machine-related problems during production, will also form part of their role.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the machine setting</p>

activities undertaken, and to report any problems with the machine, cutters, tools, equipment or setting up activities that they cannot personally resolve, or 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 of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to the setting up procedures used. The learner will understand the horizontal boring machine used, and its application, and will know about the workholding devices, cutters, tools, relevant materials and consumables, and setting up procedures, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

The learner will understand the safety precautions required when working with the machine and its 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. set horizontal boring machines for production
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 carry out all of the following activities during setting up: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, drawings, quality control documentation)• adhere to procedures or systems in place for risk assessment, COSHH, Personal Protective Equipment and other relevant safety regulations and procedures to realise a safe system of work• follow safe practice/approved setting up procedures at all times• ensure that correctly adjusted machine guards are in place• check that cutting tools are in a suitable condition• hold components securely without distortion• leave the work area and machine in a safe and appropriate

condition on completion of the activities

- 1.3 follow the correct specifications for the component to be produced
- 1.4 set the machine to produce components within all of the following quality and accuracy standards, as applicable to the operations performed:
 - components to be free from false tool cuts, burrs and sharp edges
 - flatness and squareness within 0.001" per inch or 0.025mm per 25mm
 - dimensional tolerance equivalent to BS 4500 Grade 7 or BS 1916
 - surface finish 63 μin or 1.6 μm
 - angles within ± 0.5 degree
 - bored holes within H8
- 1.5 determine what has to be done and how the machine will be set to achieve this
- 1.6 prepare the machine and its equipment in readiness for production, to include all of the following:
 - lifting equipment
 - slings
 - boring heads
 - tool/cutter holding devices
 - workholding devices
- 1.7 mount and set the required workholding devices, workpiece and cutting tools
- 1.8 position, align and secure the workpiece using three of the following work holding arrangements:
 - clamping direct to machine table
 - machine vice (eg. plain, swivel, universal)
 - three jaw chucks, hard jaws
 - pneumatic or magnetic table
 - indexing/rotating device
 - vee block and clamps
 - three jaw chucks, soft jaws
 - other workholding devices
 - four jaw chucks
 - fixtures
 - angle plate
- 1.9 select and mount horizontal boring tools/cutters to include seven of the following:
 - boring
 - turning
 - facing
 - recessing
 - twist drills
 - chamfering or radii
 - reamers
 - taps

- forming
 - milling cutters
- 1.10 set the machine tool operating parameters to achieve the component specification
- 1.11 set up the machine in accordance with instructions and specifications to include all of the following:
- alignment of workholding device/workpiece
 - position of cutters/tools in relationship to workpiece
 - position of cutters/tools in relationship to datums
 - feed rate
 - cutter/tool revolutions per minute
 - depth of cut for roughing and finishing
 - cutting fluid flow rate
 - machine guards/safety mechanisms
- 1.12 set up the machine to produce internal and external profiles that include ten of the following:
- bored holes through workpiece
 - bored holes to a depth
 - tapered bores
 - drilled holes to depth
 - drilled holes through workpiece
 - reamed holes
 - threaded holes
 - external diameters
 - grooves/recesses
 - chamfers/radii
 - flat faces
 - square faces
 - parallel faces
 - angular faces
 - slots
 - indexed or rotated forms
- 1.13 machine components made from one of the following types of material:
- ferrous
 - non-ferrous
 - non-metallic
- 1.14 check that all safety mechanisms are in place and that the equipment is set correctly for the required operations
- 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 set horizontal boring machines for production
Assessment criteria
The learner can: 2.1 describe the specific safety precautions to be taken when setting up workholding devices, tools and cutters on horizontal boring machines 2.2 describe the hazards associated with setting horizontal boring machines (such as moving parts of machinery, handling tools and cutters, lifting and moving workpieces, handling cutting fluids, airborne particles, tool breakage, insecure components), and how to minimise them and reduce any risks 2.3 explain how to start and stop the machine in normal and emergency situations 2.4 describe the importance of ensuring that the machine is isolated from the power supply before mounting tools, cutters, workpieces and work holding devices 2.5 describe the importance of wearing the appropriate protective clothing and equipment, and of keeping the work area clean and tidy 2.6 describe the basic principles of operation of the horizontal boring machine, and typical operations that it can perform 2.7 explain how to handle and store tools and cutters safely and correctly 2.8 explain how to extract and use information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS, ISO or BSEN standards) in relation to work undertaken 2.9 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing 2.10 explain the terminology used in horizontal boring in relation to the activities undertaken 2.11 describe the range of workholding methods and devices that are used on machines (such as direct clamping, machine vices, jigs and fixtures, angle brackets, vee blocks and clamps) 2.12 describe the methods of mounting and setting the workpiece in/on the workholding devices, and the tools and equipment that can be used 2.13 describe the different types of horizontal boring tools and cutters that are used, and how they are selected, prepared and mounted to the machine tool holding devices (such as tool posts, micro boring bars, arbors, collet chucks, direct mounting to machine spindle) 2.14 describe the factors which determine speeds and feeds to be used (such as material, type of cutter/tool, depth of cut, workpiece rigidity, machine condition, tolerance and finish required) 2.15 explain how the various types of material will affect the feeds and speeds that can be used 2.16 describe the types of cutting fluid that are used, and precautions to be taken when handling and using them 2.17 explain how to set up the machine for the particular operations

being performed

- 2.18 describe the need to conduct trial runs, and check that the machine is set up and running safely and correctly
- 2.19 describe the problems that can occur with setting up the horizontal boring machine, tools and cutters, work holding devices and machine operating parameters, and what to do if problems occur
- 2.20 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 317

Machining components using horizontal boring machines

UAN:	L/600/5411
Level:	3
Credit value:	77
GLH:	161
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 17: Machining Components using Horizontal Boring Machines (Level 3).
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out horizontal boring operations, in accordance with approved procedures, using horizontal boring machines and associated boring attachments. The learner will be required to check that the machine is ready for the operations to be performed, and that all the required components or materials and consumables are available. The learner will be expected to produce a range of components that combine a number of different features, such as drilled and reamed holes, parallel and tapered bored holes, counterbores, threads and special forms, external diameters, flat, parallel and square faces, steps and slots, radii and chamfers.</p> <p>The learner will be required to operate the machine in line with safe working practices and approved procedures, and to continuously monitor the machining operations, making any necessary adjustments in order to ensure that the work output is to the required quality and accuracy. Meeting production targets will be an important issue, and their production records must show consistent and satisfactory performance.</p> <p>The learner's responsibilities will require</p>

them to comply with organisational policy and procedures for the machining activities undertaken, and to report any problems with the machining activities that they cannot personally resolve, or 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 produce.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying machining procedures. The learner will understand the horizontal boring process, and its application, and will know about the equipment, materials and consumables, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

The learner will understand the safety precautions required when working with the machine and its 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. machine components using horizontal boring machines
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 they apply all of the following during the machining activities: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, drawings, quality control documentation)• adhere to procedures or systems in place for risk assessment, COSHH, Personal Protective Equipment and other relevant safety regulations and procedures to realise a safe system of work• ensure that machine guards are in place and correctly adjusted• hold components securely without distortion• maintain cutting tools in a suitable condition• apply safe working practices at all times• adjust machine settings, as required, to maintain the required

- accuracy
 - ensure that components produced meet specification
 - leave the work area and machine in a safe and appropriate condition on completion of the activities
- 1.3 confirm that the machine is set up and ready for the machining activities to be carried out
- 1.4 manipulate the machine tool controls safely and correctly in line with operational procedures
- 1.5 produce components to the required quality and within the specified dimensional accuracy
- 1.6 produce machined components which combine different operations and cover ten of the following:
 - bored holes through workpiece
 - bored holes to a depth
 - tapered bores
 - drilled holes to depth
 - drilled holes through workpiece
 - reamed holes
 - threaded holes
 - external diameters
 - grooves/recesses
 - chamfers/radii
 - flat faces
 - square faces
 - parallel faces
 - angular faces
 - slots
 - indexed or rotated forms
- 1.7 machine components made from one type of material from the following:
 - ferrous
 - non-ferrous
 - non-metallic
- 1.8 produce components within all the relevant quality and accuracy standards, as applicable to the operations performed:
 - components to be free from false tool cuts, burrs and sharp edges
 - flatness and squareness within 0.001" per inch or 0.025mm per 25mm
 - dimensional tolerance equivalent to BS 4500 Grade 7 or BS 1916
 - surface finish 63 μ m or 1.6 μ m
 - angles within +/- 0.5 degree
 - bored holes within H8
- 1.9 carry out quality sampling checks at suitable intervals
- 1.10 carry out the necessary checks during production for accuracy of six of the following:
 - external diameters

- internal diameters
- lengths/depths
- reamed hole size/fit
- tapers/angles
- thread fit
- slot/recess width
- surface finish
- flatness of faces
- squareness of faces

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

1.12 shut down the equipment to a safe condition on conclusion of the machining activities.

Learning outcome

The learner will:

2. know how to machine components using horizontal boring machines

Assessment criteria

The learner can:

- 2.1 describe the safe working practices and procedures to be followed while operating horizontal boring machines
- 2.2 describe the safety mechanisms on the machine, and the procedure for checking that they function correctly
- 2.3 describe the operation of the machine controls in both hand and power modes, and how to stop the machine in an emergency
- 2.4 describe the Personal Protective Equipment to be worn, and where this can be obtained
- 2.5 describe the hazards associated with carrying out the horizontal boring operations, and how to minimise them and reduce any risks
- 2.6 describe the importance of keeping the work area clean and tidy
- 2.7 explain where to obtain the component drawings, specifications and/or job instructions required for the components to be machined
- 2.8 explain how to extract and use information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS, ISO or BSEN standards) in relation to work undertaken
- 2.9 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing
- 2.10 describe the application of a range of horizontal boring machines and horizontal boring attachments
- 2.11 describe the various horizontal boring techniques that can be used to produce the required shapes, and the types of horizontal boring cutters and tools required (such as turning tools, single and multiple tool boring bars, milling cutters, drills, taps, profile tools)
- 2.12 describe the methods that can be used to position the workpiece in relation to the horizontal boring cutters and tools
- 2.13 describe the effects of backlash in machine slides and screws, and how this can be overcome
- 2.14 explain how to handle and store cutting tools safely and correctly

- 2.15 describe the factors which affect the selection of cutting feeds and speeds, and the depth of cut that can be taken (such as workpiece rigidity, machine condition, type of tooling being used, material type, finish and tolerance required)
- 2.16 explain how the various types of materials will affect the feeds and speeds that can be used
- 2.17 describe the application of roughing and finishing cuts, and the effect on tool life, surface finish and dimensional accuracy
- 2.18 describe the application of cutting fluids with regard to a range of different materials
- 2.19 describe the effects of clamping the workpiece, and how this can cause distortion in the finished components
- 2.20 describe the effects of removing material and, how this can cause warping/distortion of the workpiece, and how this can be overcome
- 2.21 explain how to recognise machining faults and identify when tools/cutters need re-sharpening
- 2.22 describe the quality control procedures used, inspection checks to be carried out, and the equipment to be used
- 2.23 describe the problems that can occur with the horizontal boring activities, and how these can be overcome
- 2.24 describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve.

