

Level 3 NVQ Extended Diploma in Mechanical Manufacturing Engineering (Spring Making) (1712-37)

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 – Spring Making	439	1060	1712-37	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 – spring making 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 (Spring Making)**, 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 **64** credits from a minimum of **4** units from the optional units 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			
F/600/5521	Unit 409	Making compression springs	46

		using hand forming methods	
K/600/5531	Unit 410	Making torsion springs using hand forming methods	46
Y/600/5539	Unit 411	Making extension springs using hand forming methods	46
A/600/5548	Unit 412	Making spring wire forms using hand forming methods	46
D/600/5560	Unit 413	Grinding spring ends by hand	16
H/600/5575	Unit 414	Setting automatic cold wire compression spring making machines for production	46
L/600/5635	Unit 415	Setting automatic cold wire torsion spring making machines for production	46
J/600/5648	Unit 416	Setting automatic cold wire extension spring making machines for production	46
R/600/5653	Unit 417	Setting automatic spring making machines for the production of clock, power, scroll and volute springs	46
M/600/5661	Unit 418	Setting automatic cold wire forming machines to produce spring wire forms	46
D/600/5672	Unit 419	Setting automatic hot wire compression spring making machines for production	46
L/600/5683	Unit 420	Setting automatic spring end grinding machines for production	16
H/600/5687	Unit 421	Programming CNC spring making machines	84
H/600/5690	Unit 422	Setting CNC spring making machines for production	46
T/600/5693	Unit 423	Operating CNC spring making machines	30
F/600/5695	Unit 424	Setting and using a fly press for spring making activities	30
Y/600/5699	Unit 425	Making strip spring components using shearing machines	30
L/600/5702	Unit 426	Forming strip spring components using power rolling machines	30
Y/600/5704	Unit 427	Bending strip spring components using press brakes	30
M/600/5708	Unit 428	Forming strip spring components using power presses	30
M/600/5711	Unit 429	Drilling and finishing holes in strip spring components	16

L/600/5716	Unit 430	Using heat to assist with the bending and forming of spring components	16
D/600/5719	Unit 431	Carrying out heat treatment of springs	30
H/600/5723	Unit 432	Carrying out shot peening of springs	30
M/600/5725	Unit 433	Carrying out quality control of spring making activities	46
M/600/5739	Unit 434	Manufacturing one-off tooling for spring making activities	77
A/600/5744	Unit 435	Setting and operating CNC laser profiling machines for strip spring making	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 (Spring Making)	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, eg tutor and assessor or internal verifier, but cannot internally verify their own assessments.

Assessors and internal verifier

Assessor Requirements to Demonstrate Effective Assessment Practice

Assessment must be carried out by competent Assessors that as a minimum must hold the 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 Semta 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 Semta 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 Semta 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 Unit Assessment Strategy 1 January 2011)

The evidence put forward for this qualification can only be regarded valid, reliable, sufficient and authentic if achieved and obtained in the working environment and be clearly attributable to the learner. However, in certain circumstances, simulation/replication of work activities may be acceptable.

The use of high quality, realistic simulations/replication, which impose pressures which are consistent with workplace expectations, should only be used in relation to the assessment of the following:

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

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

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

Age restrictions

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

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



3 Delivering the qualification

Initial assessment and induction

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

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

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

Recommended delivery strategies

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

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

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

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

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

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

Recording documents

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

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

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

Recording forms are available on the City & Guilds website.

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

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



4 Assessment

Assessment of the qualification

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

Evidence requirements

Carrying Out Assessments

The NVQ units were specifically developed to cover a wide range of activities. The evidence produced for the units will, therefore, depend on the learners choice of “bulleted items” listed in the unit assessment criteria.

Where the assessment criteria gives a choice of bulleted items (for example ‘any three from five’), assessors should note that learners do not need to provide evidence of the other items to complete the unit (in this example, two) items, particularly where these additional items may relate to other activities or methods that are not part of the learners normal workplace activity or area of expertise.

Minimum Performance Evidence Requirements

Performance evidence must be the main form of evidence gathered. In order to demonstrate consistent, competent performance for a unit, a minimum of 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 National Occupational Standards (NOS), other qualifications and frameworks
- Endorsement by a sector or other appropriate body
- Unit aim(s)
- Learning outcomes which are comprised of a number of assessment criteria

Unit 201

Complying with statutory regulations and organisational safety requirements

UAN:	A/601/5013
Level:	2
Credit value:	5
GLH:	35
Relationship to NOS:	This unit has been derived from Semta National occupational standard: Complying with statutory regulations and organisational safety requirements (Suite 2).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	This unit covers the skills and knowledge needed to prove the competences required to deal with statutory regulations and organisational safety requirements. It does not deal with specific safety regulations or detailed requirements, it does, however, cover the more general health and safety requirements that apply to working in an industrial environment.

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

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

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

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

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

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

1.4	follow organisational accident and emergency procedures
1.5	comply with emergency requirements, to include: <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
1.6	recognise and control hazards in the workplace
1.7	identify the hazards and risks that are associated with the following: <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
1.8	use correct manual lifting and carrying techniques
1.9	demonstrate one of the following methods of manual lifting and carrying: <ul style="list-style-type: none"> • lifting alone • with assistance of others • with mechanical assistance
1.10	apply safe working practices and procedures to include: <ul style="list-style-type: none"> • maintaining a tidy workplace, with exits and gangways free from obstruction • using equipment safely and only for the purpose intended • observing organisational safety rules, signs and hazard warnings • taking measures to protect others from any harm resulting from the work that they are carrying out.

Learning outcome	
The learner will:	
2.	know how to comply with statutory regulations and organisational safety requirements
Assessment criteria	
The learner can:	
2.1	describe the roles and responsibilities of themselves and others under the Health and Safety at Work Act, and other current legislation (such as The Management of Health and Safety at Work Regulations, Workplace Health and Safety and Welfare Regulations, Personal Protective Equipment at Work Regulations, Manual Handling Operations Regulations, Provision and Use of Work Equipment Regulations, Display Screen at Work Regulations, Reporting of Injuries, Diseases and Dangerous Occurrences Regulations)
2.2	describe the specific regulations and safe working practices and procedures that apply to their work activities
2.3	describe the warning signs for the 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).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to make effective use of text, numeric and graphical information, by interpreting and using technical information extracted from documents such as engineering drawings, technical manuals, reference tables, specifications, technical sales/marketing documentation, charts or electronic displays, in accordance with approved procedures. The learner will be required to extract the necessary information from the various documents, in order to establish and carry out the work requirements, and to make valid decisions about the work activities based on the information extracted.</p>

The learner's responsibilities will require them to comply with organisational policy and procedures for obtaining and using the documentation applicable to the activity. They will be expected to report any problems with the use and interpretation of the documents that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to work to instructions if necessary, with an appropriate level of supervision or as a member of a team, and take personal responsibility for their own actions and for the quality and accuracy of

the work that they carry out.

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

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

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

	<ul style="list-style-type: none"> • specifications (such as material, finish, process, contractual, calibration) • reference materials (such as manuals, tables, charts, guides, notes) • schedules • operation sheets • service/test information • planning documentation • quality control documents • company specific technical instructions • Semta National, interSemta National and organisational standards • health and safety standards relating to the activity (such as COSHH) • other specific related documentation
1.8	deal promptly and effectively with any problems within their control and report those which cannot be solved
1.9	report any inaccuracies or discrepancies in documentation and specifications.

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

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

Unit 303

Working efficiently and effectively in engineering

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

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:

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

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

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

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

Learning outcome

The learner will:

2. know how to work efficiently and effectively in engineering

Assessment criteria

The learner can:

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

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

Unit 409

Making compression springs using hand forming methods

UAN:	F/600/5521
Level:	3
Credit value:	46
GLH:	150
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 120: Making Compression Springs using Hand Forming Methods (Level 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to cold form wire (either round, square or rectangular section) compression springs, using hand forming methods and techniques, in accordance with approved procedures. The learner will be required to select the appropriate equipment to use, based on the forming operations required, the material to be formed and the accuracy to be achieved, and this will include such things as coiling mandrels, coiling tools, shearing tools, hand coiling machine, fly press and pedestal grinding machines. The wire compression springs to be produced will include open ended right- and left-hand helix and closed end right- and left-hand helix, conical, hour glass, barrel, variable pitch and other specific spring/wire forms.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the spring forming activities undertaken, and to report any problems with the tools and equipment, materials or activities that they cannot personally resolve or that are outside their permitted authority to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they produce.</p>

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying hand forming procedures for compression springs. The learner will understand the cold forming processes, the equipment used and its application, and will know about the materials and forming techniques in adequate depth to provide a sound basis for carrying out the activities, correcting faults and producing the springs to the required specification.

The learner will understand the safety precautions required when working with the hand forming machines, and with their associated tools and equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

Learning outcome
The learner will: 1. make compression springs using hand forming methods
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 during the compression spring making activities: <ul style="list-style-type: none"> • obtain and interpret correctly the documentation for the type of spring being made (such as job instructions, spring drawings and quality 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 • check that the tools and spring forming equipment to be used are in a safe and usable condition • carry out the hand forming activities, following good practice/approved procedures • return all tools and equipment to the correct location on completion of the spring making activities • leave the work area in a clean and safe condition on completion of the activities 1.3 follow the correct component drawing and any other related specifications for the component to be produced 1.4 determine what has to be done and how this will be achieved 1.5 use the appropriate tools and equipment for the pressure shaping operations and check that they are in a safe and usable condition

- 1.6 use all of the following types of spring forming equipment:
- coiling machine (hand or power operated)
 - pedestal grinding machine
 - fly press
 - coiling mandrels
 - spring measuring/checking equipment
- 1.7 shape the materials to the required specification using appropriate methods and techniques
- 1.8 produce springs made from two different materials from the following:
- carbon steel
 - stainless steel
 - alloy steel
 - copper based alloy
 - nickel based alloys
 - titanium and other special material
- 1.9 form three of the following types of wire compression springs:
- open ended right-hand helix
 - open ended left-hand helix
 - closed end right-hand helix
 - closed end left-hand helix
 - conical
 - hour glass
 - constant pitch
 - variable pitch
 - barrel
 - garter springs
 - other wire forms
- 1.10 produce wire compression springs, to include carrying out all of the following:
- selecting the correct type and size of wire
 - ensuring that any required wire pre-treatment activities have been carried out
 - selecting the correct type and size of coiling mandrel and securing it in the machine chuck
 - setting the coiling rest for the correct helix
 - selecting the correct angle plate to obtain pitch and free length
 - setting the coiling machine controls (such as wire guides, cams, upper and lower stops, cropping tools)
 - setting up the correct coil start and finishing points
 - using the appropriate techniques to form the springs to the required specification
 - checking the re-coil amount after coiling and adjusting, as required (where appropriate)
 - cropping spring ends prior to grinding
 - carrying out spring end grinding operations (hand grinding)
 - carrying out post-coiling operations (such as pre-setting, coil

- setting and checking squareness)
 - preparing the springs for heat treatment (such as stress relieving, hardening and tempering)
 - pre-stressing/scragging
- 1.11 complete all relevant documentation on completion of the spring making activities, to include one of the following:
- job cards
 - quality control documentation
 - computer records
 - inspection/test documentation
 - company-specific documentation
- 1.12 check that all the required shaping operations have been completed to the required standard
- 1.13 carry out checks of the wire compression springs, to include all of the following:
- size of wire and material specification
 - dimensional accuracy of the free length
 - dimensional accuracy of the outside diameter
 - dimensional accuracy of the inside diameter
 - the number of coils is as specified
 - the spring is wound with the correct hand helix
 - spring ends are flat and square to the spring axis
 - spring load and rate meets specification requirements
 - completed springs are free from tooling marks and deformation
- 1.14 use four of the following whilst checking the quality of the springs produced:
- Vernier callipers
 - micrometers
 - spring testing machines
 - Vernier protractors
 - squares
 - electronic measuring equipment
 - gauges
 - jigs
- 1.15 produce compression springs which comply with one of the following:
- BS, ISO or BSEN or standards and procedures
 - customer standards and job requirements
 - company standards and procedures
- 1.16 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 make compression springs using hand forming methods
Assessment criteria
The learner can: 2.1 describe the specific safety precautions to be taken when working with spring hand cold forming equipment and materials in a spring making environment (such as general workshop safety, appropriate Personal Protective Equipment, accident procedure; statutory regulations, risk assessment procedures and COSHH regulations) 2.2 describe the personal protective clothing and equipment to be worn when carrying out the spring making activities 2.3 describe the hazards associated with carrying out compression spring hand forming operations (such as handling coils of spring wire, using hand coiling machines and equipment, using dangerous or badly maintained tools and equipment), and how to minimise them and reduce any risks 2.4 describe the terminology used in the manufacture of the compression springs 2.5 explain how to obtain the necessary drawings, specifications and work instructions 2.6 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 2.7 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, work reference points and system of tolerancing 2.8 describe the hand tools used in the compression spring forming activities, and how to check that they are in a safe and usable condition 2.9 describe the various hand and power operated coiling machines that can be used to produce a range of open and closed end springs 2.10 describe the various types of coiling/forming tool that are used, how they are selected, prepared and mounted to the machine 2.11 explain how to set up the hand coiling machine to produce the required helix, pitch, and number of coils 2.12 describe the techniques used to feed the wire into the hand coiling machine in order to produce the spring to the required specification 2.13 describe the ways of avoiding and correcting inaccuracies in the coil forming activities 2.14 explain how the spring wire materials are to be prepared for the coiling operations, and why some materials may require a heating process prior to forming 2.15 describe the characteristics of the various materials used with regard to the coiling and forming process 2.16 describe the variations in manufacturing methods and spring characteristics that will occur with different ferrous and non-ferrous metals 2.17 describe the use of pedestal grinding machines to finish off the

spring ends

- 2.18 describe the regulations that govern the use and mounting of the abrasive wheels, and how they apply to them
- 2.19 describe the use of fly presses and tooling for coil setting and checking squareness
- 2.20 explain how to check that the tools and equipment used are in a safe and serviceable condition, and their care and maintenance procedures
- 2.21 describe the organisational quality control procedures, and recognition of coil forming defects
- 2.22 describe the dimensional and coil forming inspection checks to be carried out, and the tools and equipment to be used
- 2.23 describe the limitations of the various coil forming processes, and the accuracy that may realistically be achieved
- 2.24 describe the importance of completing all relevant documentation on conclusion of the spring making activities
- 2.25 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 410

Making torsion springs using hand forming methods

UAN:	K/600/5531
Level:	3
Credit value:	46
GLH:	150
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 121: Making Torsion Springs using Hand Forming Methods (Level 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to cold form wire (either round, square or rectangular section) torsion springs, using hand forming methods and techniques, in accordance with approved procedures. The learner will be required to select the appropriate equipment to use, based on the forming operations required, the material to be formed and the accuracy to be achieved, and this will include such things as coiling mandrels, hand coiling machine, coiling tools, shearing tools and fly presses. The wire torsion and tension springs to be produced will include right- and left-handed helix, single and double torsion springs and other specific wire forms.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the spring forming activities undertaken, and to report any problems with the tools and equipment, materials or activities that they cannot personally resolve, or that are outside their permitted authority to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they produce.</p> <p>The learner's knowledge will provide a good</p>

understanding of their work, and will provide an informed approach to applying hand forming procedures to torsion springs. The learner will understand the cold forming processes, the equipment used and its application, and will know about the materials and forming techniques in adequate depth to provide a sound basis for carrying out the activities, correcting faults and producing springs to the required specification.