Unit 318

Setting vertical boring machines for production

UAN:	F/600/5423
Level:	3
Credit value:	91
GLH:	210
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 18: Setting Vertical Boring Machines for Production (Level 3).
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to prepare and set up vertical boring machines and vertical boring attachments, in accordance with approved procedures. This involves selecting the appropriate workholding devices, and mounting and positioning them to the machine in the correct location for the type of operation being carried out. The learner will also be expected to select the appropriate boring tools and cutters, check them for defects, and mount and secure them to the relevant tool holding devices and machine spindle.</p> <p>The learner will also be expected to set up and align the workpiece in the correct relationship to the machine spindle, and to set the machine operating parameters to produce the workpiece to the required specification. The learner must produce trial cuts, and prove the machine is working satisfactorily before declaring the installation ready for production. Making adjustments to settings to achieve specification, and solving machine-related problems during production, will also form part of their role.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the machine setting activities undertaken, and to report any</p>

problems with the machine, cutters, tools, equipment or setting up activities that they cannot personally resolve, or 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 of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to the setting up procedures used. The learner will understand the vertical boring machine used, and its application, and will know about the workholding devices, cutters, tools, grinding wheels, tool holding attachments, relevant materials, consumables and setting up procedures, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

The learner will understand the safety precautions required when working with the machine and its 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. set vertical boring machines for production
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 carry out all of the following activities during setting up: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, drawings, quality control documentation)• adhere to procedures or systems in place for risk assessment, COSHH, Personal Protective Equipment and other relevant safety regulations and procedures to realise a safe system of work• follow safe practice/approved setting up procedures at all times• ensure that correctly adjusted machine guards are in place• check that cutting tools are in a suitable condition• hold components securely without distortion• leave the work area and machine in a safe and appropriate

condition on completion of the activities

- 1.3 follow the correct specifications for the component to be produced
- 1.4 set the machine to produce components within all of the following quality and accuracy standards, as applicable to the operations performed:
 - components to be free from false tool cuts, burrs and sharp edges
 - dimensional tolerance equivalent to BS 4500 Grade 7 or BS 1916
 - flatness and squareness within 0.001" per inch or 0.025mm per 25mm
 - surface finish 63 μin or 1.6 μm
 - angles within +/- 0.5 degree
 - bored holes within H8
- 1.5 determine what has to be done and how the machine will be set to achieve this
- 1.6 prepare the machine and equipment in readiness for production, to include all of the following:
 - lifting equipment
 - side heads
 - turret heads/slides
 - tool/cutter holding devices
 - workholding devices
 - multi-tooling
 - tool post
- 1.7 mount and set the required workholding devices, workpiece and cutting tools
- 1.8 position, align and secure the workpiece, using three of the following:
 - clamping direct to machine table
 - machine vice (e.g. plain, swivel, universal)
 - three jaw chucks (hard jaws)
 - pneumatic or magnetic table
 - indexing/rotating device
 - vee block and clamps
 - three jaw chucks (soft jaws)
 - other workholding devices
 - four jaw chucks
 - fixtures
 - angle plate
- 1.9 select and mount vertical boring tools and cutters, to include eight of the following:
 - boring
 - turning
 - facing
 - recessing
 - twist drills
 - chamfering/radii

- reamers
 - taps
 - forming
 - threading
 - milling cutters
 - grinding wheel
- 1.10 set the machine tool operating parameters to achieve the component specification
- 1.11 set up the machine in accordance with instructions and specifications, to include all of the following:
- position of cutters/tools/grinding wheels in relationship to workpiece
 - cutting fluid flow rate
 - cutter/tools/grinding wheel revs per minute
 - alignment of workholding device/workpiece
 - machine guards/safety mechanisms
 - depth of cut for roughing/finishing
 - feed rate
- 1.12 set up the machine to produce internal and external profiles that include ten of the following:
- external diameters
 - internal diameters
 - indexed or rotated forms
 - recesses and grooves
 - external tapers
 - taper bores
 - drilled holes
 - reamed holes
 - milled faces
 - milled slots
 - ground diameters
 - steps
 - ground faces
 - threads
 - radii/chamfers
 - turned faces
- 1.13 machine components made from one type of material from the following:
- ferrous
 - non-ferrous
 - non-metallic
- 1.14 check that all safety mechanisms are in place and that the equipment is set correctly for the required operations
- 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 set vertical boring machines for production
Assessment criteria
The learner can: 2.1 describe the specific safety precautions to be taken when setting up workholding devices, tools and cutters on vertical boring machines 2.2 describe the hazards associated with setting vertical boring machines (such as moving parts of machinery, handling tools and cutters, lifting and moving workpieces, handling cutting fluids, airborne particles, tool breakage, insecure components), and how to minimise them and reduce any risks 2.3 explain how to start and stop the machine in normal and emergency situations 2.4 describe the importance of ensuring that the machine is isolated from the power supply before mounting tools, cutters, workpieces and work holding devices 2.5 describe the importance of wearing the appropriate protective clothing and equipment, and of keeping the work area clean and tidy 2.6 describe the basic principles of operation of the vertical boring machine, and typical operations that they can perform 2.7 explain how to handle and store tools and cutters safely and correctly (such as turning tools, milling cutters, grinding wheels) 2.8 explain how to extract and use information from engineering drawings and related specifications, to include symbols and conventions to appropriate BS, ISO or BSEN standards in relation to work undertaken 2.9 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing 2.10 describe the terminology used in vertical boring in relation to the activities undertaken 2.11 describe the range of workholding methods and devices that are used on vertical boring machines (such as three and four jaw chucks, hard and soft jaws, direct clamping to machine table, jigs and fixtures, machine vice, angle plates) 2.12 describe the methods of mounting and setting the workpiece in/on the workholding devices, and the tools and equipment that can be used 2.13 describe the different types of vertical boring tools, cutters and grinding wheels that are used, and how they are selected, prepared and mounted to the machine tool holding devices (such as boring bars, collet chucks, stub arbors, tool posts, direct mounting to machine spindle) 2.14 describe the types of vertical boring attachments that are used, and their application 2.15 describe the factors which determine speeds and feeds to be used (such as material, type of cutter/tool/grinding wheel, depth of cut, workpiece rigidity, machine condition, tolerance and finish required) 2.16 explain how the various types of material will affect the feeds and speeds that can be used

- 2.17 describe the types of cutting fluid that are used, and precautions to be taken when handling and using them
- 2.18 explain how to set up the machine for the particular operations being performed
- 2.19 describe the need to conduct trial runs, and to check that the machine is set up and running safely and correctly
- 2.20 describe the problems that can occur with setting up the vertical boring tools and cutters, work holding devices and machine operating parameters, and what to do if problems occur
- 2.21 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 319

Machining components using vertical boring machines

UAN:	Y/600/5430
Level:	3
Credit value:	77
GLH:	161
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 19: Machining Components using Vertical Boring Machines (Level 3).
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out vertical boring operations, in accordance with approved procedures, using vertical boring machines and associated vertical boring attachments. The learner will be required to check that the machine is ready for the operations to be performed, and that all the required components or materials and consumables are available. The learner will be expected to produce a range of components that combine a number of different features, such as parallel diameters, parallel bores, external tapers, taper bores, steps, faces, radii, threads, ground diameters, milled faces and milled slots or profiles.</p> <p>The learner will be required to operate the machine in line with safe working practices and approved procedures, and to continuously monitor the machining operations, making any necessary adjustments in order to ensure that the work output is to the required quality and accuracy. Meeting production targets will be an important issue, and their production records must show consistent and satisfactory performance.</p> <p>The learner's responsibilities will require them to comply with organisational policy</p>

and procedures for the machining activities undertaken, and to report any problems with the machining activities that they cannot personally resolve, or 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 produce.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying machining procedures. The learner will understand the vertical boring process, and its application, and will know about the equipment, materials and consumables, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

The learner will understand the safety precautions required when working with the machine and its 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. machine components using vertical boring machines
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 they apply all of the following during the machining activities: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, drawings, quality control documentation)• adhere to procedures or systems in place for risk assessment, COSHH, Personal Protective Equipment and other relevant safety regulations and procedures to realise a safe system of work• ensure that machine guards are in place and correctly adjusted• hold components securely without distortion• maintain cutting tools in a suitable condition• apply safe working practices at all times• adjust machine settings, as required, to maintain the required accuracy

- ensure that components produced meet specification
 - leave the work area and machine in a safe and appropriate condition on completion of the activities
- 1.3 confirm that the machine is set up and ready for the machining activities to be carried out
- 1.4 manipulate the machine tool controls safely and correctly in line with operational procedures
- 1.5 produce components to the required quality and within the specified dimensional accuracy
- 1.6 produce machined components which combine different operations and cover ten of the following:
- external diameters
 - internal diameters
 - indexed or rotated forms
 - recesses and grooves
 - external tapers
 - taper bores
 - drilled holes
 - reamed holes
 - milled faces
 - milled slots
 - ground diameters
 - steps
 - ground faces
 - threads
 - radii/chamfers
 - turned faces
- 1.7 machine components made from one type of material from the following:
- ferrous
 - non-ferrous
 - non-metallic
- 1.8 produce components within all the relevant quality and accuracy standards, as applicable to the operations performed:
- components to be free from false tool cuts, burrs and sharp edges
 - dimensional tolerance equivalent to BS 4500 Grade 7 or BS 1916
 - flatness and squareness within 0.001" per inch or 0.025mm per 25mm
 - surface finish 63 μin or 1.6 μm
 - angles within +/- 0.5 degree
 - bored holes within H8
- 1.9 carry out quality sampling checks at suitable intervals
- 1.10 carry out the necessary checks during production for accuracy of five of the following:
- external diameters
 - internal diameters

- lengths/depths
- reamed hole size/fit
- tapers/angles
- thread fit
- slot/recess width
- surface finish
- flatness of faces
- squareness of faces

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

1.12 shut down the equipment to a safe condition on conclusion of the machining activities.