The learner will understand the safety precautions required when working with the hand forming machines, and with their associated tools and equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

Learning outcome
The learner will: 1. make torsion springs using hand forming methods
Assessment criteria
The learner can: 1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 ensure that the tools and equipment to be used are appropriate to the application and are in a safe and usable condition, by carrying out all of the following checks: <ul style="list-style-type: none">• obtain and interpret correctly the documentation for the type of spring being made (such as job instructions, spring drawings and quality 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• check that the tools and spring forming equipment to be used are in a safe and usable condition• carry out the hand forming activities, following good practice/approved procedures• return all tools and equipment to the correct location on completion of the spring making activities• leave the work area in a clean and safe condition on completion of the activities 1.3 follow the correct component drawing and any other related specifications for the component to be produced 1.4 determine what has to be done and how this will be achieved 1.5 use the appropriate tools and equipment for the pressure shaping operations and check that they are in a safe and usable condition 1.6 use all of the following types of spring forming equipment:

- coiling machine (hand or power operated)
 - coiling mandrels
 - hand tools
 - spring measuring/checking equipment
 - fly press
 - jigs/fixtures
- 1.7 shape the materials to the required specification using appropriate methods and techniques
- 1.8 produce torsion springs from two different materials from the following:
- carbon steel
 - stainless steel
 - alloy steel
 - copper based alloy
 - nickel based alloys
 - titanium and other special material
- 1.9 form three of the following types of wire torsion springs:
- right-hand helix
 - left-hand helix
 - single torsion
 - double torsion
 - other specific torsion springs
- 1.10 finish torsion spring ends, to include producing three of the following:
- short hook ends
 - straight offset
 - hinge ends
 - straight torsion
 - special ends
- 1.11 produce wire torsion springs, to include carrying out all of the following:
- selecting the correct type and size of wire
 - ensuring that any required wire pre-treatment activities have been carried out (where appropriate)
 - selecting the correct type and size of coiling mandrel, and securing it in the machine chuck
 - setting the coiling rest to give the correct helix
 - selecting the correct angle plate to obtain pitch and free length
 - setting the coiling machine controls (such as wire guides, cams, upper and lower stops, cropping tool)
 - setting up the correct coil start and finishing points
 - using the appropriate techniques to form the springs to the required specification
 - checking the re-coil amount after coiling and adjusting, as required (where appropriate)
 - carrying out post coiling operations (such as forming bends or loops in ends/legs, pre-setting, coil setting and checking)

- preparing the springs for heat treatment (such as stress relieving, hardening and tempering)
- 1.12 check that all the required shaping operations have been completed to the required standard
- 1.13 carry out checks of wire torsion springs, to include all of the following:
- size of wire and material specification
 - dimensional accuracy of the overall length
 - dimensional accuracy of the outside diameter
 - dimensional accuracy of the inside diameter
 - the number of coils is as specified
 - the spring is wound with the correct hand helix
 - spring ends/legs are of the correct length, angle and shape
 - spring torsion meets specification requirements
 - completed springs are free from tooling marks and deformation
- 1.14 use four of the following whilst checking the quality of the springs produced:
- Vernier callipers
 - micrometers
 - spring testing machines
 - Vernier protractors
 - squares
 - electronic measuring equipment
 - gauges
 - jigs
- 1.15 produce wire torsion springs which comply with one of the following:
- BS, ISO or BSEN standards and procedures
 - customer standards and job requirements
 - company standards and procedures
- 1.16 complete all relevant documentation on conclusion of the spring making activities, to include one of the following:
- job cards
 - quality control documentation
 - computer records
 - test documents
 - company-specific documentation
- 1.17 deal promptly and effectively with problems within their control and report those that cannot be solved.

Learning outcome
The learner will: 2. know how to make torsion springs using hand forming methods
Assessment criteria
The learner can: 2.1 describe the specific safety precautions to be taken when working with spring hand cold forming equipment and materials in a spring making environment (such as general workshop safety, appropriate Personal Protective Equipment, accident procedure; statutory regulations, risk assessment procedures and cosh regulations) 2.2 describe the personal protective clothing and equipment to be worn when carrying out the spring making activities 2.3 describe the hazards associated with carrying out torsion spring hand forming operations (such as handling spring wire, using hand coiling machines and equipment, using dangerous or badly maintained tools and equipment), and how to minimise them and reduce any risks 2.4 describe the terminology used in the manufacture of the torsion springs 2.5 describe the principles of operation of torsion springs 2.6 explain how to obtain the necessary drawings, specifications and work instructions 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, work reference points and system of tolerancing 2.9 describe the hand tools used in the torsion and tension spring forming activities, and how to check that they are in a safe and usable condition 2.10 describe the various hand and power operated coiling machines that can be used to produce a range of open and closed end springs 2.11 describe the various types of coiling/forming tool that are used, how they are selected, prepared and mounted to the machine 2.12 explain how to set up the hand coiling machine and tooling to produce the required helix, pitch, number of coils and arm extension required 2.13 describe the techniques used to feed the wire into the hand coiling machine in order to produce the spring to the required specification 2.14 describe the ways of avoiding and correcting inaccuracies in the coil forming activities 2.15 explain how the spring wire materials are to be prepared for the coiling operations, and why some materials may require a heating process prior to forming 2.16 describe the characteristics of the various materials used with regard to the coiling and forming process 2.17 describe the variations in manufacturing methods and spring characteristics that will occur with different ferrous and non-ferrous

metals

- 2.18 describe the use of fly presses and tooling for forming bends and loops in the spring ends/legs and for coil setting
- 2.19 explain how to check that the tools and equipment used are in a safe and serviceable condition, and their care and maintenance procedures
- 2.20 describe the organisational quality control procedures, and recognition of coil forming defects
- 2.21 describe the dimensional and coil forming inspection checks to be carried out, and the tools and equipment to be used for this
- 2.22 describe the limitations of the various coil forming processes, and the accuracy that may realistically be achieved
- 2.23 describe the importance of completing all relevant documentation on conclusion of the spring making activities
- 2.24 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 411

Making extension springs using hand forming methods

UAN:	Y/600/5539
Level:	3
Credit value:	46
GLH:	150
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 122: Making Extension Springs using Hand Forming Methods (Level 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to cold form wire (either round, square or rectangular section) extension springs, using hand forming methods and techniques, in accordance with approved procedures. The learner will be required to select the appropriate equipment to use, based on the forming operations required, the material to be formed and the accuracy to be achieved, and this will include such things as coiling mandrels, hand coiling machine, coiling tools, shearing tools and fly presses. The wire extension springs to be produced will include right- and left-handed helix, garter springs and other specific extension springs.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the spring forming activities undertaken, and to report any problems with the tools and equipment, materials or activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they produce.</p> <p>The learner's knowledge will provide a good understanding of their work, and will provide</p>

an informed approach to applying hand forming procedures to extension springs. The learner will understand the cold forming processes, the equipment used and its application, and will know about the materials and forming techniques in adequate depth to provide a sound basis for carrying out the activities, correcting faults and producing the springs to the required specification.

The learner will understand the safety precautions required when working with the hand forming machines, and with their associated tools and equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

Learning outcome
The learner will: 1. make extension springs using hand forming methods
Assessment criteria
The learner can: 1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 ensure that the tools and equipment to be used are appropriate to the application and are in a safe and usable condition, by carrying out all of the following checks: <ul style="list-style-type: none"> • obtain and interpret correctly the documentation for the type of spring being made (such as job instructions, spring drawings and quality 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 • check that the tools and spring forming equipment to be used are in a safe and usable condition • carry out the hand forming activities, following good practice/approved procedures • return all tools and equipment to the correct location on completion of the spring making activities • leave the work area in a clean and safe condition on completion of the activities 1.3 follow the correct component drawing and any other related specifications for the component to be produced 1.4 determine what has to be done and how this will be achieved 1.5 use the appropriate tools and equipment for the pressure shaping operations and check that they are in a safe and usable condition 1.6 use all of the following types of spring forming equipment:

- coiling machine (hand or power operated)
 - spring measuring/checking equipment
 - coiling mandrels
 - hand tools
 - fly press
- 1.7 shape the materials to the required specification using appropriate methods and techniques
- 1.8 produce extension springs from two different materials from the following:
- carbon steel
 - stainless steel
 - alloy steel
 - copper based alloy
 - nickel based alloys
 - titanium and other special material
- 1.9 form two of the following types of wire extension springs:
- right-hand helix
 - left-hand helix
 - garter springs
 - other extension springs
- 1.10 produce wire extension springs, to include carrying out all of the following:
- selecting the correct type and size of wire
 - ensuring that any required wire pre-treatment activities have been carried out (where appropriate)
 - selecting the correct type and size of coiling mandrel and securing it in the machine chuck
 - setting the coiling rest to give the correct helix
 - selecting the correct angle plate to obtain pitch and free length
 - setting the coiling machine controls (such as wire guides, cams, upper and lower stops, cropping tool)
 - setting up the correct coil start and finishing points
 - using the appropriate techniques to form the springs to the required specification
 - checking the re-coil amount after coiling and adjusting, as required (where appropriate)
 - carrying out post coiling operations (such as forming bends or loops in ends/legs, pre-setting, coil setting and checking)
 - preparing the springs for heat treatment (such as stress relieving, hardening and tempering)
- 1.11 finish extension spring ends, to include producing six of the following:
- full round hook/full round eye
 - long round end hook on centre
 - coned end to hold long swivel eye
 - eye and hook at right angles
 - extended eye on centre or side

- small eye on centre
 - square end
 - English loop
 - continental (German) loop
 - enlarged loop
 - side loop
 - plain ends
 - machine loop
 - crossover
 - double loop
 - 45 degree loop
 - extended leg
- 1.12 check that all the required shaping operations have been completed to the required standard
- 1.13 carry out checks of wire extension springs, to include all of the following:
- size of wire and material specification
 - dimensional accuracy of the overall length
 - dimensional accuracy of the outside diameter
 - dimensional accuracy of the inside diameter
 - the number of coils is as specified
 - the spring is wound with the correct hand helix
 - spring ends/legs are of the correct length, angle and shape
 - spring extension meets specification requirements
 - completed springs are free from tooling marks and deformation
- 1.14 use four of the following whilst checking the quality of the springs produced:
- Vernier callipers
 - micrometers
 - spring testing machines
 - Vernier protractors
 - squares
 - electronic measuring equipment
 - gauges
 - jigs
- 1.15 produce wire extension springs which comply with one of the following:
- BS, ISO or BSEN standards and procedures
 - customer standards and job requirements
 - company standards and procedures
- 1.16 complete all relevant documentation on conclusion of the spring making activities, to include one of the following:
- job cards
 - quality control documentation
 - computer records
 - test documents

- company-specific documentation
- 1.17 deal promptly and effectively with problems within your control and report those that cannot be solved.

Learning outcome
The learner will:
2. know how to make extension springs using hand forming methods
Assessment criteria
The learner can:
2.1 describe the specific safety precautions to be taken when working with spring hand cold forming equipment and materials in a spring making environment (such as general workshop safety, appropriate Personal Protective Equipment, accident procedure; statutory regulations, risk assessment procedures and COSHH regulations)
2.2 describe the personal protective clothing and equipment to be worn when carrying out the spring making activities
2.3 describe the hazards associated with carrying out extension spring hand forming operations (such as handling spring wire, using hand coiling machines and equipment, using dangerous or badly maintained tools and equipment), and how to minimise them and reduce any risks
2.4 describe the terminology used in the manufacture of the extension springs
2.5 describe the principles of operation of extension springs
2.6 explain how to obtain the necessary drawings, specifications and work instructions
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, work reference points and system of tolerancing
2.9 describe the hand tools used in the extension spring forming activities, and how to check that they are in a safe and usable condition
2.10 describe the various hand and power operated coiling machines that can be used to produce a range of open and closed end springs
2.11 describe the various types of coiling/forming tool that are used, and how they are selected, prepared and mounted to the machine
2.12 explain how to set up the hand coiling machine and tooling to produce the required helix, pitch, number of coils and arm extension required
2.13 describe the techniques used to feed the wire into the hand coiling machine in order to produce the spring to the required specification
2.14 describe the ways of avoiding and correcting inaccuracies in the coil forming activities
2.15 explain how the spring wire materials are to be prepared for the coiling operations, and why some materials may require a heating process prior to forming
2.16 describe the characteristics of the various materials used with

regard to the coiling and forming process

- 2.17 describe the variations in manufacturing methods and spring characteristics that will occur with different ferrous and non-ferrous metals
- 2.18 describe the use of fly presses and tooling for forming bends and loops in the spring ends/legs and for coil setting
- 2.19 explain how to check that the tools and equipment used are in a safe and serviceable condition, and their care and maintenance procedures
- 2.20 describe the organisational quality control procedures, and recognition of coil forming defects
- 2.21 describe the dimensional and coil forming inspection checks to be carried out, and the tools and equipment to be used for this
- 2.22 describe the limitations of the various coil forming processes, and the accuracy that may realistically be achieved
- 2.23 describe the importance of completing all relevant documentation on conclusion of the spring making activities
- 2.24 describe the extent of your own responsibility and to whom you should report if you have problems that you cannot resolve.

Unit 412

Making spring wire forms using hand forming methods

UAN:	A/600/5548
Level:	3
Credit value:	46
GLH:	150
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 123: Making Spring Wire Forms using Hand Forming Methods (Level 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to cold form wire (either round, square or rectangular section) to produce specific spring wire forms, using hand forming methods and techniques, in accordance with approved procedures. The learner will be required to select the appropriate equipment to use, based on the forming operations required, the material to be formed and the accuracy to be achieved, and this will include such things as coiling mandrels, hand coiling machine, coiling tools, shearing tools and fly presses. The wire forms to be produced will include spring pins, retaining clips, key rings and other specific wire forms.</p>

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

The learner's knowledge will provide a good

understanding of their work, and will provide an informed approach to applying hand forming procedures to spring wire forms. The learner will understand the cold wire forming processes, the equipment used and its application, and will know about the materials and forming techniques in adequate depth to provide a sound basis for carrying out the activities, correcting faults and producing the wire forms to the required specification.

The learner will understand the safety precautions required when working with the hand forming machines, and with their associated tools and equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

Learning outcome
The learner will: 1. making spring wire forms using hand forming methods
Assessment criteria
The learner can: 1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 ensure that the tools and equipment to be used are appropriate to the application and are in a safe and usable condition, by carrying out all of the following checks: <ul style="list-style-type: none"> • obtain and interpret correctly the documentation for the type of wire form being made (such as job instructions, spring drawings and quality 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 • check that the tools and spring wire forming equipment to be used are in a safe and usable condition • carry out the hand wire forming activities, following good practice/approved procedures • return all tools and equipment to the correct location on completion of the spring making activities • leave the work area in a clean and safe condition on completion of the activities 1.3 follow the correct component drawing and any other related specifications for the component to be produced 1.4 determine what has to be done and how this will be achieved 1.5 use the appropriate tools and equipment for the pressure shaping operations and check that they are in a safe and usable condition 1.6 use all of the following types of spring wire forming equipment:

- wire forming machine (hand or power operated)
 - wire forming mandrels
 - hand tools
 - spring measuring/checking equipment
 - fly press
- 1.7 shape the materials to the required specification using appropriate methods and techniques
- 1.8 produce spring wire forms from two different materials from the following:
- carbon steel
 - stainless steel
 - alloy steel
 - copper based alloy
 - nickel based alloys
 - titanium and other special material
- 1.9 form three of the following types of spring wire form:
- spring pins/clips
 - key rings
 - plain wire rings
 - retaining rings
 - other specific spring wire forms
- 1.10 produce spring wire forms, to include carrying out all of the following:
- selecting the correct type and size of wire
 - ensuring that any required wire pre-treatment activities have been carried out (where appropriate)
 - selecting the correct type and size of forming mandrel
 - using the appropriate techniques to form the spring wire forms to the required specification
 - checking spring-back after forming and adjusting, as required (where appropriate)
 - carrying out post forming operations (such as forming bends or loops in ends/legs)
 - preparing the spring wire forms for heat treatment (such as stress relieving, hardening and tempering)
- 1.11 check that all the required shaping operations have been completed to the required standard
- 1.12 carry out checks of the spring wire forms, to include all of the following:
- size and shape of wire used
 - type of material used
 - dimensional accuracy of the spring wire form
 - shape/geometry of the wire form
 - spring wire form tension/torsion meets specification requirements
 - completed spring wire forms are free from tooling marks and deformation
- 1.13 use four of the following whilst checking the quality of the spring wire forms produced:

<ul style="list-style-type: none"> • Vernier callipers • micrometers • spring testing machines • Vernier protractors • squares • electronic measuring equipment • gauges • jigs <p>1.14 produce spring wire forms which comply with one of the following:</p> <ul style="list-style-type: none"> • BS, ISO or BSEN standards and procedures • customer standards and job requirements • company standards and procedures <p>1.15 complete all relevant documentation on conclusion of the spring wire form making activities, to include one of the following:</p> <ul style="list-style-type: none"> • job cards • quality control documentation • computer records • test documents • company-specific documentation <p>1.16 deal promptly and effectively with problems within their control and report those that cannot be solved.</p>

<p>Learning outcome</p> <p>The learner will:</p> <p>2. know how to make spring wire forms using hand forming methods</p>
<p>Assessment criteria</p> <p>The learner can:</p> <p>2.1 describe the specific safety precautions to be taken when working with spring cold wire hand forming equipment and materials in a spring making environment (such as general workshop safety, appropriate Personal Protective Equipment, accident procedure; statutory regulations, risk assessment procedures and COSHH regulations)</p> <p>2.2 describe the personal protective clothing and equipment to be worn when carrying out the spring wire form making activities</p> <p>2.3 describe the hazards associated with carrying out spring wire form hand forming operations (such as handling spring wire, using hand coiling machines and equipment, using dangerous or badly maintained tools and equipment), and how to minimise them and reduce any risks</p> <p>2.4 describe the terminology used in the manufacture of the spring wire forms</p> <p>2.5 describe the principles of operation of spring wire forms being made</p> <p>2.6 explain how to obtain the necessary drawings, specifications and work instructions</p> <p>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</p>

- 2.8 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, work reference points and system of tolerancing
- 2.9 describe the hand tools used in the spring wire forming activities, and how to check that they are in a safe and usable condition
- 2.10 describe the various hand and power operated coiling machines that can be used to produce a range of spring wire forms
- 2.11 describe the various types of spring wire forming tools that are used, and how they are selected, prepared and mounted to the machine
- 2.12 explain how to set up the hand wire forming machine and tooling to produce the required forms
- 2.13 describe the techniques used to feed the wire into the hand wire forming machine in order to produce the wire form to the required specification
- 2.14 describe the ways of avoiding and correcting inaccuracies in the wire forming activities
- 2.15 explain how the spring wire materials are to be prepared for the forming operations, and why some materials may require a heating process prior to forming
- 2.16 describe the characteristics of the various materials used with regard to the forming process
- 2.17 describe the variations in manufacturing methods and spring characteristics that will occur with different ferrous and non-ferrous metals
- 2.18 describe the use of fly presses and tooling for forming bends and loops in the wire forms
- 2.19 explain how to check that the tools and equipment used are in a safe and serviceable condition, and their care and maintenance procedures
- 2.20 describe the organisational quality control procedures, and recognition of wire forming defects
- 2.21 describe the dimensional and forming inspection checks to be carried out, and the tools and equipment to be used for this
- 2.22 describe the limitations of the various wire forming processes, and the accuracy that may realistically be achieved
- 2.23 describe the importance of completing all relevant documentation on conclusion of the spring wire forming activities
- 2.24 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

UAN:	D/600/5560
Level:	3
Credit value:	16
GLH:	57
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 124: Grinding Spring Ends by Hand (Level 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	This unit covers the skills and knowledge needed to prove the competences required to prepare bench, pedestal grinding machines, and belt finishing machines for spring end grinding operations, in accordance with approved procedures. The learner will be expected to prepare the equipment to grind the ends flat and square, and to the correct dimensional requirements. This will involve selecting the appropriate grinding machine/equipment and spring holding device.

In preparing the machines, the learner will need to check that an appropriate grinding wheel or finishing belt is fitted, and that they are free from defects. The learner will be expected to prepare the grinding wheels for operation by dressing the wheels, and creating any necessary relief, as applicable to the operation to be performed. The learner must set up the machine work rest to give sufficient wheel clearance, in keeping with safe operating methods.

The learner's responsibilities will require them to comply with organisational policy and procedures for the spring end hand grinding activities undertaken, and to report any problems with the grinding machines, equipment or grinding activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision,

taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to the grinding of spring ends using hand methods. The learner will understand the spring end hand grinding equipment used, and its application, and will know about the spring holding devices, grinding wheels, wheel dressing, spring materials and consumables, 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 spring end hand grinding machines, and with their associated tools and equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

Learning outcome
The learner will: 1. grind spring ends by hand
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 during the spring end grinding activities: <ul style="list-style-type: none">• obtain and interpret correctly the documentation for the type of spring being ground (such as job instructions, spring drawings and quality 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• check that the grinding machine and workholding device to be used is in a safe and usable condition• carry out the spring end grinding activities, following good practice/approved procedures• ensure that the grinding wheels are correctly dressed/formed and are in a usable condition• hold components securely, without distortion• ensure that correctly adjusted machine guards are in place• leave the machine and work area in a safe and clean condition

- on completion of the grinding activities
- 1.3 follow relevant specifications for the component to be produced
 - 1.4 obtain the appropriate tools and equipment for the shaping operations and check that they are in a safe and useable condition
 - 1.5 prepare two of the following types of spring end grinding machine in readiness for production:
 - single end
 - double end
 - finishing belt
 - 1.6 select and mount grinding wheels, to include carrying out all of the following:
 - selecting grinding wheels for specific materials and applications (such as grain size, grade, structure, bond)
 - testing wheels for soundness/cracks
 - mounting wheels (such as paper washers, flanges, locking pressure)
 - balancing wheels, where appropriate
 - dressing and 'trueing up' grinding wheels
 - 1.7 shape the materials using appropriate methods and techniques
 - 1.8 grind springs made from two of the following types of material:
 - carbon steel
 - stainless steel
 - alloy steel
 - copper based alloy
 - nickel based alloys
 - titanium and other special material
 - 1.9 carry out the grinding of spring ends by hand, to include all of the following:
 - checking springs for cleanliness and freedom from burrs
 - mounting the springs in an appropriate holding device
 - setting machine rests to give an appropriate wheel clearance less than the wire diameter of the spring
 - setting guards and safety mechanisms
 - applying appropriate pressure and technique to grind the spring ends without burning
 - removing sufficient material from each end to give equal tip end thickness
 - de-burring/chamfering inside and outside diameter
 - reaming and edging, if required
 - checking that spring length, squareness and finish is to specification
 - 1.10 check that all the required shaping operations have been completed to the required specification
 - 1.11 carry out checks of the springs, to include all of the following:
 - free length
 - squareness
 - coil diameter of end
 - solid length

<ul style="list-style-type: none"> • finish • tip end thickness <p>1.12 use four of the following whilst checking the quality of the springs produced:</p> <ul style="list-style-type: none"> • Vernier callipers • micrometers • spring testing machines • Vernier protractors • squares • electronic measuring equipment • gauges • jigs <p>1.13 grind spring ends by hand, in compliance with one of the following:</p> <ul style="list-style-type: none"> • BS, EN or ISO standards and procedures • customer standards and job requirements • company standards and procedures <p>1.14 complete all relevant documentation on conclusion of the spring grinding activities, to include one of the following:</p> <ul style="list-style-type: none"> • job cards • quality control documentation • company-specific documentation • computer records • test documents <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 grind spring ends by hand
Assessment criteria
The learner can:
2.1 describe the specific safety precautions to be taken when setting up and using grinding wheels for spring end grinding by hand
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 spring end grinding by hand (such as moving parts of machinery, sparks/airborne particles, the possibility of fire when grinding titanium, 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
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 off-hand grinding and finishing

- 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 spring end grinding, in relation to the activities undertaken
 - 2.12 describe the workholding devices that are used to hold the springs for hand grinding
 - 2.13 describe the selection of grinding wheels with regard to the type of material being ground and operations being carried out
 - 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 explain how grinding wheels are balanced, and the equipment that is used for this
 - 2.16 describe the methods of mounting and securing the grinding wheels to the machine spindles
 - 2.17 explain the need for frequent dressing of wheels to prevent glazing and burning of the spring surface
 - 2.18 describe the organisational quality control procedures, and recognition of grinding defects
 - 2.19 describe the problems that can occur with the hand grinding operations, and what to do if problems occur
 - 2.20 describe the importance of completing all relevant documentation on conclusion of the spring end grinding activities
 - 2.21 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 414

Setting automatic cold wire compression spring making machines for production

UAN:	H/600/5575
Level:	3
Credit value:	46
GLH:	150
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 125: Setting Automatic Cold Wire Compression Spring Making Machines for Production (Level 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	This unit covers the skills and knowledge needed to prove the competences required to prepare and set up an automatic cold wire compression spring making machine for production, in accordance with approved procedures. This will involve setting up for the production of a range of compression springs, such as open and closed end and right- and left-hand helix springs.

The learner will need to select the appropriate material, feed and guide mechanisms, bending, forming and cut-off tools, and to check that they are in a safe and usable condition. The learner will then set the machine operating parameters to produce the springs to the required specification. This will involve mounting and setting up all the required tooling, wire feed mechanisms, operating cams and cam timing, and setting mechanical or pneumatic actuators, electromechanical controls, stops, feed and speed mechanisms, as appropriate to the machine type. The learner must produce trial runs and prove that the machine is working satisfactorily before allowing it to run in automatic production mode. Making adjustments to settings to achieve spring 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 automatic compression spring machine-setting activities undertaken, and to report any problems with the machine, tooling, equipment or setting-up activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality 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 on automatic cold wire compression spring making machines. The learner will understand the automatic compression spring making machine used, and its application, and will know about the material feed mechanisms, tooling, relevant materials, consumables and setting-up procedures, in adequate depth to provide a sound basis for setting up the equipment, correcting faults and ensuring that the springs are produced to the required specification.