Learning outcome

The learner will:

2. know how to machine components using vertical boring machines

Assessment criteria

The learner can:

- 2.1 describe the safe working practices and procedures to be followed while operating vertical boring machines
- 2.2 describe the safety mechanisms on the machine, and the procedure for checking that they function correctly
- 2.3 describe the operation of the machine controls in both hand and power modes, and how to stop the machine in an emergency
- 2.4 describe the Personal Protective Equipment to be worn, and where this can be obtained
- 2.5 describe the hazards associated with carrying out the vertical boring operations, and how to minimise them and reduce any risks they can be minimised
- 2.6 describe the importance of keeping the work area clean and tidy
- 2.7 explain where to obtain the component drawings, specifications and/or job instructions required for the components to be machined
- 2.8 explain how to extract and use information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS, ISO or BSEN standards) in relation to work undertaken
- 2.9 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing
- 2.10 describe the application of a range of vertical boring machines and vertical boring attachments
- 2.11 describe the various vertical boring techniques that can be used to produce the required shapes, and the types of vertical boring tools required (such as boring tools, turning tools, chamfering tools, recessing tools, form tools, drills, reamers, taps, milling cutters and grinding wheels)
- 2.12 describe the methods that can be used to position the workpiece in relation to the vertical boring cutters and tools
- 2.13 describe the effects of backlash in machine slides and screws, and how this can be overcome

- 2.14 explain how to handle and store cutting tools safely and correctly (such as turning and boring tools, milling cutters, grinding wheels)
- 2.15 describe the factors which affect the selection of cutting feeds and speeds, and the depth of cut that can be taken (such as workpiece rigidity, machine condition, type of tooling being used, material type, finish and tolerance required)
- 2.16 explain how the various types of material will affect the feeds and speeds that can be used
- 2.17 describe the application of roughing and finishing cuts, and the effect on tool life, surface finish and dimensional accuracy
- 2.18 describe the application of cutting fluids with regard to a range of different materials
- 2.19 describe the effects of clamping the workpiece, and how this can cause distortion in the finished components
- 2.20 describe the effects of removing material, how this can cause warping/distortion of the workpiece, and how this can be overcome
- 2.21 explain how to recognise machining faults and identify when cutters need re-sharpening or grinding wheels need dressing
- 2.22 describe the quality control procedures used, inspection checks to be carried out, and the equipment to be used
- 2.23 describe the problems that can occur with the vertical boring activities, and how these can be overcome
- 2.24 describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve.

Unit 320

Setting electro-discharge machines for production

UAN:	H/600/5432
Level:	3
Credit value:	91
GLH:	210
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 20: Setting Electro-Discharge Machines for Production (Level 3).
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to prepare and set up electro-discharge machines, such as spark erosion or wire erosion machines, in accordance with approved procedures. This involves selecting the appropriate workholding devices, and mounting and positioning them to the machine in the correct location for the type of operation being carried out. The learner will also be expected to select the appropriate electrodes or wires to use, check them for defects, and mount and secure them to the relevant parts of the machine.</p> <p>The learner will be expected to set the electrical conditions; wire or electrode feed rate, dielectric flow rate, filtration and fume extraction systems. The learner must produce trial cuts, and prove the machine is working satisfactorily before declaring the installation ready for production. Making adjustments to settings to achieve specification, and solving machine-related problems during production, will also form part of their role.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the machine setting activities undertaken, and to report any</p>

problems with the machines, equipment or setting up activities that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to the setting up procedures used. The learner will understand the electro-discharge machine used, and its application, and will know about the workholding devices, electrodes, relevant materials, consumables and setting up procedures, in adequate depth to provide a sound basis for carrying out the activities, correcting faults and ensuring that the work output is to the required specification.

The learner will understand the safety precautions required when working with the machines and their 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. set electro-discharge machines for production
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 carry out all of the following activities during setting up: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, drawings, quality control documentation)• adhere to procedures or systems in place for risk assessment, COSHH, Personal Protective Equipment and other relevant safety regulations and procedures to realise a safe system of work• follow safe practice/approved setting up procedures at all times• ensure that correctly adjusted machine guards are in place• check that cutting tools are in a suitable condition• hold components securely without distortion• leave the work area and machine in a safe and appropriate condition on completion of the activities

- 1.3 follow the correct specifications for the component to be produced
- 1.4 set the machine to produce components within all of the following quality and accuracy standards, as applicable to the operations performed:
 - components to be free from false starts and sharp edges
 - tolerance to BS 4500 or BS 1916 Grade 7
 - surface texture 32 μin or 0.8 μm or 18VDI
- 1.5 determine what has to be done and how the machine will be set to achieve this
- 1.6 prepare one of the following types of electro-discharge machine in readiness for production:
 - spark erosion
 - wire erosion
- 1.7 mount and set the required workholding devices, workpiece and cutting tools
- 1.8 position and secure workpieces to machine table, to include all of the following:
 - clamping direct to machine table
 - pneumatic or magnetic table
 - machine vice (such as plain, swivel, universal)
 - angle plate
 - vee block and clamps
 - fixtures
 - chucks (such as 3 or 4 jaw)
 - ancillary indexing device
- 1.9 select and mount electrodes for roughing and finishing, to include one of the following:
 - plain electrodes
 - profile electrodes
 - hollow electrodes
 - wire
- 1.10 set the machine tool operating parameters to achieve the component specification
- 1.11 set up the machine in accordance with instructions and specifications, to include all of the following:
 - electrical conditions (such as current density, spark frequency)
 - alignment of electrodes
 - wire tension
 - wire speeds
 - filtration equipment
 - linear feeds and speeds
 - dielectric flow rates
 - ventilation and fume extraction
 - correct threading of wire through wire guides and feed mechanisms
 - safety mechanisms/devices
- 1.12 set up the machine to produce internal and external profiles that include six of the following:

- flat faces
- square faces
- convex forms
- profile forms
- radii/arcs
- slots
- square/rectangular forms
- angular faces
- parallel faces
- concave forms
- holes
- cavities
- threads
- engraving
- other special activities

1.13 machine components made from one of the following types of material:

- ferrous
- non-ferrous

1.14 check that all safety mechanisms are in place and that the equipment is set correctly for the required operations

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 set electro-discharge machines for production

Assessment criteria

The learner can:

2.1 describe the specific safety precautions to be taken when setting up workholding devices and electrodes or wires on electro-discharge machines

2.2 describe the hazards associated with setting electro-discharge machines (such as moving parts of machinery, electrical components, handling dielectrics, fumes), and how to minimise them and reduce any risks

2.3 explain how to start and stop the machine in normal and emergency situations

2.4 describe the importance of ensuring that the machine is isolated from the power supply before mounting electrodes, wires and workholding devices

2.5 describe the importance of wearing the appropriate protective clothing and equipment, and of keeping the work area clean and tidy

2.6 describe the basic principles of operation of the various electro-discharge machines, and typical operations that they can perform

2.7 explain how to handle and store electrodes and wires safely and correctly

2.8 explain how to extract and use information from engineering

- drawings and related specifications (to include symbols and conventions to appropriate BS, ISO or BSEN standards) in relation to work undertaken
- 2.9 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing
 - 2.10 describe the terminology used in electro-discharge machining in relation to the activities undertaken
 - 2.11 describe the range of eroded features that are produced on the electro-discharge machines
 - 2.12 describe the range of workholding methods and devices that are used on electro-discharge machines
 - 2.13 describe the methods of mounting and setting the workpiece in/on the workholding devices, and the tools and equipment that can be used
 - 2.14 describe the different types of electrodes and wires that are used, and how they are selected, prepared and mounted to the machine tool holding devices
 - 2.15 describe the factors that determine current density, spark frequency, wire speeds and feeds, or linear feeds and speeds
 - 2.16 explain how the various types of material will affect the feeds and speeds that can be used
 - 2.17 describe the type of dielectrics that are used; filtration requirements; and precautions to be taken when handling and using them
 - 2.18 explain how to set up the various machines for the particular operations being performed
 - 2.19 describe the need to conduct trial runs, and to check that the machine is set up and running safely and correctly
 - 2.20 describe the problems that can occur with setting up the electrodes or wires, workholding devices, and machine operating parameters, and what to do if problems occur
 - 2.21 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 321

Machining components using electro-discharge machines

UAN:	L/600/5439
Level:	3
Credit value:	77
GLH:	161
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 21: Machining Components using Electro-Discharge Machines (Level 3).
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out electro-discharge machining operations, using spark erosion or wire erosion machines, in accordance with approved procedures. The learner will be required to check that the machine is ready for the operations to be performed, and that all the required components, consumables and measuring equipment is available. The learner will be expected to produce a range of component shapes, such as internal and external profiles, that have flat, square, parallel, and tapered faces, square/rectangular forms, concave and convex forms, holes, slots, radii/arcs, cavities and special forms.</p> <p>The learner must operate the machine in line with safe working practices and approved procedures, and continuously monitor the erosion operations, making any necessary adjustments to settings in order to ensure that the work output is to the required quality and accuracy. Meeting production targets will be an important issue, and their production records must show consistent and satisfactory performance.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the electro discharge</p>

machining activities undertaken, and to report any problems with the equipment or activities that they cannot personally resolve, or 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 produce.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying electro-discharge machining procedures. The learner will understand the electro discharge process undertaken, and its application, and will know about the equipment, materials and consumables, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

The learner will understand the safety precautions required when working with the machine and its 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. machine components using electro-discharge machines
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 they apply all of the following during the machining activities: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, drawings, quality control documentation)• adhere to procedures or systems in place for risk assessment, COSHH, Personal Protective Equipment and other relevant safety regulations and procedures to realise a safe system of work• ensure that machine guards are in place and correctly adjusted• hold components securely without distortion• maintain cutting tools in a suitable condition• apply safe working practices at all times• adjust machine settings, as required, to maintain the required accuracy• ensure that components produced meet specification

- leave the work area and machine in a safe and appropriate condition on completion of the activities
- 1.3 confirm that the machine is set up and ready for the machining activities to be carried out
- 1.4 operate one of the following types of electro-discharge machine:
 - spark erosion
 - wire erosion
- 1.5 manipulate the machine tool controls safely and correctly in line with operational procedures
- 1.6 produce components to the required quality and within the specified dimensional accuracy
- 1.7 rough and finish components which include six of the following features:
 - flat faces
 - square faces
 - concave forms
 - convex forms
 - profile forms
 - cavities
 - square/rectangular forms
 - angular faces
 - parallel faces
 - threads
 - holes
 - engraving
 - radii/arcs
 - slots
 - other special activities
- 1.8 produce components within all the relevant quality and accuracy standards, as applicable to the operations performed:
 - components to be free from false starts and sharp edges
 - tolerance to BS 4500 or BS 1916 Grade 7
 - surface texture 32 μin or 0.8 μm or 18VDI
- 1.9 machine components made from one of the following types of material:
 - ferrous
 - non-ferrous
- 1.10 carry out quality sampling checks at suitable intervals
- 1.11 carry out the necessary checks during production for accuracy of four of the following:
 - dimensions
 - parallelism
 - angle/taper
 - squareness
 - surface texture
 - profile
- 1.12 deal promptly and effectively with problems within their control and report those that cannot be solved

1.13 shut down the equipment to a safe condition on conclusion of the machining activities.

Learning outcome

The learner will:

2. know how to machine components using electro-discharge machines

Assessment criteria

The learner can:

- 2.1 describe the safe working practices and procedures to be followed while operating electro-discharge machines
- 2.2 describe the hazards associated with carrying out the electro-discharge machining operations (such as moving machine parts, electrical components, handling dielectrics, fumes), and how to minimise them and reduce any risks
- 2.3 describe the safety mechanisms on the machine, and the procedure for checking that they function correctly
- 2.4 describe the operation of the machine controls in both hand and power modes, and how to stop the machine in an emergency
- 2.5 describe the Personal Protective Equipment to be worn, and where this can be obtained
- 2.6 explain the importance of keeping the work area clean and tidy
- 2.7 explain where to obtain the component drawings, specifications and/or job instructions required for the components to be machined
- 2.8 explain how to extract and use information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS, ISO or BSEN standards) in relation to work undertaken
- 2.9 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing
- 2.10 explain the terminology used in electro-discharge machining in relation to the activities undertaken
- 2.11 describe the various erosion operations that are used to produce the required forms, and the types of electrodes or wires used
- 2.12 explain how to dress and reshape electrodes, and the equipment to be used
- 2.13 describe the methods that can be used to position the workpiece in relation to the electrodes/wire, and the equipment that is used
- 2.14 explain the importance of checking the position and alignment of the workpiece before commencing the erosion operations, and the tools and equipment that are used
- 2.15 describe the effects of backlash in machine slides and screws, and how this can be overcome
- 2.16 explain how to handle and store electrodes and wires safely and correctly
- 2.17 describe the factors which affect the selection of electrode or wire feeds and speeds (such as material type, finish and tolerance required)
- 2.18 describe the application of roughing and finishing cuts, and the effect on electrode life, surface finish and dimensional accuracy
- 2.19 explain the reason for using dielectrics, and the type of fluid used
- 2.20 describe the effects of clamping the workpiece, and how this can

cause distortion in the finished components

- 2.21 explain how to recognise erosion faults and identify when electrodes need changing
- 2.22 describe the quality control procedures used, inspection checks to be carried out, and the equipment to be used
- 2.23 describe the problems that can occur with the electro-discharge machining activities, and how these can be overcome
- 2.24 describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve.

Unit 322

Setting grinding machines for production

UAN:	M/600/5448
Level:	3
Credit value:	91
GLH:	210
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 22: Setting Grinding Machines for Production (Level 3).
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to prepare and set up grinding machines, such as surface grinding, external cylindrical grinding, internal cylindrical, universal, centreless, profile and thread grinding machines, in accordance with approved procedures. The learner will be expected to set up the machines to grind a range of component shapes, such as internal and external parallel, stepped and tapered diameters, flat, parallel, square and angular faces, steps, slots, radii, chamfers, threads and special forms. This involves selecting the appropriate workholding devices, and mounting and positioning them to the machine in the correct location for the type of operation being carried out.</p> <p>The learner will also be expected to select the appropriate grinding wheels to use, check them for defects, balance them when appropriate, and mount and secure them to the machine spindle. The learner will be expected to prepare the grinding wheels for operation by 'trueing up' and dressing the wheels, and creating any necessary relief or form as applicable to the operation to be performed. The learner must set up the appropriate mechanisms, stops and controls for feeds and speeds, as applicable for the particular operations and machine type used. Making adjustments to settings to</p>

achieve specification, and solving machine-related problems during production, will also form part of their role.

The learner's responsibilities will require them to comply with organisational policy and procedures for the machine setting activities undertaken, and to report any problems with the grinding machines, equipment or setting up activities that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to the setting up procedures used. The learner will understand the grinding machine used, and its application, and will know about the workholding devices, grinding wheels, wheel forming, relevant materials, consumables and setting up procedures, in adequate depth to provide a sound basis for carrying out the activities, correcting faults and ensuring the work output is to the required specification.

The learner will understand the safety precautions required when working with the machines and their 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. set grinding machines for production
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 carry out all of the following activities during setting up: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, drawings, quality control documentation)• adhere to procedures or systems in place for risk assessment, COSHH, Personal Protective Equipment and other relevant safety regulations and procedures to realise a safe system of

- work
 - follow safe practice/approved setting up procedures at all times
 - ensure that correctly adjusted machine guards are in place
 - check that grinding wheels are in a safe and usable condition
 - hold components securely without distortion
 - leave the work area and machine in a safe and appropriate condition on completion of the activities
- 1.3 follow the correct specifications for the component to be produced
- 1.4 prepare one of the following types of grinding machine in readiness for production:
- horizontal surface
 - vertical surface
 - external cylindrical
 - internal cylindrical
 - universal
 - centreless
 - thread grinding
- 1.5 determine what has to be done and how the machine will be set to achieve this
- 1.6 prepare gear grinding wheels to include carrying out two of the following:
- dressing and 'trueing up' grinding wheels
 - wheel forming (such as chamfers, radii, angular forms, profiles)
 - relieving the wheel sides
 - dressing and 'trueing up' control wheels
- 1.7 mount and set the required workholding devices, workpiece and cutting tools
- 1.8 position and secure workpieces using four of the following workholding methods and devices:
- chucks
 - collets
 - centres
 - face plate
 - machine vices
 - power chucks
 - clamps
 - angle plates
 - vee blocks
 - work rests
 - control stops
 - fixtures
 - injector mechanisms
 - magnetic blocks
 - pots
- 1.9 select and mount grinding wheels, to include all of the following:
- selecting grinding wheels for specific materials and applications (such as grain size, grade, structure, bond)

- mounting wheels (such as paper washers, flanges, locking pressure)
 - testing wheels for cracks
 - balancing wheels, where appropriate
- 1.10 set the machine tool operating parameters to achieve the component specification
- 1.11 set up grinding machines to grind six of the following forms, as applicable to the machine type:
- flat faces
 - vertical faces
 - parallel faces
 - faces square to each other
 - shoulders and faces
 - slots
 - parallel diameters
 - tapered diameters
 - counterbores
 - tapered bores
 - parallel bores
 - profile forms
 - other thread forms
 - vee form threads
 - left hand threads
 - right hand threads
 - single start threads
 - multi-start threads
 - internal threads
 - external threads
 - angular faces
- 1.12 grind components made from one of the following types of material:
- ferrous
 - non-ferrous
 - non-metallic
- 1.13 set the machine to produce components within all of the following quality and accuracy standards, as applicable to the operations performed:
- tolerance to BS 4500 or BS 1916 Grade 5
 - surface texture 8 μin or 0.2 μm
 - components to be free from false grinding cuts, burrs and sharp edges
- 1.14 check that all safety mechanisms are in place and that the equipment is set correctly for the required operations
- 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 set grinding machines for production
Assessment criteria
The learner can: 2.1 describe the specific safety precautions to be taken when setting up workholding devices and grinding wheels on grinding machines (such as cylindrical, internal, surface, centreless and thread grinding) 2.2 describe their duties and responsibilities under The Abrasive Wheels Regulations, with particular reference to the mounting of abrasive wheels 2.3 describe the hazards associated with setting grinding machines (such as moving parts of machinery, sparks/airborne particles, bursting grinding wheels, insecure components), and how to minimise them and reduce any risks 2.4 explain how to start and stop the machine in normal and emergency situations 2.5 describe the importance of ensuring that the machine is isolated from the power supply before mounting grinding wheels and workholding devices 2.6 describe the importance of wearing the appropriate protective clothing and equipment, and of keeping the work area clean and tidy 2.7 describe the basic operation of the various grinding machines, and typical operations that they can perform 2.8 explain how to handle and store grinding wheels safely and correctly 2.9 explain how to extract and use information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS, ISO or BSEN standards) in relation to work undertaken 2.10 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing 2.11 describe the terminology used in grinding in relation to the activities undertaken 2.12 describe the range of workholding methods and devices that are used on grinding machines 2.13 describe the methods of mounting and setting the workpiece in/on the workholding devices, and the tools and equipment that can be used 2.14 describe the various grinding operations that are used to produce the required profiles, and the types of wheels that are used 2.15 explain how to check that the grinding wheels are in a safe and serviceable condition (such as free from damage, cracks, correctly balanced) 2.16 describe the methods of mounting and securing the grinding wheels to the machine spindles 2.17 describe the methods of forming the wheels to the required profile (such as use of pantograph, diamond dressing units, thread crushing rolls) 2.18 describe the need for 'trueing up' and dressing of wheels to