The learner will understand the safety precautions required when working with the automatic cold wire compression spring making machine, and with its associated tools and equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

Learning outcome
The learner will: 1. set automatic cold wire compression spring making 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 during the setting up of the automatic cold wire compression spring making machines: <ul style="list-style-type: none"> • obtain and interpret correctly the documentation for the type

- of compression spring being made (such as job instructions, spring drawings and quality 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
 - check that the machine and spring forming equipment to be used is in a safe and usable condition
 - carry out the setting-up activities, following good practice/approved procedures
 - ensure that first-off springs are correctly heat treated for inspection/verification
 - ensure that correctly adjusted machine guards are in place
 - leave the machine and work area in a safe and clean condition on completion of the setting-up activities
- 1.3 follow the correct component drawing and any other related 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 mount and set the correct forming tools and devices for the component being produced
- 1.6 select and set up four of the following types of spring making tooling:
- bending tools
 - forming tools
 - looping tools
 - straightening tools
 - cut-off/cropping tools
 - other special-purpose tooling
- 1.7 set the machine operating parameters to achieve the required pressure shaping requirements and component specification
- 1.8 produce wire compression springs from two different types of material from the following:
- carbon steel
 - stainless steel
 - alloy steel
 - copper based alloy
 - nickel based alloys
 - titanium and other special material
- 1.9 set up an automatic cold wire compression spring forming machine for the production of four of the following:
- open ended right-hand helix
 - open ended left-hand helix
 - closed end right-hand helix
 - closed end left-hand helix
 - conical
 - hour glass
 - constant pitch
 - variable pitch

- barrel
 - garter springs
 - other wire forms
- 1.10 set up the operating control systems on automatic cold wire compression spring making machine, to include four of the following devices:
- material guide/wire feed mechanisms (such as feed rollers, pneumatic, magazine)
 - cams and mechanical actuators
 - pneumatic/hydraulic actuators
 - de-reeler
 - electro-mechanical actuators
 - pitch spacers
 - feed fingers
 - straighteners
- 1.11 set up the machine in accordance with instructions and specifications, to include all of the following, as appropriate:
- wire feed/speed rollers
 - wire stop mechanisms
 - selecting and setting appropriate cams/gears
 - correct helix
 - correct pitch
 - number of coils required
 - spring arm/leg length
 - finished spring length
 - trip dogs and limit switches
 - position and operation of forming tools
 - position and operation of cropping tool
 - guards/safety mechanisms
- 1.12 check that all safety mechanisms are in place and that the equipment is set correctly for the required operations
- 1.13 carry out checks of the wire compression springs, to include all of the following:
- size of wire and material specification
 - dimensional accuracy of the free/overall length
 - dimensional accuracy of the outside diameter
 - dimensional accuracy of the inside diameter
 - the number of coils is as specified
 - the spring is wound with the correct hand helix
 - spring ends are flat and square to spring axis (where appropriate)
 - spring load and rate meets specification requirements
 - completed springs are free from tooling marks and deformation
- 1.14 use four of the following whilst checking the quality of the springs produced:
- Vernier callipers
 - micrometers

<ul style="list-style-type: none"> • spring testing machines • Vernier protractors • squares • electronic measuring equipment • gauges • jigs <p>1.15 set up an automatic cold wire compression spring making machine to produce springs to one of the following:</p> <ul style="list-style-type: none"> • BS, ISO or BSEN standards and procedures • customer standards and job requirements • company standards and procedures <p>1.16 complete all relevant documentation on conclusion of the spring making activities, to include one of the following:</p> <ul style="list-style-type: none"> • job cards • quality control documentation • company-specific documentation • computer records • test documents <p>1.17 deal promptly and effectively with problems within their control and report those that cannot be solved.</p>

<p>Learning outcome</p> <p>The learner will:</p> <p>2. know how to set automatic cold wire compression spring making machines 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 automatic cold wire compression spring making machines (such as general workshop safety, appropriate Personal Protective Equipment, accident procedure; statutory regulations, risk assessment procedures and COSHH regulations)</p> <p>2.2 describe the hazards associated with working on automatic cold wire compression spring making machines (such as handling coils of spring wire, moving parts of machinery, tool malfunction, automatic operations, using dangerous or badly maintained tools and equipment), and how to minimise them and reduce any risks</p> <p>2.3 describe the safety mechanisms on the machine, and the procedure for checking that they function correctly</p> <p>2.4 explain how to start and stop the machine in normal and emergency situations</p> <p>2.5 describe the importance of ensuring that the machine is isolated from the power supply before setting up the various cams and operating systems</p> <p>2.6 describe the importance of wearing the appropriate protective clothing and equipment, and of keeping the work area clean and tidy</p> <p>2.7 describe the basic principles of operation of the cold wire compression spring making machine used and its accessories, and typical operations that it can perform</p>

- 2.8 explain how to handle and store spring forming tools and equipment, 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 relationship to the automatic cold wire compression spring making machine used, the activities undertaken and types of springs produced
- 2.12 explain how to check that the tools and equipment used are in a safe and serviceable condition, and their care and maintenance procedures
- 2.13 describe the range of forming tools and devices that are used on the machine (such as for forming, bending, straightening, cropping)
- 2.14 describe the selection of cams, and how they are set up and timed in order to produce the components to the required specification
- 2.15 describe the factors which determine the coiling/forming speed and material feed to be used, and how they are set (such as type of material, type of tooling, operations performed, simultaneous multiple operations, tolerance required)
- 2.16 explain how the spring wire materials are to be prepared for the coiling operations, and why some materials may require a heating process prior to forming
- 2.17 describe the characteristics of the various materials used with regard to the coiling and forming process
- 2.18 describe the variations in manufacturing methods and spring characteristics that will occur with different ferrous and non-ferrous metals
- 2.19 explain how the various types of material will affect the feeds and speeds that can be used
- 2.20 explain how to set up the automatic spring making machine and its accessories for the particular operations being performed
- 2.21 explain the need to conduct trial runs, and to check that the machine is set up and producing the components correctly
- 2.22 describe the organisational quality control procedures, and the recognition of coil forming defects
- 2.23 describe the various checks to be carried out on the compression springs (such as dimensional checks, coil forming checks and tension/load checks), and the tools and equipment to be used for this
- 2.24 describe the importance of completing all relevant documentation on conclusion of the compression spring making activities
- 2.25 describe the problems that can occur with setting up the tooling and machine operating parameters, and what to do if they occur
- 2.26 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 415

Setting automatic cold wire torsion spring making machines for production

UAN:	L/600/5635
Level:	3
Credit value:	46
GLH:	150
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 126: Setting Automatic Cold Wire Torsion Spring Making Machines for Production (Level 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	This unit covers the skills and knowledge needed to prove the competences required to prepare and set up automatic cold wire torsion spring making machines for production, in accordance with approved procedures. This will involve setting up for the production of a range of torsion springs, such as right- and left-handed helix, single and double torsion springs and other specific torsion spring forms.

The learner will need to select the appropriate material, feed and guide mechanisms, bending, forming and cut off tools, and to check that they are in a safe and usable condition. The learner will then set the machine operating parameters to produce the torsion springs to the required specification. This will involve mounting and setting up all the required tooling, wire feed mechanisms, operating cams and cam timing, and setting mechanical or pneumatic actuators, electromechanical controls, stops, feed and speed mechanisms, as appropriate to the machine type. The learner must produce trial runs and prove that the machine is working satisfactorily before allowing it to run in automatic production mode. Making adjustments to settings to achieve the spring 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 automatic torsion spring machine setting activities undertaken, and to report any problems with the machine, tooling, equipment or setting-up activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality 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 on automatic cold wire torsion spring making machines. The learner will understand the automatic torsion spring making machine used, and its application, and will know about the material feed mechanisms, tooling, relevant materials, consumables and setting-up procedures, in adequate depth to provide a sound basis for setting up the equipment, correcting faults and ensuring that springs are produced to the required specification.

The learner will understand the safety precautions required when working with the automatic cold wire torsion spring making machine, and with its associated tools and equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

Learning outcome
The learner will: 1. set automatic cold wire torsion spring making 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 during the setting up of the automatic cold wire torsion spring making machines: <ul style="list-style-type: none">• obtain and interpret correctly the documentation for the type of torsion spring being made (such as job instructions, spring

- drawings and quality 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
 - check that the machine and spring forming equipment to be used is in a safe and usable condition
 - carry out the setting-up activities, following good practice/approved procedures
 - ensure that first-off springs are correctly heat treated for inspection/verification
 - ensure that correctly adjusted machine guards are in place
 - leave the machine and work area in a safe and clean condition on completion of the setting-up activities
- 1.3 follow the correct component drawing and any other related 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 mount and set the correct forming tools and devices for the component being produced
- 1.6 select and set up four of the following types of spring making tooling:
- bending tools
 - forming tools
 - looping tools
 - straightening tools
 - cut-off/cropping tools
 - other special-purpose tooling
- 1.7 set the machine operating parameters to achieve the required pressure shaping requirements and component specification
- 1.8 produce wire coil torsion springs/forms from two different types of material from the following:
- carbon steel
 - stainless steel
 - alloy steel
 - copper based alloy
 - nickel based alloys
 - titanium and other special material
- 1.9 set up automatic wire spring forming machines for the production of four of the following:
- right-hand helix
 - left-hand helix
 - single torsion
 - double torsion
 - wire forms
 - other specific torsion springs
- 1.10 set the machine to finish torsion spring ends, to include producing three of the following:
- short hook ends

- straight offset
 - hinge ends
 - straight torsion
 - special ends
- 1.11 set up the operating control systems for an automatic cold wire torsion spring making machine, to include four of the following devices:
- material guide/wire feed mechanisms (such as feed rollers, pneumatic, magazine)
 - cams and mechanical actuators
 - pneumatic/hydraulic actuators
 - de-reeler
 - electro-mechanical actuators
 - pitch spacers
 - feed fingers
 - straighteners
- 1.12 set up the machine in accordance with instructions and specifications, to include all of the following, as appropriate:
- wire feed/speed rollers
 - wire stop mechanisms
 - selecting and setting appropriate cams/gears
 - correct helix
 - correct pitch
 - number of coils required
 - spring arm/leg length
 - finished spring length
 - trip dogs and limit switches
 - position and operation of forming tools
 - position and operation of cropping tool
 - guards/safety mechanisms
- 1.13 check that all safety mechanisms are in place and that the equipment is set correctly for the required operations
- 1.14 carry out checks of the wire torsion springs, to include all of the following:
- size of wire and material specification
 - dimensional accuracy of the free/overall length
 - dimensional accuracy of the outside diameter
 - dimensional accuracy of the inside diameter
 - the number of coils is as specified
 - the spring is wound with the correct hand helix
 - spring ends/legs are of the correct length, angle and shape (where appropriate)
 - spring torsion meets specification requirements
 - completed springs are free from tooling marks and deformation
- 1.15 use four of the following whilst checking the quality of the springs produced:
- Vernier callipers

<ul style="list-style-type: none"> • micrometers • spring testing machines • Vernier protractors • squares • electronic measuring equipment • gauges • jigs <p>1.16 set up automatic cold wire torsion spring making machines to produce springs to one of the following:</p> <ul style="list-style-type: none"> • BS, ISO or BSEN standards and procedures • customer standards and job requirements • company standards and procedures <p>1.17 complete all relevant documentation on conclusion of the spring making activities, to include one of the following:</p> <ul style="list-style-type: none"> • job cards • quality control documentation • company-specific documentation • computer records • test documents <p>1.18 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 automatic cold wire torsion spring making machines for production
Assessment criteria
The learner can:
2.1 describe the specific safety precautions to be taken when setting up automatic cold wire torsion spring making machines (such as general workshop safety, appropriate Personal Protective Equipment, accident procedure; statutory regulations, risk assessment procedures and COSHH regulations)
2.2 describe the hazards associated with working on automatic cold wire spring making machines (such as handling coils of spring wire, moving parts of machinery, tool malfunction, automatic operations using dangerous or badly maintained tools and equipment), 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 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 setting up the various cams and operating systems
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 principles of operation of the automatic cold wire torsion spring making machine used and its accessories, and

- typical operations that it can perform
- 2.8 explain how to handle and store spring forming tools and equipment, 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 relationship to the automatic cold wire torsion spring making machine used, the activities undertaken and types of spring produced
 - 2.12 explain how to check that the tools and equipment used are in a safe and serviceable condition, and their care and maintenance procedures
 - 2.13 describe the range of forming tools and devices that are used on the machine (such as for forming, bending, straightening, looping, cropping)
 - 2.14 describe the selection of cams, and how they are set up and timed in order to produce the components to the required specification
 - 2.15 describe the factors which determine the coiling/forming speed and material feed to be used, and how they are set (such as type of material, type of tooling, operations performed, simultaneous multiple operations, tolerance required)
 - 2.16 explain how the spring wire materials are to be prepared for the coiling operations, and why some materials may require a heating process prior to forming
 - 2.17 describe the characteristics of the various materials used with regard to the coiling and forming process
 - 2.18 describe the variations in manufacturing methods and spring characteristics that will occur with different ferrous and non-ferrous metals
 - 2.19 explain how the various types of material will affect the feeds and speeds that can be used
 - 2.20 explain how to set up the automatic cold wire torsion spring making machine and its accessories for the particular operations being performed
 - 2.21 explain the need to conduct trial runs, and to check that the machine is set up and producing the components correctly
 - 2.22 describe the organisational quality control procedures, and the recognition of coil forming defects
 - 2.23 describe the various checks to be carried out on the torsion springs (such as dimensional checks, coil forming checks and torsion/load checks), and the tools and equipment to be used for this
 - 2.24 describe the importance of completing all relevant documentation on conclusion of the spring making activities
 - 2.25 describe the problems that can occur with setting up the tooling and machine operating parameters, and what to do if they occur
 - 2.26 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 416

Setting automatic cold wire extension spring making machines for production

UAN:	J/600/5648
Level:	3
Credit value:	46
GLH:	150
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 127: Setting Automatic Cold Wire Extension Spring Making Machines for Production (Level 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	This unit covers the skills and knowledge needed to prove the competences required to prepare and set up automatic cold wire extension spring making machines for production, in accordance with approved procedures. This will involve setting up for the production of a range of extension springs, such as right- and left-handed helix, garter springs and other specific extension springs.

The learner will need to select the appropriate material, feed and guide mechanisms, bending, forming and cut off tools, and to check that they are in a safe and usable condition. The learner will then set the machine operating parameters to produce the extension springs to the required specification. This will involve mounting and setting up all the required tooling, wire feed mechanisms, operating cams and cam timing, and setting mechanical or pneumatic actuators, electromechanical controls, stops, feed and speed mechanisms, as appropriate to the machine type. The learner must produce trial runs and prove that the machine is working satisfactorily before allowing it to run in automatic production mode. Making adjustments to settings to achieve the spring 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 automatic cold wire extension spring machine-setting activities undertaken, and to report any problems with the machine, tooling, equipment or setting-up activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality 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 on automatic cold wire extension spring making machines. The learner will understand the automatic cold wire extension spring making machine used, and its application, and will know about the material feed mechanisms, tooling, relevant materials, consumables and setting-up procedures, in adequate depth to provide a sound basis for setting up the equipment, correcting faults and ensuring that springs are produced to the required specification.