- prevent glazing and burning of workpiece
- 2.19 explain how to set up the various machines for the particular operations being performed
 - 2.20 explain how the various types of material will affect the feeds and speeds that can be used
 - 2.21 describe the application of cutting fluids with regard to a range of different materials
 - 2.22 describe the need to conduct trial runs, and to check that the machine is set up and running safely and correctly
 - 2.23 describe the problems that can occur with setting up of the grinding wheels, workholding devices and machine operating parameters, and what to do if problems occur
 - 2.24 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 323

Machining components using grinding machines

UAN:	Y/600/5458
Level:	3
Credit value:	77
GLH:	161
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 23: Machining Components using Grinding Machines (Level 3).
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out grinding operations, using machines such as horizontal and vertical surface grinding, external cylindrical, internal cylindrical, universal, centreless, profile and thread grinding machines, in accordance with approved procedures. The learner will be required to check that the machine is ready for the operations to be performed, and that all the required components, consumables and measuring equipment is available. The learner will be expected to grind a range of component shapes, such as internal and external parallel, stepped and tapered diameters, flat, parallel, square and angular faces, steps, slots, radii, chamfers, threads and special forms.</p> <p>The learner must operate the machine in line with safe working practices and approved procedures, and continuously monitor the grinding operations, making any necessary adjustments to settings in order to ensure that the work output is to the required quality and accuracy. Meeting production targets will be an important issue, and their production records must show consistent and satisfactory performance.</p> <p>The learner's responsibilities will require them to comply with organisational policy</p>

and procedures for the grinding activities undertaken, and to report any problems with the grinding equipment or grinding activities that they cannot personally resolve, or 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 produce.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying grinding procedures. The learner will understand the grinding process undertaken, and its application, and will know about the equipment, materials and consumables, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

The learner will understand the safety precautions required when working with the grinding machine and its associated grinding wheels 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. machine components using grinding machines
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 they apply all of the following during the machining activities: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, drawings, quality control documentation)• adhere to procedures or systems in place for risk assessment, COSHH, Personal Protective Equipment and other relevant safety regulations and procedures to realise a safe system of work• ensure that machine guards are in place and correctly adjusted• hold components securely without distortion• maintain grinding wheels in a safe and usable condition• apply safe working practices at all times• adjust machine settings, as required, to maintain the required accuracy

- ensure that components produced meet specification
 - leave the work area and machine in a safe and appropriate condition on completion of the activities
- 1.3 confirm that the machine is set up and ready for the machining activities to be carried out
- 1.4 operate two of the following types of grinding machine:
- horizontal surface
 - vertical surface
 - external cylindrical
 - internal cylindrical
 - universal
 - centreless
 - thread grinding
 - profile grinding
- 1.5 manipulate the machine tool controls safely and correctly in line with operational procedures
- 1.6 produce components to the required quality and within the specified dimensional accuracy
- 1.7 finish grind components which include six of the following features:
- flat faces
 - vertical faces
 - parallel faces
 - faces square to each other
 - shoulders and faces
 - slots
 - parallel diameters
 - tapered diameters
 - counter bores
 - tapered bores
 - parallel bores
 - profile forms
 - other thread forms
 - vee form threads
 - left hand threads
 - right hand threads
 - single start threads
 - multi-start threads
 - internal threads
 - external threads
 - angular faces
- 1.8 produce components with dimensional accuracy, form and surface texture within all the following standards:
- tolerance to BS 4500 or BS 1916 Grade 5
 - surface texture 8 μin or 0.2 μm
 - components to be free from false grinding cuts, burrs and sharp edges
- 1.9 grind components made from one of the following types of

material:

- ferrous
- non-ferrous
- non-metallic

1.10 carry out quality sampling checks at suitable intervals

1.11 carry out the necessary checks for accuracy during production of at least four of the following:

- dimensions
- parallelism
- squareness
- profile
- concentricity
- thread form
- surface texture
- angle/taper
- ovality/lobbing

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

1.13 shut down the equipment to a safe condition on conclusion of the machining activities.

Learning outcome

The learner will:

2. know how to machine components using grinding machines

Assessment criteria

The learner can:

2.1 describe the safe working practices and procedures to be followed while operating grinding machines

2.2 describe their duties and responsibilities under The Abrasive Wheels Regulations, with particular reference to the mounting of abrasive wheels

2.3 describe the hazards associated with carrying out the grinding operations (such as moving machine parts, sparks/airborne particles, bursting grinding wheels, insecure workpieces), and how they can be minimised

2.4 describe the safety mechanisms on the machine, and the procedure for checking that they function correctly

2.5 describe the operation of the machine controls in both hand and power modes, and how to stop the machine in an emergency

2.6 describe the Personal Protective Equipment to be worn, and where this can be obtained

2.7 describe the importance of keeping the work area clean and tidy

2.8 explain where to obtain the component drawings, specifications and/or job instructions required for the components to be machined

2.9 explain how to extract and use information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS, ISO or BSEN standards) in relation to work undertaken

2.10 explain how to interpret first and third angle drawings, imperial and

metric systems of measurement, workpiece reference points and system of tolerancing

- 2.11 describe the terminology used in grinding in relation to the activities undertaken
- 2.12 describe the various grinding operations that are used to produce the required forms, and the types of grinding wheels used
- 2.13 explain how to dress and reshape grinding wheels, and the equipment to be used
- 2.14 describe the methods that can be used to position the workpiece in relation to the grinding wheel
- 2.15 describe the importance of checking the concentricity and/or position/alignment of the workpiece before grinding, and the tools and equipment that are used
- 2.16 describe the effects of backlash in machine slides and screws, and how this can be overcome
- 2.17 explain how to handle and store grinding wheels safely and correctly
- 2.18 describe the factors which affect the selection of grinding wheel feeds and speeds, and the depth of cut that can be taken (such as wheel size, material type, finish and tolerance required)
- 2.19 describe the application of roughing and finishing cuts, and the effect on wheel life, surface finish and dimensional accuracy
- 2.20 describe the reason for using cutting fluids, and the type of fluid used
- 2.21 describe the effects of clamping the workpiece, and how this can cause distortion in the finished components
- 2.22 explain how to recognise grinding faults and identify when grinding wheels need re-dressing/forming
- 2.23 describe the quality control procedures used, inspection checks to be carried out, and the equipment to be used
- 2.24 describe the problems that can occur with the grinding activities, and how these can be overcome
- 2.25 describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve.

Unit 324

Setting honing and lapping machines for production

UAN:	L/600/5473
Level:	3
Credit value:	78
GLH:	175
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 24: Setting Honing and Lapping Machines for Production (Level 3).
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to prepare and set up honing and lapping machines, such as horizontal, vertical honing machines, rotary and reciprocal lapping machines, in accordance with approved procedures. This involves selecting the appropriate workholding devices, and mounting and positioning them to the machine in the correct location for the type of operation being carried out. The learner will be expected to select the appropriate honing mandrels, stones, discs and grit to use, check them for defects and mount and secure them to the machine spindle. The learner will also be expected to mount the workpiece, and to check that it is correctly positioned and aligned before starting the honing or lapping operations.</p> <p>The learner must set up the appropriate mechanisms, stops and controls for stroke lengths, stroke over-run, speed of stroke, RPM, and stone pressure, as applicable for the particular operations and machine type used. Making adjustments to settings to achieve specification, and solving machine-related problems during production, will also form part of their role.</p> <p>The learner's responsibilities will require them to comply with organisational policy</p>

and procedures for the machine setting activities undertaken, and to report any problems with the honing and lapping machines, equipment or setting up activities that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to the setting up procedures used. The learner will understand the honing and lapping machines used, and their application, and will know about the workholding devices, honing stones, equipment, relevant materials, consumables and setting up procedures, in adequate depth to provide a sound basis for carrying out the activities, correcting faults and ensuring the work output is to the required specification.

The learner will understand the safety precautions required when working with the machines and their 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. set honing and lapping machines for production
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 carry out all of the following activities during setting up: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, drawings, quality control documentation)• adhere to procedures or systems in place for risk assessment, COSHH, Personal Protective Equipment and other relevant safety regulations and procedures to realise a safe system of work• follow safe practice/approved setting up procedures at all times• ensure that correctly adjusted machine guards are in place• check that the honing stones or discs are in a usable condition

- hold components securely without distortion
 - leave the work area and machine in a safe and appropriate condition on completion of the activities
- 1.3 follow the correct specifications for the component to be produced
- 1.4 determine what has to be done and how the machine will be set to achieve this
- 1.5 prepare one of the following types of honing or lapping machine in readiness for production:
- horizontal honing
 - vertical honing
 - rotary disc lapping
 - reciprocating machines
- 1.6 prepare honing or lapping machines, to include all the following, as applicable to the machine type:
- RPM or reciprocating speed
 - stroke length
 - stroke over-run length
 - stroke speed
 - stone or disc pressure
- 1.7 mount and set the required workholding devices, workpiece and cutting tools
- 1.8 position and secure workpieces, using four of the following workholding methods and devices:
- chucks
 - collets
 - pots
 - vee-blocks
 - magnetic chucks
 - magnetic blocks
 - face plate
 - clamps
 - jigs/fixtures
 - angle plates
- 1.9 select, prepare and mount all the following for honing machines:
- selecting mandrels and wedges to suit bore size and through or blind hole
 - selecting honing stones for specific materials and applications (roughing, finishing, polishing)
 - checking stones for damage
- or:** select, prepare and mount all the following for lapping machines:
- selecting discs/pads for specific materials and applications (roughing, finishing, polishing)
 - selecting appropriate grits for specific materials and applications (roughing, finishing, polishing)
 - checking discs for damage
- 1.10 set the machine tool operating parameters to achieve the component specification
- 1.11 set up honing machines to finish two of the following features:

<ul style="list-style-type: none"> • through holes • blind holes • tapered holes <p>or: set up lapping machines to finish all of the following features:</p> <ul style="list-style-type: none"> • flat faces • parallel faces • angular faces <p>1.12 hone or lap components made from one of the following types of material:</p> <ul style="list-style-type: none"> • ferrous • non-ferrous <p>1.13 set the machine to produce components within all of the following quality and accuracy standards, as applicable to the operations performed:</p> <ul style="list-style-type: none"> • tolerance to BS 4500 or BS 1916 Grade 5 • surface texture 8 µin or 0.2µm • components to be free from stone marks, burrs and sharp edges <p>1.14 check that all safety mechanisms are in place and that the equipment is set correctly for the required operations</p> <p>1.15 deal promptly and effectively with problems within their control and report those that cannot be solved.</p>