The learner will understand the safety precautions required when working with the automatic cold wire extension spring making machine, and with its associated tools and equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

Learning outcome
The learner will: 1. set automatic cold wire extension spring making 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 during the setting up of the automatic cold wire extension spring making machines: <ul style="list-style-type: none">• obtain and interpret correctly the documentation for the type of extension spring being made (such as job instructions,

- spring drawings and quality 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
 - check that the machine and spring forming equipment to be used is in a safe and usable condition
 - carry out the setting-up activities, following good practice/approved procedures
 - ensure that first-off springs are correctly heat treated for inspection/verification
 - ensure that correctly adjusted machine guards are in place
 - leave the machine and work area in a safe and clean condition on completion of the setting-up activities
- 1.3 follow the correct component drawing and any other related 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 mount and set the correct forming tools and devices for the component being produced
- 1.6 select and set up four of the following types of spring making tooling:
- bending tools
 - forming tools
 - looping tools
 - straightening tools
 - cut-off/cropping tools
 - other special-purpose tooling
- 1.7 set the machine operating parameters to achieve the required pressure shaping requirements and component specification
- 1.8 produce wire extension springs from two different types of material from the following:
- carbon steel
 - stainless steel
 - alloy steel
 - copper based alloy
 - nickel based alloys
 - titanium and other special material
- 1.9 set up automatic cold wire extension spring forming machines for the production of three of the following:
- right-hand helix
 - left-hand helix
 - garter springs
 - other specific extension springs
- 1.10 set the machine to finish extension spring ends, to include producing three of the following:
- full round hook/full round eye
 - long round end hook on centre
 - coned end to hold long swivel eye

- eye and hook at right angles
 - extended eye on centre or side
 - small eye on centre
 - square end
 - English loop
 - continental (German) loop
 - enlarged loop
 - side loop
 - plain ends
 - machine loop
 - crossover
 - double loop
 - 45 degree loop
 - extended leg
- 1.11 set up the operating control systems for an automatic cold wire extension spring making machine, to include four of the following devices:
- material guide/wire feed mechanisms (such as feed rollers, pneumatic, magazine)
 - cams and mechanical actuators
 - pneumatic/hydraulic actuators
 - de-reeler
 - straighteners
 - electro-mechanical actuators
 - pitch spacers
 - feed fingers
- 1.12 set up the machine in accordance with instructions and specifications, to include all of the following, as appropriate:
- wire feed/speed rollers
 - wire stop mechanisms
 - selecting and setting appropriate cams/gears
 - correct helix
 - correct pitch
 - number of coils required
 - spring arm/leg length
 - finished spring length
 - trip dogs and limit switches
 - position and operation of forming tools
 - position and operation of cropping tool
 - guards/safety mechanisms
- 1.13 check that all safety mechanisms are in place and that the equipment is set correctly for the required operations
- 1.14 carry out checks of the wire springs, to include all of the following:
- size of wire and material specification
 - dimensional accuracy of the free/overall length
 - dimensional accuracy of the outside diameter
 - dimensional accuracy of the inside diameter

<ul style="list-style-type: none"> • the number of coils is as specified • the spring is wound with the correct hand helix • spring ends/legs are of the correct length, angle and shape (where appropriate) • spring load/extension meets specification requirements • completed springs are free from tooling marks and deformation <p>1.15 use four of the following whilst checking the quality of the springs produced:</p> <ul style="list-style-type: none"> • Vernier callipers • micrometers • spring testing machines • Vernier protractors • squares • electronic measuring equipment • gauges • jigs <p>1.16 set up automatic cold wire extension spring making machines to produce springs to one of the following:</p> <ul style="list-style-type: none"> • BS, ISO or BSEN standards and procedures • customer standards and job requirements • company standards and procedures <p>1.17 complete all relevant documentation on conclusion of the spring making activities, to include one of the following:</p> <ul style="list-style-type: none"> • job cards • quality control documentation • company-specific documentation • computer records • test documents <p>1.18 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 automatic cold wire extension spring making machines for production
Assessment criteria
The learner can: 2.1 describe the specific safety precautions to be taken when setting up automatic cold wire extension spring making machines (such as general workshop safety, appropriate Personal Protective Equipment, accident procedure; statutory regulations, risk assessment procedures and COSHH regulations) 2.2 describe the hazards associated with working on automatic cold wire extension spring making machines (such as handling coils of spring wire, moving parts of machinery, tool malfunction, automatic operations using dangerous or badly maintained tools and equipment), 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 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 setting up the various cams and operating systems
 - 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 principles of operation of the automatic cold wire extension spring making machine used and its accessories, and typical operations that it can perform
 - 2.8 explain how to handle and store spring forming tools and equipment, 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 relationship to the automatic cold wire extension spring making machine used, the activities undertaken and types of springs produced
 - 2.12 explain how to check that the tools and equipment used are in a safe and serviceable condition, and their care and maintenance procedures
 - 2.13 describe the range of forming tools and devices that are used on the machine (such as for forming, bending, straightening, looping, cropping)
 - 2.14 describe the selection of cams, and how they are set up and timed in order to produce the components to the required specification
 - 2.15 describe the factors which determine the coiling/forming speed and material feed to be used, and how they are set (such as type of material, type of tooling, operations performed, simultaneous multiple operations, tolerance required)
 - 2.16 explain how the spring wire materials are to be prepared for the coiling operations, and why some materials may require a heating process prior to forming
 - 2.17 describe the characteristics of the various materials used with regard to the coiling and forming process
 - 2.18 describe the variations in manufacturing methods and spring characteristics that will occur with different ferrous and non-ferrous metals
 - 2.19 explain how the various types of material will affect the feeds and speeds that can be used
 - 2.20 explain how to set up the automatic cold wire extension spring making machine and its accessories for the particular operations being performed
 - 2.21 explain the need to conduct trial runs, and to check that the machine is set up and producing the components correctly
 - 2.22 describe the organisational quality control procedures, and the recognition of coil forming defects
 - 2.23 describe the various checks to be carried out on the extension springs (such as dimensional checks, coil forming checks and

- extension/load checks), and the tools and equipment to be used
- 2.24 describe the importance of completing all relevant documentation on conclusion of the spring making activities
 - 2.25 describe the problems that can occur with setting up the tooling and machine operating parameters, and what to do if they occur
 - 2.26 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 417

Setting automatic spring making machines for the production of clock, power, scroll and volute springs

UAN:	R/600/5653
Level:	3
Credit value:	46
GLH:	150
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 128: Setting Automatic Spring Making Machines for the Production of Clock, Power, Scroll and Volute Springs (Level 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to prepare and set up automatic spring making machines for production, in accordance with approved procedures. This will involve setting up for the production of a range of springs such as clock, power, scroll/spiral, constant force and volute.</p> <p>The learner will need to select the appropriate material, feed and guide mechanisms, bending, forming and cut off tools, and to check that they are in a safe and usable condition. The learner will then set the machine operating parameters to produce the springs to the required specification. This will involve mounting and setting up all the required tooling, strip feed mechanisms, operating cams and cam timing, and setting mechanical or pneumatic actuators, electromechanical controls, stops, feed and speed mechanisms, as appropriate to the machine type. The learner must produce trial runs and prove that the machine is working satisfactorily before allowing it to run in automatic production mode. Making adjustments to settings to achieve the spring specification, and solving machine-related problems during</p>

production, will also form part of their role.

The learner's responsibilities will require them to comply with organisational policy and procedures for the automatic spring machine setting activities undertaken, and to report any problems with the machine, tooling, equipment or setting-up activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality 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 on automatic spring making machines. The learner will understand the automatic spring making machine used, and its application, and will know about the material feed mechanisms, tooling, relevant materials, consumables and setting-up procedures, in adequate depth to provide a sound basis for setting up the equipment, correcting faults and ensuring that springs are produced to the required specification.

The learner will understand the safety precautions required when working with the automatic spring making machine, and with its associated tools and equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

Learning outcome
The learner will: 1. set automatic spring making machines for the production of clock, power, scroll and volute springs
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 during the setting up of the automatic spring making machine: <ul style="list-style-type: none">• obtain and interpret correctly the documentation for the type of spring being made (such as job instructions, spring drawings and quality 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
 - check that the machine and spring forming equipment to be used is in a safe and usable condition
 - carry out the setting-up activities, following good practice/approved procedures
 - ensure that first-off springs are correctly heat treated for inspection/verification
 - ensure that correctly adjusted machine guards are in place
 - leave the machine and work area in a safe and clean condition on completion of the setting-up activities
- 1.3 follow the correct component drawing and any other related 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 mount and set the correct forming tools and devices for the component being produced
- 1.6 select and set up four of the following types of spring making tooling:
- bending tools
 - forming tools
 - looping tools
 - straightening tools
 - cut-off/cropping tools
 - other special-purpose tooling
- 1.7 set the machine operating parameters to achieve the required pressure shaping requirements and component specification
- 1.8 produce clock/power springs from two different types of material from the following:
- carbon steel
 - stainless steel
 - alloy steel
 - copper based alloy
 - nickel based alloys
 - titanium and other special material
- 1.9 set up automatic spring making machines for the production of three of the following types of spring:
- clock
 - power
 - scroll/spiral
 - constant force
 - variable force
 - volute
 - other wire forms
- 1.10 set up the operating control systems for an automatic spring making machine, to include four of the following devices:
- material guide/wire feed mechanisms (such as feed rollers,

- pneumatic, magazine)
 - cams and mechanical actuators
 - pneumatic/hydraulic actuators
 - electro-mechanical actuators
 - de-reeler
 - pitch spacers
 - feed fingers
 - straighteners
- 1.11 set up the machine in accordance with instructions and specifications, to include all of the following, as appropriate:
- strip feed/speed rollers
 - strip stop mechanisms
 - selecting and setting appropriate cams/gears
 - correct helix
 - correct pitch
 - number of coils required
 - spring arm/leg length
 - finished spring dimensions
 - trip dogs and limit switches
 - position and operation of forming tools
 - position and operation of cropping tool
 - guards/safety mechanisms
- 1.12 check that all safety mechanisms are in place and that the equipment is set correctly for the required operations
- 1.13 carry out checks of the springs, to include all of the following:
- size of strip and material specification
 - dimensional accuracy of the finished spring
 - the number of coils is as specified
 - the spring is wound with the correct hand helix
 - spring ends are finished correctly
 - spring tension/load meets specification requirements
 - completed springs are free from tooling marks and deformation
- 1.14 use four of the following whilst checking the quality of the springs produced:
- Vernier callipers
 - micrometers
 - spring testing machines
 - Vernier protractors
 - squares
 - electronic measuring equipment
 - gauges
 - jigs
- 1.15 set up automatic spring making machines to produce springs to one of the following:
- BS, ISO or BSEN standards and procedures
 - customer standards and job requirements

<ul style="list-style-type: none"> • company standards and procedures <p>1.16 complete all relevant documentation on completion of the spring making activities, to include one of the following:</p> <ul style="list-style-type: none"> • job cards • quality control documentation • company-specific documentation • computer records • test documents <p>1.17 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 automatic spring making machines for the production of clock, power, scroll and volute springs
Assessment criteria
The learner can:
2.1 describe the specific safety precautions to be taken when setting up automatic spring making machines (such as general workshop safety, appropriate Personal Protective Equipment, accident procedure; statutory regulations, risk assessment procedures and COSHH regulations)
2.2 describe the hazards associated with working on automatic spring making machines (such as handling coils of spring material, moving parts of machinery, tool malfunction, automatic operations, using dangerous or badly maintained tools and equipment), 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 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 setting up the various cams and operating systems
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 principles of operation of the automatic spring making machine used and its accessories, and typical operations that it can perform
2.8 explain how to handle and store spring forming tools and equipment, 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 relationship to the automatic spring making machine used, the activities undertaken and types of springs produced

- 2.12 explain how to check that the tools and equipment used are in a safe and serviceable condition, and their care and maintenance procedures
- 2.13 describe the range of forming tools and devices that are used on the machine (such as for forming, bending, straightening, cropping)
- 2.14 describe the selection of cams, and how they are set up and timed in order to produce the components to the required specification
- 2.15 describe the factors which determine the coiling/forming speed and material feed to be used, and how they are set (such as type of material, type of tooling, operations performed, simultaneous multiple operations, tolerance required)
- 2.16 explain how the spring strip materials are to be prepared for the coiling operations, and why some materials may require a heating process prior to forming
- 2.17 describe the characteristics of the various materials used with regard to the coiling and forming process
- 2.18 describe the variations in manufacturing methods and spring characteristics that will occur with different ferrous and non-ferrous metals
- 2.19 explain how the various types of materials will affect the feeds and speeds that can be used
- 2.20 explain how to set up the automatic spring making machine and its accessories for the particular operations being performed
- 2.21 explain the need to conduct trial runs, and to check that the machine is set up and producing the components correctly
- 2.22 describe the organisational quality control procedures, and the recognition of coil forming defects
- 2.23 describe the various checks to be carried out on the springs (such as dimensional checks, coil forming checks and tension/load checks), and the tools and equipment to be used
- 2.24 describe the importance of completing all relevant documentation on conclusion of the spring making activities
- 2.25 describe the problems that can occur with setting up the tooling and machine operating parameters, and what to do if they occur
- 2.26 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 418

Setting automatic cold wire forming machines to produce spring wire forms

UAN:	M/600/5661
Level:	3
Credit value:	46
GLH:	150
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 129: Setting Automatic Cold Wire Forming Machines to Produce Spring Wire Forms (Level 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	This unit covers the skills and knowledge needed to prove the competences required to prepare and set up automatic cold wire forming machines, to produce specific spring wire forms, in accordance with approved procedures. This will involve setting up for the production of a range of spring wire forms, such as spring pins, retaining clips, keyrings and other specific wire forms.

The learner will need to select the appropriate material, feed and guide mechanisms, bending, forming and cut off tools, and to check that they are in a safe and usable condition. The learner will then set the machine operating parameters to produce the wire forms to the required specification. This will involve mounting and setting up all the required tooling, wire feed mechanisms, operating cams and cam timing, and setting mechanical or pneumatic actuators, electromechanical controls, stops, feed and speed mechanisms, as appropriate to the machine type. The learner must produce trial runs and prove that the machine is working satisfactorily before allowing it to run in automatic production mode. Making adjustments to settings to achieve the spring 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 automatic cold wire forming machine-setting activities undertaken, and to report any problems with the machine, tooling, equipment or setting-up activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality 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 on automatic cold wire forming machines. The learner will understand the automatic cold wire form making machine used, and its application, and will know about the material feed mechanisms, tooling, relevant materials, consumables and setting-up procedures, in adequate depth to provide a sound basis for setting up the equipment, correcting faults and ensuring that springs are produced to the required specification.

The learner will understand the safety precautions required when working with the automatic cold wire form making machine, and with its associated tools and equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

Learning outcome
The learner will: 1. set automatic cold wire forming machines to produce spring wire forms
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 during the setting up of the automatic cold wire forming machines: <ul style="list-style-type: none">• obtain and interpret correctly the documentation for the type of wire form being made (such as job instructions, spring drawings and quality 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
 - check that the machine and spring forming equipment to be used is in a safe and usable condition
 - carry out the setting-up activities, following good practice/approved procedures
 - ensure that first-off spring wire forms are correctly heat treated for inspection/verification
 - ensure that correctly adjusted machine guards are in place
 - leave the machine and work area in a safe and clean condition on completion of the setting-up activities
- 1.3 follow the correct component drawing and any other related 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 mount and set the correct forming tools and devices for the component being produced
- 1.6 select and set up four of the following types of spring making tooling:
- bending tools
 - forming tools
 - looping tools
 - straightening tools
 - cut-off/cropping tools
 - other special-purpose tooling
- 1.7 set the machine operating parameters to achieve the required pressure shaping requirements and component specification
- 1.8 produce wire forms from two different types of material from the following:
- carbon steel
 - stainless steel
 - alloy steel
 - copper based alloy
 - nickel based alloys
 - titanium and other special material
- 1.9 set up automatic cold wire forming machines for the production of three of the following:
- spring pins/clips
 - keyrings
 - plain wire rings
 - retaining rings
 - other specific spring wire forms
- 1.10 set up operating control systems for an automatic cold wire forming machine, to include four of the following devices:
- material guide/wire feed mechanisms (such as feed rollers, pneumatic, magazine)
 - cams and mechanical actuators

- pneumatic/hydraulic actuators
 - de-reeler
 - electro-mechanical actuators
 - pitch spacers
 - feed fingers
 - straighteners
- 1.11 set up the machine in accordance with instructions and specifications, to include all of the following, as appropriate:
- wire feed/speed rollers
 - wire stop mechanisms
 - selecting and setting appropriate cams/gears
 - correct form/shape
 - trip dogs and limit switches
 - position and operation of forming tools
 - position and operation of cropping tool
 - guards/safety mechanisms
- 1.12 check that all safety mechanisms are in place and that the equipment is set correctly for the required operations
- 1.13 carry out checks of the wire forms, to include all of the following:
- size of wire and material specification
 - dimensional accuracy of the form produced
 - shape of the form produced
 - wire form load/tension meets specification requirements
 - completed wire forms are free from tooling marks and deformation
- 1.14 use four of the following whilst checking the quality of the wire forms produced:
- Vernier callipers
 - micrometers
 - spring testing machines
 - Vernier protractors
 - squares
 - electronic measuring equipment
 - gauges
 - jigs
- 1.15 set up automatic cold wire forming machines to produce wire forms to one of the following:
- BS, ISO or BSEN standards and procedures
 - customer standards and job requirements
 - company standards and procedures
- 1.16 complete all relevant documentation on completion of the wire form making activities, to include one of the following:
- job cards
 - quality control documentation
 - company-specific documentation
 - computer records
 - test documents

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

Learning outcome

The learner will:

2. know how to set automatic cold wire forming machines to produce spring wire forms

Assessment criteria

The learner can:

- 2.1 describe the specific safety precautions to be taken when setting up automatic cold wire forming machines (such as general workshop safety, appropriate Personal Protective Equipment, accident procedure; statutory regulations, risk assessment procedures and COSHH Regulations)
- 2.2 describe the hazards associated with working on automatic cold wire forming machines (such as handling coils of spring wire, moving parts of machinery, tool malfunction, automatic operations using dangerous or badly maintained tools and equipment), 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 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 setting up the various cams and operating systems
- 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 principles of operation of the automatic cold wire, wire forming machine used and its accessories, and typical operations that it can perform
- 2.8 explain how to handle and store wire forming tools and equipment 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 relationship to the automatic cold wire forming machine used, the activities undertaken and types of wire forms produced
- 2.12 explain how to check that the tools and equipment used are in a safe and serviceable condition, and their care and maintenance procedures
- 2.13 describe the range of forming tools and devices that are used on the machine (such as for forming, bending, straightening, looping, cropping)
- 2.14 describe the selection of cams, and how they are set up and timed in order to produce the components to the required specification
- 2.15 describe the factors which determine the forming speed and

material feed to be used, and how they are set (such as type of material, type of tooling, operations performed, simultaneous multiple operations, tolerance required)

- 2.16 explain how the spring wire materials are to be prepared for the forming operations, and why some materials may require a heating process prior to forming
- 2.17 describe the characteristics of the various materials used with regard to the wire forming process
- 2.18 describe the variations in manufacturing methods and spring characteristics that will occur with different ferrous and non-ferrous metals
- 2.19 explain how the various types of materials will affect the feeds and speeds that can be used
- 2.20 explain how to set up the automatic cold wire forming machine and its accessories for the particular operations being performed
- 2.21 explain the need to conduct trial runs, and to check that the machine is set up and producing the components correctly
- 2.22 describe the organisational quality control procedures, and the recognition of wire forming defects
- 2.23 describe the various checks to be carried out on the wire forms (such as dimensional checks, wire forming checks and tension/load checks), and the tools and equipment to be used for this
- 2.24 describe the importance of completing all relevant documentation on completion of the wire forming activities
- 2.25 describe the problems that can occur with setting up the tooling and machine operating parameters, and what to do if they occur
- 2.26 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 419

Setting automatic hot wire compression spring making machines for production

UAN:	D/600/5672
Level:	3
Credit value:	46
GLH:	150
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 130: Setting Automatic Hot Wire Compression Spring Making Machines for Production (Level 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	This unit covers the skills and knowledge needed to prove the competences required to prepare and set up automatic hot wire compression spring making machines for production, in accordance with approved procedures. This will involve setting up for the production of a range of compression springs, such as open and closed end and right- and left-hand helix springs.

The learner will need to select the appropriate material, feed and guide mechanisms, bending, forming and cut off tools, and to check that they are in a safe and usable condition. The learner will then set the machine operating parameters to produce the springs to the required specification. This will involve mounting and setting up all the required tooling, wire feed mechanisms, operating cams and cam timing, and setting mechanical or pneumatic actuators, electromechanical controls, stops, feed and speed mechanisms and wire heating elements, as appropriate to the machine type. The learner must produce trial runs and prove that the machine is working satisfactorily before allowing it to run in automatic production mode. Making adjustments to settings to achieve the spring 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 automatic hot wire compression spring machine setting activities undertaken, and to report any problems with the machine, tooling, equipment or setting-up activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality 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 on automatic hot wire compression spring making machines. The learner will understand the automatic hot wire compression spring making machine used, and its application, and will know about the material feed mechanisms, tooling, relevant material heating and quenching requirements, consumables and setting-up procedures, in adequate depth to provide a sound basis for setting up the equipment, correcting faults and ensuring that springs are produced to the required specification.

The learner will understand the safety precautions required when working with the automatic hot wire compression spring making machine, and with its associated tools and equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

Learning outcome
The learner will: 1. set automatic hot wire compression spring making 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 during the setting up of the automatic

hot wire compression spring making machines:

- obtain and interpret correctly the documentation for the type of compression spring being made (such as job instructions, spring drawings and quality 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
 - check that the machine and spring forming equipment to be used is in a safe and usable condition
 - carry out the setting-up activities, following good practice/approved procedures
 - ensure that first-off springs are correctly heat treated for inspection/verification
 - ensure that correctly adjusted machine guards are in place
 - leave the machine and work area in a safe and clean condition on completion of the setting-up activities
- 1.3 follow the correct component drawing and any other related 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 mount and set the correct forming tools and devices for the component being produced
- 1.6 select and set up two of the following types of spring making tooling:
- bending tools
 - forming tools
 - looping tools
 - straightening tools
 - cut-off/cropping tools
 - other special-purpose tooling
- 1.7 set the machine operating parameters to achieve the required pressure shaping requirements and component specification
- 1.8 produce wire compression springs from two different types of material from the following:
- carbon steel
 - alloy steel
 - other special material
- 1.9 set up automatic hot wire compression spring forming machines for the production of four of the following:
- open ended right-hand helix
 - open ended left-hand helix
 - closed end right-hand helix
 - conical
 - variable pitch
 - closed end left-hand helix
 - barrel
 - garter springs
 - other wire forms
- 1.10 set up operating control systems for an automatic hot wire

compression spring making machine, to include four of the following devices:

- material/wire heating equipment
- material guide/wire feed mechanisms (such as feed rollers, pneumatic, magazine)
- cams and mechanical actuators
- pneumatic/hydraulic actuators
- de-reeler
- electro-mechanical actuators
- pitch spacers
- feed fingers
- straighteners
- quenching equipment

1.11 set up the machine in accordance with instructions and specifications, to include all of the following, as appropriate:

- wire feed/speed rollers
- wire stop mechanisms
- selecting and setting appropriate cams/gears
- correct helix
- correct pitch
- number of coils required
- spring arm/leg length
- finished spring length
- trip dogs and limit switches
- position and operation of forming tools
- position and operation of cropping tool
- guards/safety mechanisms

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

1.13 carry out checks of the wire compression spring, to include all of the following:

- size of wire and material specification
- dimensional accuracy of the free/overall length
- dimensional accuracy of the outside diameter
- dimensional accuracy of the inside diameter
- the number of coils is as specified
- the spring is wound with the correct hand helix
- spring ends are flat and square to spring axis (where appropriate)
- heat treatment meets specification requirements
- spring load and rate meets specification requirements
- completed springs are free from tooling marks and deformation

1.14 use four of the following whilst checking the quality of the springs produced:

- Vernier callipers
- micrometers

<ul style="list-style-type: none"> • spring testing machines • Vernier protractors • squares • electronic measuring equipment • gauges • jigs <p>1.15 set up automatic hot wire compression spring making machines to produce springs to one of the following:</p> <ul style="list-style-type: none"> • BS, ISO or BSEN standards and procedures • customer standards and job requirements • company standards and procedures <p>1.16 complete all relevant documentation on completion of the spring making activities, to include one of the following:</p> <ul style="list-style-type: none"> • job cards • quality control documentation • company-specific documentation • computer records • test documents <p>1.17 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 automatic hot wire compression spring making machines 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 automatic hot wire compression spring making machines (such as general workshop safety, appropriate Personal Protective Equipment, accident procedure; statutory regulations, risk assessment procedures and COSHH regulations)</p> <p>2.2 describe the hazards associated with working on automatic hot wire compression spring making machines (such as handling coils of spring wire, hot components, moving parts of machinery, tool malfunction, automatic operations, using dangerous or badly maintained tools and equipment), and how to minimise them and reduce any risks</p> <p>2.3 describe the safety mechanisms on the machine, and the procedure for checking that they function correctly</p> <p>2.4 explain how to start and stop the machine in normal and emergency situations</p> <p>2.5 describe the importance of ensuring that the machine is isolated from the power supply before setting up the various cams and operating systems</p> <p>2.6 describe the importance of wearing the appropriate protective clothing and equipment, and of keeping the work area clean and tidy</p> <p>2.7 describe the basic principles of operation of the hot wire compression spring making machine used and its accessories, and</p>

- typical operations that it can perform
- 2.8 explain how to handle and store spring forming tools and equipment, 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 relationship to the automatic hot wire compression spring making machine used, the activities undertaken and types of springs produced
 - 2.12 explain how to check that the tools and equipment used are in a safe and serviceable condition, and their care and maintenance procedures
 - 2.13 describe the range of forming tools and devices that are used on the machine (such as for forming, bending, straightening, cropping)
 - 2.14 describe the selection of cams, and how they are set up and timed in order to produce the components to the required specification
 - 2.15 describe the factors which determine the coiling/forming speed and material feed to be used, and how they are set (such as type of material, type of tooling, operations performed, simultaneous multiple operations, tolerance required)
 - 2.16 explain how the spring wire material is heated for the coiling operations
 - 2.17 explain how the finished springs are to be quenched/heat treated
 - 2.18 describe the characteristics of the various materials used with regard to the coiling and forming process
 - 2.19 describe the variations in manufacturing methods and spring characteristics that will occur with different ferrous and non-ferrous metals
 - 2.20 explain how to set up the automatic spring making machine and its accessories for the particular operations being performed
 - 2.21 explain the need to conduct trial runs, and to check that the machine is set up and producing the components correctly
 - 2.22 describe the organisational quality control procedures, and the recognition of coil forming defects
 - 2.23 describe the various checks to be carried out on the compression springs (such as dimensional checks, coil forming checks, heat treatment checks and tension/load checks), and the tools and equipment to be used for this
 - 2.24 describe the importance of completing all relevant documentation on conclusion of the compression spring making activities
 - 2.25 describe the problems that can occur with setting up the tooling and machine operating parameters, and what to do if they occur
 - 2.26 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 420

Setting automatic spring end grinding machines for production

UAN:	L/600/5683
Level:	3
Credit value:	16
GLH:	60
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 131: Setting Automatic Spring End Grinding Machines for Production (Level 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to prepare and set up automatic spring end grinding machines, such as single end and double end spring grinding machines, in accordance with approved procedures. The learner will be expected to set up the machines to grind the ends flat, square and to the correct dimensional requirements. This will involve 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, to check them for defects, balance them when appropriate, and to mount and secure them to the machine spindles. The learner will be expected to prepare the grinding wheels for operation by 'trueing up' and dressing the wheels, and creating any necessary relief, 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 achieve specification, and solving machine-related problems during production, will also form</p>

part of their role.