Learning outcome
The learner will:
2. know how to set honing and lapping machines for production
Assessment criteria
The learner can:
2.1 describe the specific safety precautions to be taken when setting up workholding devices and honing/lapping equipment on machines (such as horizontal, vertical, rotary disc and reciprocating honing and lapping machines)
2.2 describe the hazards associated with setting honing and lapping (such as moving parts of machinery, airborne particles, insecure components), and how to minimise them and reduce any risks
2.3 explain how to start and stop the machine in normal and emergency situations
2.4 describe the importance of ensuring that the machine is isolated from the power supply before mounting honing mandrels, stones and workholding devices
2.5 describe the importance of wearing the appropriate protective clothing and equipment, and of keeping the work area clean and tidy
2.6 describe the basic operation of the various honing and lapping machines, and typical operations that they can perform
2.7 explain how to handle and store honing and lapping equipment and stones safely and correctly
2.8 explain how to extract and use information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS, ISO or BSEN standards) in relation to work undertaken

- 2.9 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing
- 2.10 describe the terminology used in honing and lapping in relation to the activities undertaken
- 2.11 describe the range of workholding methods and devices that are used on honing and lapping machines
- 2.12 describe the methods of mounting and setting the workpiece in/on the workholding devices, and the tools and equipment that can be used
- 2.13 describe the various honing and lapping operations that are used to produce the required profiles, and the types of stones, discs and grits that are used
- 2.14 explain how to check that the honing mandrels, wedges and stones are in a safe and serviceable condition (such as free from damage, correct type, correctly fitted and secured)
- 2.15 describe the methods of mounting and securing the mandrels and discs to the machine spindles
- 2.16 explain how to set up the various machines for the particular operations being performed (such as stroke length, stroke speed, rpm, stone pressure)
- 2.17 explain how the various types of material will affect the feeds and speeds that can be used
- 2.18 describe the application of cutting fluids with regard to a range of different materials
- 2.19 describe the filtration requirements, and how to recognise when filters require changing/cleaning
- 2.20 describe the need to conduct trial runs, and to check that the machine is set up and running safely and correctly
- 2.21 describe the problems that can occur with setting up of the honing and lapping equipment, workholding devices and machine operating parameters, and what to do if problems occur
- 2.22 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 325

Machining components using honing and lapping machines

UAN:	L/600/5487
Level:	3
Credit value:	33
GLH:	119
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 25: Machining Components using Honing and Lapping Machines (Level 3).
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out honing and lapping operations using horizontal or vertical honing machines and lapping machines, in accordance with approved procedures. The learner will be required to check that the machine is ready for the operations to be performed, and that all the required components, consumables and measuring equipment is available. The learner will be expected to hone/lap a range of components, which will include through holes, blind holes and flat surfaces.</p> <p>The learner must operate the machine in line with safe working practices and approved procedures, and continuously monitor the honing and lapping operations, making any necessary adjustments to settings, in order to ensure that the work output is to the required quality and accuracy. Meeting production targets will be an important issue, and their production records must show consistent and satisfactory performance.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the honing and lapping activities undertaken, and to report any problems with the equipment or activities that they cannot resolve, or are outside their</p>

permitted authority, to the relevant people. The learner will be expected to work with minimum supervision, taking personal responsibility for their actions and for the quality and accuracy of the work that they produce.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying honing and lapping procedures. The learner will understand the honing and lapping process undertaken, and its application, and will know about the equipment, materials and consumables, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

The learner will understand the safety precautions required when working with the machine and its 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. machine components using honing and lapping machines
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 they apply all of the following checks and practices at all times during the machining activities: <ul style="list-style-type: none">• appropriate machine guards are in place and correctly adjusted• components are held securely without distortion• honing stones or discs are maintained in a usable condition• safe working practices are observed• machine settings are adjusted, as necessary, to maintain the required accuracy• components produced meet specification 1.3 confirm that the machine is set up and ready for the machining activities to be carried out 1.4 operate one of the following types of honing or lapping machine: <ul style="list-style-type: none">• horizontal honing• vertical honing• rotary disc lapping• reciprocating machine 1.5 manipulate the machine tool controls safely and correctly in line

<p>with operational procedures</p> <p>1.6 produce components to the required quality and within the specified dimensional accuracy</p> <p>1.7 rough, finish and polish components which include two of the following (for honing machines):</p> <ul style="list-style-type: none"> • through holes • blind holes • tapered holes <p>or: rough, finish and polish components which include all of the following (for lapping machines):</p> <ul style="list-style-type: none"> • flat faces • parallel faces • angular faces <p>1.8 produce components with dimensional accuracy, form and surface texture within all of the following standards:</p> <ul style="list-style-type: none"> • tolerance to BS 4500 or BS 1916 Grade 5 • surface texture 8 μin or 0.2 μm • components to be free from stone/disc marks, burrs and sharp edges <p>1.9 hone and lap components made from one of the following types of material:</p> <ul style="list-style-type: none"> • ferrous • non-ferrous <p>1.10 carry out quality sampling checks at suitable intervals</p> <p>1.11 carry out all of the following checks during production for accuracy (using honing machines):</p> <ul style="list-style-type: none"> • dimensions • parallelism • surface texture • ovality/lobing <p>or: carry out all of the following checks during production for accuracy (using lapping machines):</p> <ul style="list-style-type: none"> • dimensions • parallelism • surface texture • flatness <p>1.12 deal promptly and effectively with problems within their control and report those that cannot be solved</p> <p>1.13 shut down the equipment to a safe condition on conclusion of the machining activities.</p>
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Learning outcome
The learner will:
2. know how to machine components using honing and lapping machines
Assessment criteria
The learner can:
2.1 describe the safe working practices and procedures to be followed while operating honing and lapping machines

- 2.2 describe the hazards associated with the honing and lapping operations (such as moving machine parts, airborne particles, insecure workpieces), and how they can be minimised
- 2.3 describe the safety mechanisms on the machine, and the procedure for checking that they function correctly
- 2.4 describe the operation of the machine controls in both hand and power modes, and how to stop the machine in an emergency
- 2.5 describe the Personal Protective Equipment to be worn, and where this can be obtained
- 2.6 describe the importance of keeping the work area clean and tidy
- 2.7 explain where to obtain the component drawings, specifications and/or job instructions required for the components to be machined
- 2.8 explain how to extract and use information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS or ISO standards) in relation to work undertaken
- 2.9 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing
- 2.10 describe the terminology used in honing and lapping in relation to the activities undertaken
- 2.11 describe the various honing and lapping operations that are used to produce the required forms, and the types of stones and abrasives used
- 2.12 describe the methods that can be used to position the workpiece in relation to the honing mandrel
- 2.13 describe the importance of checking the concentricity and/or position/alignment of the workpiece before honing, and the tools and equipment that are used
- 2.14 explain how to adjust the equipment to correct taper in bores and achieve workpiece tolerances
- 2.15 explain how to handle and store honing and lapping stones and equipment safely and correctly
- 2.16 describe the factors which affect the selection of honing and lapping stroke speeds, rpm and stone pressures (stock removal, material type, finish and tolerance required)
- 2.17 describe the application of roughing and finishing cuts, and the effect on stone life, surface finish and dimensional accuracy
- 2.18 describe the reason for using cutting fluids; the type of fluid used and filtration requirements
- 2.19 describe the effects of clamping the workpiece, and how this can cause distortion in the finished components
- 2.20 explain how to recognise honing and lapping faults and identify when stones need replacing
- 2.21 describe the quality control procedures used, inspection checks to be carried out, and the equipment to be used
- 2.22 describe the problems that can occur with the honing and lapping activities, and how these can be overcome
- 2.23 describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve.

Unit 326

Setting broaching machines for production

UAN:	L/600/5490
Level:	3
Credit value:	78
GLH:	175
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 26: Setting Broaching Machines for Production (Level 3).
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to prepare and set up horizontal and/or vertical broaching machines for production, in accordance with approved procedures. This will involve selecting the appropriate workholding devices and securing them to the machine, and mounting and setting the workpiece in correct relationship to the broaching tool. The learner will be expected to select the appropriate broaching tools, check that they are in a usable condition, and mount and secure them to the relevant tool holding devices.</p> <p>The learner will also need to set the machine operating parameters to produce the workpiece to the required specification. This will involve setting the appropriate stroke length, pulling pressure and feed required. The learner must produce trial cuts and prove that the machine is working satisfactorily before declaring the machine ready for production. Making adjustments to settings to achieve specification, and solving machine-related problems during production, will also form part of their role.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the machine setting activities undertaken, and to report any problems with the machine, tooling,</p>

equipment or setting up activities that they cannot personally resolve, or 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 of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to the setting up procedures used. The learner will understand the broaching machine used and its application, and will know about the workholding devices, broaching tools, relevant materials, consumables and setting up procedures, in adequate depth to provide a sound basis for carrying out the activities, correcting faults and ensuring the work output is produced to the required specification.