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

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to the setting-up procedures used. The learner will understand the automatic spring end grinding machine used, and its application, and will know about the workholding devices, grinding wheels, wheel dressing, 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 automatic spring end grinding machines, and with their associated tools and equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

Learning outcome
The learner will: 1. set automatic spring end 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 interpret correctly the documentation for the type of spring to be ground (such as job instructions, spring drawings and quality 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
- check that the machine and workholding device to be used is in a safe and usable condition
 - carry out the setting-up activities, following good practice/approved procedures
 - ensure that grinding wheels are correctly dressed/formed and are in a usable condition
 - hold components securely, without distortion
 - ensure that correctly adjusted machine guards are in place
 - leave the machine and work area in a safe and clean condition on completion of the setting-up 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 automatic spring end grinding machine in readiness for production:
- single end
 - double end
- 1.6 mount and set the required workholding devices, workpiece and cutting tools
- 1.7 position and secure the springs, using three of the following workholding methods and devices:
- loading plate
 - pots
 - magnetic table
 - bushes
 - fixtures
- 1.8 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)
 - testing wheels for soundness/cracks
 - mounting wheels (such as paper washers, flanges, locking pressure)
 - balancing wheels, where appropriate
 - dressing and 'trueing up' grinding wheels
- 1.9 set the machine tool operating parameters to achieve the component specification
- 1.10 grind components made from two of the following types of material:
- carbon steel
 - stainless steel
 - alloy steel
 - copper based alloy
 - nickel based alloys
 - titanium and other special material
- 1.11 use one of the following methods when grinding the springs:
- crash grinding
 - down-feed grinding

- 1.12 set up the spring end grinding machines in accordance with instructions and specifications, to include all of the following, as appropriate:
- mounting and securing the appropriate loading plate/fixture to the machine
 - checking springs for cleanliness and freedom from burrs, reaming and edging if required
 - loading springs in the fixture, using bushes, where appropriate
 - setting guards and safety mechanisms and checking that they operate correctly
 - setting the grinding machine to grind one or both ends, as appropriate to the machine type
 - setting to give equal tip end thickness
 - setting automatic trips and limit switches
 - checking that spring length, squareness and finish are to specification
- 1.13 check that all safety mechanisms are in place and that the equipment is set correctly for the required operations
- 1.14 carry out checks of the springs, to include all of the following:
- free length
 - squareness
 - coil diameter of end
 - solid length
 - tip end thickness
 - finish
- 1.15 use four of the following whilst checking the quality of the springs produced:
- Vernier callipers
 - micrometers
 - spring testing machines
 - Vernier protractors
 - squares
 - electronic measuring equipment
 - gauges
 - jigs
- 1.16 set up automatic spring end grinding machines, to grind spring ends to meet one of the following:
- BS, ISO or BSEN standards and procedures
 - customer standards and job requirements
 - company standards and procedures
- 1.17 complete all relevant documentation on completion of the spring grinding activities, to include one of the following:
- job cards
 - quality control documentation
 - company-specific documentation
 - computer records
 - test documents
- 1.18 deal promptly and effectively with problems within their control

and report those that cannot be solved.

Learning outcome

The learner will:

2. know how to set automatic spring end 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 automatic spring end grinding machines (such as single or double ended)
- 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 spring end grinding (such as moving parts of machinery, sparks/airborne particles, the possibility of fire when grinding titanium, 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 spring end grinding machine, 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 spring end grinding, in relation to the activities undertaken
- 2.12 describe the range of workholding methods and devices that are used on the spring end grinding machines
- 2.13 describe the methods of mounting and setting the springs in the workholding devices, and the tools and equipment that are to be used for this
- 2.14 describe the selection of grinding wheels with regard to the type of material being ground and operations being carried out
- 2.15 explain how the various types of spring material will affect the feeds and speeds that can be used
- 2.16 explain how to check that the grinding wheels are in a safe and serviceable condition (such as free from damage, cracks, correctly balanced)
- 2.17 explain how grinding wheels are balanced, and the equipment that is used for this

- 2.18 describe the methods of mounting and securing the grinding wheels to the machine spindles
- 2.19 explain the need for 'trueing up' and frequent dressing of wheels to prevent glazing and burning of the spring surface
- 2.20 explain how to set up the machines for the particular operations being performed
- 2.21 describe the application of cutting fluids with regard to a range of different materials
- 2.22 explain the need to conduct trial runs, and to check that the machine is set up and running safely and correctly
- 2.23 describe the organisational quality control procedures, and the recognition of grinding defects
- 2.24 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
- 2.25 describe the importance of completing all relevant documentation on conclusion of the spring grinding activities
- 2.26 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 421

Programming CNC spring making machines

UAN:	H/600/5687
Level:	3
Credit value:	84
GLH:	231
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 132: Programming CNC Spring Making Machines (Level 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to produce, load and prove machine operating programs on computer numerically controlled (CNC) spring making machines, in accordance with approved procedures. The CNC machines covered by this unit include single head, multi-head and coiling and bending centres. The learner will be required to produce the spring program, using manual data input or by use of a remote computer, saving the prepared program on tape or disc, or downloading it directly into the machine controller from the computer. The learner will need to check the program using single block run and program edit facilities. The learner will also be required to adjust the spring making machine equipment and program, following the proving/editing activities, to achieve the component specification. The learner must ensure that any edited programs are saved safely and correctly.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for producing, loading and proving the spring programs, and to report any problems with these activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision,</p>

taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying CNC spring making machine programming procedures. The learner will understand the CNC spring making machine used in the process and its application, and will know about the programming, editing and proving process, in adequate depth to provide a sound basis for carrying out the activities, correcting faults and ensuring that the machine controller is set up to produce springs to the required specification.

The learner will understand the safety precautions required when working on the CNC spring making machine, and with its associated tools and equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

Learning outcome
The learner will: 1. programme CNC spring making 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 apply all of the following checks and practices during the CNC spring making machine programming activities: <ul style="list-style-type: none">• obtain and interpret correctly the documentation for the type of spring being made (such as job instructions, spring drawings, and quality 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• check that the machine and spring forming equipment to be used is in a safe and usable condition• carry out the setting-up activities, following good practice/approved procedures• ensure that correctly adjusted machine guards are in place• leave the machine and work area in a safe and clean condition on completion of the setting-up activities 1.3 use the correct control program and ensure that it is correctly loaded into the machine controller

- 1.4 prepare CNC spring programs for four of the following:
- open ended right-hand helix
 - open ended left-hand helix
 - closed end right-hand helix
 - closed end left-hand helix
 - single torsion
 - double torsion
 - conical
 - hourglass
 - constant pitch
 - variable pitch
 - barrel
 - garter spring
 - clock
 - power
 - scroll/spiral
 - volute
 - other wire forms
- 1.5 prepare programs to finish extension spring ends, to include producing three of the following:
- full round hook/full round eye
 - long round end hook on centre
 - coned end to hold long swivel eye
 - eye and hook at right angles
 - extended eye on centre or side
 - small eye on centre
 - square end
 - short hook end
 - hinge end
 - English loop
 - continental (German) loop
 - straight offset
 - enlarged loop
 - side loop
 - plain ends
 - machine loop
 - crossover
 - double loop
 - 45 degree loop
 - extended leg
 - other specific end configuration
- 1.6 produce CNC spring programs, using one of the following methods:
- written
 - entered directly into the machine controller
 - using computer software
- 1.7 develop spring programs, which contain all of the following:

- all necessary dimensional information
 - all necessary positional information
 - all necessary geometry (such as helix, bend angle, loop)
 - appropriate letter address codes
 - preparatory commands and machine management/auxiliary functions
 - repetitive programs (such as sub-routines, canned cycles, labels)
 - absolute or incremental systems of measurement
 - forming tool/shearing tool change/stop positions
 - forming tool information (such as lengths, offsets, radius compensation)
- 1.8 follow the correct procedures for calling up the program and dealing with any error messages or faults
- 1.9 input the spring program to the controller, to include carrying out all of the following:
- using the appropriate reference manuals and programming codes to suit the type of machine controller
 - preparing the machine controller to accept the operating program
 - inputting/loading the prepared program into the controller, safely and correctly
 - saving programs safely and correctly, in the appropriate format
 - storing completed program media safely away from contaminants or electromagnetic sources
- 1.10 confirm the program integrity
- 1.11 prove the spring program, using six of the following:
- data input facilities single block run
 - search facilities
 - graphic displays
 - full dry run
 - program save/store facilities
 - edit facilities
 - program override controls (such as speed, feed, tool data)
- 1.12 adjust the equipment and program operating parameters to optimise the outcomes to be achieved
- 1.13 confirm that the spring making machine and program operates safely and correctly, by checking all of the following:
- all operations are carried out to the program co-ordinates
 - the correct tools are selected at the appropriate points in the program (where applicable)
 - tool change/park positions are safe and clear of the workpiece and machine equipment (where applicable)
 - tool data is checked and, where applicable, updated in the machine controller
 - material feed mechanisms operate safely and correctly
 - auxiliary functions operate at the correct point in the program (such as bending, looping, shearing)

- finished springs are ejected into the correct storage bins
 - programs have been saved in the appropriate format
- 1.14 load and correctly set up all associated equipment
- 1.15 check that all safety mechanisms are in place and that the equipment is set correctly for the required operations
- 1.16 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 programme CNC spring making machines
Assessment criteria
The learner can:
2.1 describe the specific safety precautions to be taken when loading and proving CNC spring making machine operating programs
2.2 explain how to start and stop the machine, in normal and emergency situations
2.3 describe the importance of wearing the appropriate protective clothing and equipment, and of keeping the work area clean and tidy
2.4 describe the computing/coding language used in CNC spring making machine programs, with regard to machine axes, positional information, machine management and auxiliary functions
2.5 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
2.6 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, and system of tolerancing
2.7 explain how to interpret CNC drawings and the use of workpiece zero/reference points
2.8 explain how to carry out currency/issue checks on the specifications they are working with
2.9 describe the systems of measurement used on CNC drawing (including absolute and incremental)
2.10 describe the use of repetitive programs and canned cycles to reduce program size and inputting time
2.11 explain how to prepare spring programs, using operational sequences and bending and forming techniques which avoid unnecessary tool movements or tool changes
2.12 describe the function keys and operating system for the CNC spring making machine being operated
2.13 describe the operation of the various hand and automatic modes of machine control (such as hand wheels, joysticks, program operating and control buttons)
2.14 explain how to set machine datums for each machine axis being used
2.15 explain how to set the machine controller in the program and editing mode, and how to enter or download the prepared program
2.16 explain how to deal with error messages and faults on the program or equipment
2.17 explain how to access the program edit facility, in order to enter

tooling data (such as tool datums, positions, lengths, offsets and radius compensation)

- 2.18 describe the use of tool posts, magazines and carousels, and how to identify the tools in relationship to the operating program
- 2.19 explain how to conduct trial runs using single-block run, dry run, and feed and speed override controls
- 2.20 describe the factors that will affect the operating speeds that can be used, and why they may need to be adjusted from the program setting (such as condition of material, operations to be performed, tooling used, tolerance to be achieved)
- 2.21 describe the things to check before allowing the machine to operate in full program run mode
- 2.22 explain how to save the completed programs in the appropriate format
- 2.23 explain how to handle and store program tapes and disks, safely and correctly, away from contaminants and electromagnetic sources
- 2.24 describe the typical problems that can occur with the programming, loading and editing activities, and what to do if they occur
- 2.25 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 422

Setting CNC spring making machines for production

UAN:	H/600/5690
Level:	3
Credit value:	46
GLH:	150
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 133: Setting CNC Spring Making Machines for Production (Level 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to prepare and set up computer numerically controlled (CNC) spring making machines, in accordance with approved procedures. The CNC machines covered by this unit include single head, multi-head and coiling and bending centres. The learner will be expected to select the appropriate material feed and guide devices, and to mount and secure them to the machine. The learner will also be required to select the appropriate forming and cropping tools, to mount and secure them to the appropriate tool holding devices, and to place the cutting/forming tools in the relevant positions within the tool posts, slides or tool change magazine/carousel, where this is applicable.</p> <p>The learner will need to ensure that all the tools have been allocated a relevant tool number, and that the relevant data on their co-ordinates and datum positions is entered into the operating program and machine. This will involve loading and proving programs, checking for errors/faults, and editing and saving program changes. The learner must produce trial springs, and prove that the machine is working satisfactorily, before declaring the machine ready for production. Making adjustments to settings to achieve the spring specification, and solving machine-related problems</p>

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

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to the setting-up procedures used. The learner will understand the CNC spring making machine used, and its application, and will know about the material feed and ejection mechanisms, forming and bending tools, machine operating programs and setting-up procedures, in adequate depth to provide a sound basis for setting up the equipment, correcting faults and ensuring that the springs output are to the required specification.