The learner will understand the safety precautions required when working with the machine and its 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. set broaching machines for production
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 carry out all of the following activities during setting up: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, drawings, quality control documentation)• adhere to procedures or systems in place for risk assessment, COSHH, Personal Protective Equipment and other relevant safety regulations and procedures to realise a safe system of work• follow safe practice/approved setting up procedures at all times• ensure that correctly adjusted machine guards are in place• check that broaching tools are in a safe and usable condition• hold components securely without distortion• leave the work area and machine in a safe and appropriate condition on completion of the activities

- 1.3 follow the correct specifications for the component to be produced
- 1.4 set the machine to produce components within all of the following quality and accuracy standards, as applicable to the operations performed:
 - dimensional tolerance equivalent to BS 4500 or BS 1916 Grade 7
 - surface finish 63 μm or 1.6 μm
 - components to be free from false tool cuts, burrs and sharp edges
- 1.5 determine what has to be done and how the machine will be set to achieve this
- 1.6 set up one of the following types of machine:
 - horizontal broaching machine
 - vertical broaching machine
- 1.7 mount and set the required workholding devices, workpiece and cutting tools
- 1.8 set up the workpiece and broach, to include all of the following:
 - selecting and setting the appropriate work holding device
 - locating and, where appropriate, securing the workpiece in the holding device
 - fitting and aligning the appropriate broach
 - aligning the workpiece in relationship to machine axis
- 1.9 set the machine tool operating parameters to achieve the component specification
- 1.10 set up machine in accordance with instructions and specifications, to include setting all of the following:
 - stroke position and length mechanisms
 - machine guards/safety mechanisms
 - broach pulling pressure
 - cutting fluid flow rate
 - stroke speed/feed
- 1.11 set up the machine to produce internal and external profiles that include four of the following:
 - keyways
 - flat sided holes
 - square holes
 - hexagonal holes
 - octagonal holes
 - splines
 - serrations
 - other/special forms
- 1.12 machine components made from one type of material from the following:
 - ferrous
 - non-ferrous
 - non-metallic
- 1.13 check that all safety mechanisms are in place and that the equipment is set correctly for the required operations
- 1.14 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 set broaching machines for production

Assessment criteria

The learner can:

- 2.1 describe the specific safety precautions to be taken when setting up workholding devices and accessories, workpiece and broaching tools
- 2.2 describe the hazards associated with setting broaching machines (such as moving parts of machinery, handling broaching tools, handling cutting fluids, tool breakage, insecure components), and how to minimise them and reduce any risks
- 2.3 explain how to start and stop the machine in normal and emergency situations
- 2.4 describe the importance of ensuring that the machine is isolated from the power supply before mounting broaching tools and workholding devices
- 2.5 describe the importance of wearing the appropriate protective clothing and equipment, and of keeping the work area clean and tidy
- 2.6 describe the basic principles of operation of the broaching machine and its accessories, and typical operations that they can perform
- 2.7 explain how to handle and store broaching tools safely and correctly
- 2.8 explain how to extract and use information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS, ISO or BSEN standards) in relation to work undertaken
- 2.9 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing
- 2.10 describe the terminology used in broaching in relation to the activities undertaken
- 2.11 describe the range of workholding methods and devices that are used on broaching machines (jigs and fixtures, direct clamping to machine table)
- 2.12 describe the methods of mounting and setting the workpiece in/on the workholding devices, and the tools and equipment that can be used
- 2.13 describe the different types of broaching tools that are used, and how they are selected, prepared and mounted to the machine tool holding devices
- 2.14 describe the factors which determine pulling pressure and feeds to be used (such as material, type of tooling, machine condition, tolerance and finish required)
- 2.15 explain how the various types of materials will affect the feeds that can be used
- 2.16 describe the types of cutting fluid that are used, and precautions to be taken when handling and using them
- 2.17 explain how to set up the broaching machine and its accessories for the particular operations being performed (such as setting stroke

length, stroke position, pulling pressure and feed required)

- 2.18 describe the need to conduct trial runs, and to check that the machine is set up and producing the components correctly
- 2.19 describe the problems that can occur with setting up the workholding devices, tooling and machine operating parameters, and what to do if problems occur
- 2.20 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 327

Machining components using broaching machines

UAN:	A/600/5503
Level:	3
Credit value:	33
GLH:	119
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 27: Machining Components using Broaching Machines (Level 3).
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out broaching operations using horizontal or vertical broaching machines, in accordance with approved procedures. The learner will be required to check that the machine is ready for the operations to be performed and that all the required components/materials and consumables are available. The learner will be expected to produce a range of components that contain features such as keyways, square holes, hexagonal and octagonal holes, holes with one flat, splines, serrations, and special forms.</p> <p>The learner will be required to operate the machine in line with safe working practices and approved procedures, and to continuously monitor the machining operations, making any necessary adjustments in order to ensure that the work output is to the required quality and accuracy. Meeting production targets will be an important issue, and their production records must show consistent and satisfactory performance.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the machining activities undertaken, and to report any problems with</p>

the machining activities that they cannot personally resolve, or 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 produce.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying machining procedures. The learner will understand the broaching process, and its application, and will know about the equipment, materials and consumables, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

The learner will understand the safety precautions required when working with the machine and its 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. machine components using broaching machines
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 they apply all of the following during the machining activities: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, drawings, quality control documentation)• adhere to procedures or systems in place for risk assessment, COSHH, Personal Protective Equipment and other relevant safety regulations and procedures to realise a safe system of work• ensure that machine guards are in place and correctly adjusted• hold components securely without distortion• maintain cutting tools in a suitable condition• apply safe working practices at all times• adjust machine settings, as required, to maintain the required accuracy ensure that components produced meet specification• leave the work area and machine in a safe and appropriate condition on completion of the activities

- 1.3 confirm that the machine is set up and ready for the machining activities to be carried out
- 1.4 operate one type of machine from the following:
 - horizontal broaching machine
 - vertical broaching machine
- 1.5 manipulate the machine tool controls safely and correctly in line with operational procedures
- 1.6 produce components to the required quality and within the specified dimensional accuracy
- 1.7 produce machined components which cover four of the following:
 - keyways
 - flat sided holes
 - square holes
 - hexagonal holes
 - octagonal holes
 - splines
 - serrations
 - other/special forms
- 1.8 machine components made from one type of material from the following:
 - ferrous
 - non-ferrous
 - non-metallic
- 1.9 produce components within all the relevant quality and accuracy standards:
 - dimensional tolerance equivalent to BS 4500 or BS 1916 Grade 7
 - surface finish 63 μm or 1.6 μm
 - components to be free from false tool cuts, burrs and sharp edges
- 1.10 carry out quality sampling checks at suitable intervals
- 1.11 carry out the necessary checks during production for accuracy of five of the following:
 - dimensions
 - squareness
 - spline/serration fit
 - surface finish
 - keyway width
 - keyway position
- 1.12 deal promptly and effectively with problems within their control and report those that cannot be solved
- 1.13 shut down the equipment to a safe condition on conclusion of the machining activities.

Learning outcome
The learner will: 2. know how to machine components using broaching machines
Assessment criteria
The learner can: 2.1 describe the safe working practices and procedures to be followed while operating broaching machines 2.2 describe the safety mechanisms on the machine, and the procedure for checking that they function correctly 2.3 describe the operation of the machine controls in both hand and power modes, and how to stop the machine in an emergency 2.4 describe the Personal Protective Equipment to be worn, and where this can be obtained 2.5 describe the hazards associated with carrying out the broaching operations (such as moving parts of machines, handling broaches, handling cutting oils, insecure components, breakages of broaches), and how they can be minimised 2.6 describe the importance of keeping the work area clean and tidy 2.7 explain where to obtain the component drawings, specifications and/or job instructions required for the components to be machined 2.8 explain how to extract and use information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS, ISO or BSEN standards) in relation to work undertaken 2.9 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing 2.10 describe the various broaching techniques that can be used to produce the required shapes, and the types of broaches used (such as roughing and finishing broaches, high speed steel and tipped broaches) 2.11 describe the methods that can be used to position the workpiece in relation to the broach 2.12 explain how to handle and store broaches safely and correctly 2.13 describe the factors which affect the selection of broaching speeds (such as workpiece rigidity, machine condition, type of broach being used, material type, finish and tolerance required) 2.14 explain how the various types of materials will affect the broaching feeds that can be used 2.15 describe the application of cutting fluids with regard to a range of different materials 2.16 describe the effects of clamping the workpiece, and how this can cause distortion in the finished components 2.17 explain how to recognise broaching faults and identify when tools need re-sharpening 2.18 describe the quality control procedures used, inspection checks to be carried out, and the equipment to be used 2.19 describe the problems that can occur with the broaching activities, and how these can be overcome 2.20 describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve.

Unit 328

Setting metal spinning machines for production

UAN:	D/600/5509
Level:	3
Credit value:	78
GLH:	175
Relationship to NOS:	This unit is linked to the Semta National Occupational Standards Mechanical Manufacturing Engineering Unit 28: Setting metal spinning machines for production (Level 3).
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to prepare and set up metal spinning machines and metal spinning equipment, in accordance with approved procedures. This involves selecting the appropriate workholding devices, and mounting and positioning them to the machine in the correct location for the type of operation being carried out. The learner will also be expected to select the appropriate metal spinning tools and forming devices, check them for defects, and mount and secure them to the relevant tool holding device or forming device.</p> <p>The learner will also be expected to set up and align the workpiece in the correct relationship to the machine spindle, and to set the machine operating parameters to produce the workpiece to the required specification. The learner must carry out trial forming, and prove the machine is working satisfactorily before declaring the installation ready for production. Making adjustments to settings to achieve specification, and solving machine-related problems during production, will also form part of their role.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the machine setting</p>

activities undertaken, and to report any problems with the machine, forming device, tools, equipment or setting up activities that they cannot personally resolve, or 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 of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to the setting up procedures used. The learner will understand the metal spinning machine used, and its application, and will know about the workholding devices, forming tools, relevant materials, consumables and setting up procedures, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

The learner will understand the safety precautions required when working with the machine and its 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. set metal spinning machines for production
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 carry out all of the following activities during setting up: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, drawings, quality control documentation)• adhere to procedures or systems in place for risk assessment, COSHH, Personal Protective Equipment and other relevant safety regulations and procedures to realise a safe system of work• follow safe practice/approved setting up procedures at all times• ensure that correctly adjusted machine guards are in place• check that the metal spinning tools and cutters are in a safe and usable condition• hold components securely without distortion• leave the work area and machine in a safe and appropriate

- condition on completion of the activities
- 1.3 follow the correct specifications for the component to be produced
 - 1.4 set the machine to produce components within all of the following quality and accuracy standards, as applicable to the operations performed:
 - dimensional tolerance equivalent to BS 4500 or BS 1916 Grade 9
 - surface finish $63\mu\text{in}$ or $1.6\mu\text{m}$
 - angles/tapers within ± 0.5 degree
 - shape and form comply with template and/or specification requirements
 - components to be free from ripples, deformity, burrs and sharp edges
 - 1.5 determine what has to be done and how the machine will be set to achieve this
 - 1.6 prepare one of the following metal spinning machines in readiness for production:
 - hand spinning
 - special purpose spinning
 - power spinning
 - 1.7 mount and set the required workholding devices, workpiece and cutting tools
 - 1.8 select forming device or method, to include four of the following:
 - plain formers
 - segmental formers
 - split formers
 - top slide-mounted rollers
 - tailstock-mounted back plates
 - pre-forms
 - on-air
 - 1.9 select and mount metal spinning tools and cutters, to include four of the following:
 - finishing rollers
 - rough forming rollers
 - burnishing tools/skimbers
 - trimming/cutting tools
 - handheld metal/wooden spinning tools
 - power spinning tools and cutters
 - 1.10 set the machine tool operating parameters to achieve the component specification
 - 1.11 set up the machine in accordance with instructions and specifications, to include setting all of the following:
 - forming template/jig
 - workpiece
 - forming tool work rests
 - forming tools in tool holding devices
 - machine guards/safety mechanisms
 - feed rates (where appropriate)

<ul style="list-style-type: none"> • spindle speeds <p>1.12 set up the machine to rough and finish internal and external forms, that must include ten of the following:</p> <ul style="list-style-type: none"> • convex shapes • concave shapes • bulging/necking • flanges • lipping • hemispheres • re-entrant • trimming • cones • cylinders • joints and joining • double seaming • beading <p>1.13 make components from one of the following types of material:</p> <ul style="list-style-type: none"> • ferrous • non-ferrous <p>1.14 check that all safety mechanisms are in place and that the equipment is set correctly for the required operations</p> <p>1.15 deal promptly and effectively with problems within their control and report those that cannot be solved.</p>
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Learning outcome
The learner will: 2. know how to set metal spinning machines for production
Assessment criteria
The learner can: 2.1 describe the specific safety precautions to be taken when setting up workholding devices, tools and cutters on metal spinning machines 2.2 describe the hazards associated with setting metal spinning machines (such as moving parts of machinery, handling tools and cutters, lifting and moving workpieces, tool breakage, insecure components), and how to minimise them and reduce any risks 2.3 explain how to start and stop the machine in normal and emergency situations 2.4 describe the importance of ensuring that the machine is isolated from the power supply before mounting tools, workpieces and workholding devices 2.5 describe the importance of wearing the appropriate protective clothing and equipment, and of keeping the work area clean and tidy 2.6 describe the basic principles of operation of the metal spinning machine, and typical operations that it can perform 2.7 explain how to handle and store forming tools and cutters safely and correctly 2.8 explain how to extract and use information from engineering drawings and related specifications (to include symbols and

- conventions to appropriate BS, ISO or BSEN standards) in relation to work undertaken
- 2.9 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing
 - 2.10 describe the terminology used in metal spinning in relation to the activities undertaken
 - 2.11 describe the range of workholding methods and devices that are used on metal spinning machines
 - 2.12 describe the methods of mounting and setting the workpiece on the workholding device, and the tools and equipment that can be used
 - 2.13 describe the different types of metal spinning tools and cutters that are used, and how they are selected, prepared and mounted to the machine tool holding devices
 - 2.14 describe the factors which determine speeds to be used (such as material, type of forming tool used, workpiece rigidity, operation being performed, tolerance and finish required)
 - 2.15 explain how the various types of materials will affect the speeds and forming pressures that can be used
 - 2.16 explain how to set up the machine for the particular operations being performed
 - 2.17 describe the need to conduct trial runs, and to check that the machine is set up and running safely and correctly
 - 2.18 describe the problems that can occur with setting up the metal spinning tools and cutters, workholding devices and machine operating parameters, and what to do if problems occur
 - 2.19 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 329

Producing components using metal spinning machines

UAN:	K/600/5514
Level:	3
Credit value:	77
GLH:	161
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 29: Producing Components using Metal Spinning Machines (Level 3).
Assessment requirements specified by a sector or regulatory body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out metal spinning operations, in accordance with approved procedures, using metal spinning machines and associated metal spinning attachments. The learner will be required to check that the machine is ready for the operations to be performed, and that all the required components or materials and consumables are available. The learner will be expected to produce a range of components that combine a number of different features, such as roughing and finishing forms, producing concave and convex profiles, cones, cylinders, hemispheres, re-entrant, bulging/necking, lipping, beading, flanging, joins and jointing, double seaming and trimming operations.</p> <p>The learner will be required to operate the machine in line with safe working practices and approved procedures, and to continuously monitor the spinning operations, making any necessary adjustments, in order to ensure that the work output is to the required quality and accuracy. Meeting production targets will be an important issue, and their production records must show consistent and satisfactory performance.</p>

The learner's responsibilities will require them to comply with organisational policy and procedures for the spinning activities undertaken, and to report any problems with the spinning activities, equipment or forming tools that they cannot personally resolve, or 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 produce.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying metal spinning procedures. The learner will understand the metal spinning process, and its application, and will know about the equipment, materials and consumables, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

The learner will understand the safety precautions required when working with the machine and its 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. produce components using metal spinning machines
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 they apply all of the following during the spinning activities: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, drawings, quality control documentation)• adhere to procedures or systems in place for risk assessment, COSHH, Personal Protective Equipment and other relevant safety regulations and procedures to realise a safe system of work• ensure that machine guards are in place and correctly adjusted• hold components securely without distortion• maintain forming and cutting tools in a safe and usable condition

- apply safe working practices at all times
 - adjust machine settings, as required, to maintain the required accuracy
 - ensure that components produced meet specification
 - leave the work area and machine in a safe and appropriate condition on completion of the activities
- 1.3 confirm that the machine is set up and ready for the machining activities to be carried out
- 1.4 manipulate the machine tool controls safely and correctly in line with operational procedures
- 1.5 produce components to the required quality and within the specified dimensional accuracy
- 1.6 produce components which combine different operations and which cover ten of the following:
- convex shapes
 - concave shapes
 - bulging/necking
 - flanges
 - cones
 - cylinders
 - joints and joining
 - lipping
 - hemispheres
 - re-entrant
 - trimming
 - double seaming
 - beading
- 1.7 make components from one of the following types of material:
- ferrous
 - non-ferrous
- 1.8 produce components within all of the relevant quality and accuracy standards, as applicable to the operations performed:
- dimensional tolerance equivalent to BS 4500 or BS 1916 Grade 9
 - surface finish 63µin or 1.6µm
 - angles/tapers within +/- 0.5 degree
 - shape and form comply with template and/or specification requirements
 - components to be free from ripples, deformity, burrs and sharp edges
- 1.9 carry out quality sampling checks at suitable intervals
- 1.10 carry out the necessary checks during production for accuracy of five of the following:
- external diameters
 - internal diameters
 - lengths
 - depths
 - angles

<ul style="list-style-type: none"> • profiles • surface finish <p>1.11 deal promptly and effectively with problems within their control and report those that cannot be solved</p> <p>1.12 shut down the equipment to a safe condition on conclusion of the machining activities.</p>

Learning outcome
The learner will: 2. know how to produce components using metal spinning machines
Assessment criteria
The learner can: 2.1 describe the safe working practices and procedures to be followed while operating metal spinning machines 2.2 describe the safety mechanisms on the machine, and the procedure for checking that they function correctly 2.3 describe the operation of the machine controls in both hand and power modes, and how to stop the machine in an emergency 2.4 describe the Personal Protective Equipment to be worn, and where this can be obtained 2.5 describe the hazards associated with carrying out the metal spinning operations, and how to minimise them and reduce any risks 2.6 describe the importance of keeping the work area clean and tidy 2.7 explain where to obtain the component drawings, specifications and/or job instructions required for the components to be machined 2.8 explain how to extract and use information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS, ISO or BSEN standards) in relation to work undertaken 2.9 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing 2.10 describe the application of a range of metal spinning machines and metal spinning attachments 2.11 describe the various metal spinning techniques that can be used to produce the required shapes, and the types of metal spinning formers, cutters and tools required 2.12 describe the methods that can be used to position the workpiece in relation to the metal spinning former, cutters and tools 2.13 explain how to handle and store formers and cutting tools, safely and correctly 2.14 describe the factors which affect the selection of speeds required, and the pressure that can be put on to the workpiece (such as workpiece rigidity, machine condition, type of formers/tooling being used, material type, finish and tolerance required) 2.15 explain how the various types of materials will affect the speeds that can be used 2.16 describe the application of roughing and finishing forms, and the effect on former and tool life, surface finish and dimensional accuracy

- 2.17 describe the effects of clamping the workpiece, and how this can cause distortion in the finished components
- 2.18 describe the effects of displacing material, how this can cause warping/distortion of the workpiece, and how this can be overcome
- 2.19 explain how to recognise spinning faults and identify when forming tools need dressing or sharpening
- 2.20 describe the quality control procedures used, inspection checks to be carried out, and the equipment to be used
- 2.21 describe the problems that can occur with the metal spinning activities, and how these can be overcome
- 2.22 describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve.



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 Mechanical Manufacturing Engineering (1682)

Literacy, language, numeracy and ICT skills development

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

- Functional Skills (England) – see **Functional Skills | City & Guilds (cityandguilds.com)**
- Essential Skills (Northern Ireland) – see **Essential Skills (Northern Ireland) qualifications and training courses | City & Guilds (cityandguilds.com)**
- Essential Skills Wales – see **Skills for Wales - Wales | City & Guilds (cityandguilds.com)**



Appendix 1 Sources of general information

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

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:

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

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

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www.cityandguilds.com

Useful contacts

UK learners

General qualification information

T: +44 (0)844 543 0033

E: learnersupport@cityandguilds.com

International learners

General qualification information

T: +44 (0)844 543 0033

F: +44 (0)20 7294 2413

E: intcg@cityandguilds.com

Centres

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

T: +44 (0)844 543 0000

F: +44 (0)20 7294 2413

E: centresupport@cityandguilds.com

Single subject qualifications

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

T: +44 (0)844 543 0000

F: +44 (0)20 7294 2413

F: +44 (0)20 7294 2404 (BB forms)

E: singlesubjects@cityandguilds.com

International awards

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

T: +44 (0)844 543 0000

F: +44 (0)20 7294 2413

E: intops@cityandguilds.com

Walled Garden

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

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Employer

Employer solutions, Mapping, Accreditation, Development Skills, Consultancy

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Publications

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