The learner will understand the safety precautions required when working with the CNC spring making machine, and with its associated tools and equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

Learning outcome
The learner will: 1. set CNC spring making 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 during the setting up of the CNC spring making machines: <ul style="list-style-type: none">• obtain and interpret correctly the documentation for the type of spring being made (such as job instructions, spring drawings and quality 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
 - confirm that the correct operating program has been loaded
 - check that forming tools and other required tooling is in a usable condition
 - carry out the setting-up activities, following good practice/approved procedures
 - update the program tool data, as applicable
 - ensure that correctly adjusted machine guards are in place
 - leave the machine and work area in a safe and clean condition on completion of the setting-up activities
- 1.3 follow the correct component drawing and any other related 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 mount and set the correct forming tools and devices for the component being produced
- 1.6 select and mount, in the appropriate holding device, four of the following types of spring forming tool:
- pitching
 - bending tools
 - forming tools
 - coiling tools
 - looping tools
 - straightening tools
 - cutting/cropping tools
 - other special-purpose tooling
- 1.7 prepare the spring tooling by carrying out all of the following activities, as applicable to the machine type:
- pre-setting tooling, using setting jigs/fixtures
 - setting tool datums
 - mounting tools in the correct position in the tool posts, turrets, magazine or carousel
 - checking that tools have a specific tool number in relationship to the operating program
 - entering all relevant tool data to the operating program (such as tool lengths, tool offsets, radius compensation)
 - making adjustments to program settings for spring-back
 - saving changes to the program
- 1.8 set the machine operating parameters to achieve the required pressure shaping requirements and component specification
- 1.9 set up CNC spring making machine operating control mechanisms/systems, to include three of the following devices:
- material guide/wire feed mechanisms (such as feed rollers, pneumatic, magazine)
 - mechanical actuators
 - pneumatic/hydraulic actuators

- electro-mechanical actuators
 - ejection chutes/storage systems
 - hook touch sensor
 - feed fingers
 - de-reeler
 - inspection equipment (such as cameras)
 - spring sorter
- 1.10 set up CNC spring making machines for the production of four of the following:
- open ended right-hand helix
 - open ended left-hand helix
 - closed end right-hand helix
 - closed end left-hand helix
 - single torsion
 - double torsion
 - conical
 - hourglass
 - variable pitch
 - barrel
 - garter spring
 - clock
 - power
 - scroll/spiral
 - volute
 - other wire forms
- 1.11 set the machine to finish the spring ends, to include three of the following:
- full round hook/full round eye
 - long round end hook on centre
 - coned end to hold long swivel eye
 - eye and hook at right angles
 - extended eye on centre or side
 - small eye on centre
 - square end
 - short hook end
 - hinge end
 - English loop
 - continental (German) loop
 - straight offset
 - enlarged loop
 - side loop
 - plain ends
 - machine loop
 - crossover
 - double loop
 - 45 degree loop

- extended leg
 - other specific end configuration
- 1.12 set up the machine to produce springs/forms from two different types of material from the following:
- carbon steel
 - stainless steel
 - alloy steel
 - copper based alloy
 - nickel based alloys
 - titanium and other special material
- 1.13 check that all safety mechanisms are in place and that the equipment is set correctly for the required operations
- 1.14 make trial springs to prove that the machine is operating to the required specification, and check all of the following:
- the first-off springs are heat treated for inspection/verification
 - size of wire/strip and material specification
 - dimensional accuracy of the finished spring
 - the number of coils is as specified
 - the spring is wound with the correct hand helix
 - spring ends are flat and square to spring axis (where appropriate)
 - spring ends/legs are of the correct length, angle and shape (where appropriate)
 - spring load/tension meets specification requirements
 - completed springs are free from tooling marks and deformation
- 1.15 use four of the following whilst checking the quality of the springs produced:
- Vernier callipers
 - micrometers
 - spring testing machines
 - Vernier protractors
 - squares
 - electronic measuring equipment
 - gauges
 - jigs
- 1.16 set up CNC spring making machines to produce springs to one of the following:
- BS, ISO or BSEN standards and procedures
 - customer standards and job requirements
 - company standards and procedures
- 1.17 complete all relevant documentation on conclusion of the spring making activities, to include one of the following:
- job cards
 - quality control documentation
 - company-specific documentation
 - computer records
 - test documents

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

Learning outcome

The learner will:

2. know how to set CNC spring making machines for production

Assessment criteria

The learner can:

- 2.1 describe the specific safety precautions to be taken when setting up CNC spring making machines
- 2.2 explain how to start and stop the machine, in normal and emergency situations
- 2.3 describe the importance of ensuring that the machine is isolated from the power supply before setting up the operating mechanisms and forming tools
- 2.4 describe the importance of wearing the appropriate protective clothing and equipment, and of keeping the work area clean and tidy
- 2.5 describe the hazards associated with working on CNC spring making machines (such as moving machinery, automatic machine operation, handling coils of spring materials), and how to minimise them and reduce any risks
- 2.6 explain how to handle and store forming tools, and verified tapes and programs, 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 explain how to carry out currency/issue checks on the specifications they are working with
- 2.10 describe the material holding and feeding devices that are used on CNC spring making machines
- 2.11 explain why it is important to set the material start point in relation to the machine datums and reference points
- 2.12 describe the methods of setting the forming tools, and the equipment that can be used for this
- 2.13 describe the range of forming and cropping tools that are used on the CNC spring making machine
- 2.14 explain how to check that the forming tools are in a safe and serviceable condition
- 2.15 describe the various tool holding devices that are used, and the methods of correctly mounting and securing the forming tools to the tool holders
- 2.16 describe the advantages of using pre-set tooling, and how to set the tooling using setting jigs/fixtures
- 2.17 describe the use of tool posts, magazines and carousels, and how to position and identify the tools in relationship to the operating program
- 2.18 explain how to place the machine into the correct operating mode, and how to access the program edit facility in order to enter tooling

data (such as form tool datums, positions, lengths, offsets and radius compensation)

- 2.19 explain how to conduct trial runs using single block run, dry run, and feed and speed override controls
- 2.20 describe the things to check before allowing the machine to operate in full program run mode
- 2.21 explain how the various types of material used will affect the production speeds that can be used
- 2.22 describe the typical problems that can occur with the setting up of the CNC mechanisms and tooling, and what to do if they 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 423

Operating CNC spring making machines

UAN:	T/600/5693
Level:	3
Credit value:	30
GLH:	91
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 134: Operating CNC Spring Making Machines (Level 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to operate computer numerically controlled (CNC) spring making machines, in accordance with approved procedures. The CNC machines covered by this unit include single head, multi-head and coiling and bending centres. In operating the machine, the learner will be expected to follow the correct procedures for calling up the operating program, dealing with any error messages, and executing the program activities safely and correctly. The learner will be required to monitor the spring making operations continuously, making any necessary adjustments to machine parameters, in order to maintain the spring production within specification requirements. 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 CNC spring making activities undertaken, and to report any problems with the equipment, tooling, programs or production activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision,</p>

taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying CNC spring making procedures. The learner will understand the CNC spring making machine used, and its application, and will know about the tooling, materials, spring making activities and consumables, in adequate depth to provide a sound background to the machine operation and for carrying out the activities, correcting faults and ensuring that the springs output are to the required specification.

The learner will understand the safety precautions required when working with the CNC spring making machine, and with its associated tools and equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

Learning outcome
The learner will: 1. operate CNC spring making 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 carry out all of the following during the CNC spring making activities: <ul style="list-style-type: none">• obtain and interpret correctly the documentation for the type of spring being made (such as job instructions, spring drawings and quality 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• check that machine guards/safety mechanisms are in place and correctly adjusted• check that forming tools and other required tooling is in a usable condition• check that material stocks are sufficient for the springs being made• ensure that the operating program is at the correct start point• use safe working practices and machine start-up and operating procedures

- adjust machine settings, as required, to maintain spring accuracy and quality
 - leave the machine and work area in a safe and clean condition on completion of the activities
- 1.3 confirm that the equipment is set up and ready for operation
- 1.4 follow the defined procedures for starting and running the operating system
- 1.5 produce springs/forms from two different types of material from the following:
- carbon steel
 - stainless steel
 - alloy steel
 - copper based alloy
 - nickel based alloys
 - titanium and other special material
- 1.6 produce a range of springs, to include four of the following:
- open ended right-hand helix
 - open ended left-hand helix
 - closed end right-hand helix
 - closed end left-hand helix
 - single torsion
 - double torsion
 - conical
 - hourglass
 - constant pitch
 - variable pitch
 - barrel
 - garter spring
 - clock
 - power
 - scroll/spiral
 - volute
 - other wire forms
- 1.7 produce springs that have three of the following finished ends:
- full round hook/full round eye
 - long round end hook on centre
 - coned end to hold long swivel eye
 - eye and hook at right angles
 - extended eye on centre or side
 - small eye on centre
 - square end
 - short hook end
 - hinge end
 - English loop
 - continental (German) loop
 - straight offset

<ul style="list-style-type: none"> • enlarged loop • side loop • plain ends • machine loop • crossover • double loop • 45 degree loop • extended leg • other specific end configuration
1.8 deal promptly and effectively with error messages or equipment faults that are within their control and report those that cannot be solved
1.9 monitor the computer process and ensure that the production output is to the required specification
1.10 use four of the following whilst checking the quality of the springs produced: <ul style="list-style-type: none"> • Vernier callipers • micrometers • spring testing machines • Vernier protractors • squares • electronic measuring equipment • gauges • jigs
1.11 produce springs within all the following relevant quality and accuracy standards: <ul style="list-style-type: none"> • BS, ISO or BSEN standards and procedures • customer standards and job requirements • company standards and procedures
1.12 complete all relevant documentation on conclusion of the spring making activities, to include one of the following: <ul style="list-style-type: none"> • job cards • quality control documentation • company-specific documentation • computer records • test documents
1.13 shut down the equipment to a safe condition on conclusion of the activities.

Learning outcome
The learner will: 2. know how to operate CNC spring making machines
Assessment criteria
The learner can: 2.1 describe the safe working practices and procedures to be followed while operating CNC spring making 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 set-up and run modes, and how to stop the machine in an emergency
- 2.4 describe the hazards associated with working on CNC spring making machines (such as moving machinery, automatic machine operation, handling coils of spring materials), and how to minimise them and reduce any risks
- 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 discs, tapes and programs, 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 explain how to carry out currency/issue checks on the specifications they are working with
- 2.10 explain how to read the visual display and understand the various messages displayed
- 2.11 explain how to place the machine into the correct operating mode, and how to access the program edit facility in order to enter or update tooling data (such as form tool datums, positions, lengths, offsets and radius compensation)
- 2.12 describe the function of error messages, and what to do when an error message is displayed
- 2.13 explain how to find the correct restart point in the program when the machine has been stopped before completion of the program
- 2.14 describe the operation of the various hand and automatic modes of machine control (such as hand wheels, joysticks, program operating and control buttons)
- 2.15 explain how to operate the machine using single block run, full program run and feed/speed override controls
- 2.16 explain how to make adjustments to the program operating parameters to take account of tool wear or material spring-back
- 2.17 describe the various types of bending and forming tools used, and how they are located and secured to the machine tool posts, turrets, slides and tool magazine or carousel
- 2.18 explain how to check that the bending and forming tools are in a serviceable condition, and the effects that worn tooling will have on the finished springs
- 2.19 explain how to recognise machine faults, and how to identify when tooling needs refurbishment
- 2.20 explain how to handle and store all bending and forming tools and kit, safely and correctly
- 2.21 describe the problems that can occur with the spring making activities, and how these can be overcome
- 2.22 describe the quality control procedures used, inspection checks to be carried out, and the equipment that is used for this
- 2.23 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 424

Setting and using a fly press for spring making activities

UAN:	F/600/5695
Level:	3
Credit value:	30
GLH:	91
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 135: Setting and Using a Fly Press for Spring Making Activities (Level 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to set and use a fly press for bending and forming materials used in the manufacture of strip and coil springs, in accordance with approved procedures. In setting up the fly press, the learner will need to select the correct bending and forming tools for the operations being performed. The learner will mount, align and secure them to the appropriate points on the fly press bed and spindle. The learner will be required to set the fly press to perform the required operations, which will include punching holes, punching slots and profiles, bending, forming spring ends such as loops and setting/adjusting spacing in spring coils.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the fly press setting and operating activities undertaken, and to report any problems with the equipment, materials, tooling or spring making activities that they cannot resolve, or that are outside their authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.</p> <p>The learner's knowledge will be sufficient to</p>

provide a good understanding of their work, and will provide an informed approach to applying appropriate setting and operating methods and techniques for fly presses. The learner will have an understanding of the punching and bending processes, and will know about the equipment and its application, in adequate depth to provide a sound basis for carrying out the activities, correcting faults and producing the spring components to the required specification.

The learner will understand the safety precautions required when working with fly presses, and the safeguards necessary for undertaking the activities safely and correctly. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

Learning outcome
The learner will: 1. set and use a fly press for spring making activities
Assessment criteria
The learner can: 1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 carry out all of the following in preparation for the fly press spring making activities: <ul style="list-style-type: none"> • obtain and interpret correctly the documentation for the type of spring being made (such as job instructions, spring drawings and quality 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 • check that the fly press and tooling to be used is in a safe and usable condition • ensure that the fly press used is suitable for the material thickness and operations to be performed • carry out the setting-up activities, following good practice/approved procedures • leave the machine and work area in a safe and clean condition on completion of the setting-up activities 1.3 confirm that the equipment is set up correctly and is ready for use 1.4 manipulate the machine controls safely and correctly in line with operational procedures 1.5 produce components to the required specification 1.6 use a fly press to bend and form two of the following materials:

- carbon steel
 - stainless steel
 - mild steel
 - alloy steel
 - copper based alloy
 - nickel based alloys
 - titanium and other special material
- 1.7 set up and operate a fly press to perform operations on one of the following types of spring:
- coil springs
 - flat/strip springs
 - wire forms
- 1.8 set up a fly press, to include carrying out all of the following:
- selecting an appropriate size of press for the operations being performed
 - selecting the correct tooling for the activities being carried out
 - mounting the tooling to the fly press
 - correctly setting and aligning the tooling (such as punch and die)
 - setting the screw stop at the appropriate length of travel/stroke of the spindle/adjusting ram movement
 - checking that the operation performed is to the specification requirements
- 1.9 set up and operate a fly press to carry out four of the following activities:
- punching/piercing holes
 - punching slots
 - blanking profiles
 - cropping
 - producing bends at 90 degrees
 - producing bends of various angles
 - producing a round hook
 - producing a round eye
 - setting/adjusting coil pitch
 - setting/adjusting squareness
 - pre-stressing springs
 - other specific operation (specify)
- 1.10 carry out quality sampling checks at suitable intervals
- 1.11 use four of the following whilst checking the quality of the spring components produced:
- Vernier callipers
 - micrometers
 - spring testing machines
 - Vernier protractors
 - squares
 - electronic measuring equipment
 - gauges

<ul style="list-style-type: none"> • jigs <p>1.12 produce spring components which meet all of the following quality and accuracy standards:</p> <ul style="list-style-type: none"> • bend position and dimensional accuracy is within the tolerances specified on the drawing/specification • the pressed/punched spring components conform to best practice and or specification, without uncontrolled deformation or cracking • the spring component conforms to the required shape/geometry <p>1.13 complete all relevant documentation on completion of the spring making activities, to include one of the following:</p> <ul style="list-style-type: none"> • job cards • quality control documentation • company-specific documentation • computer records • test documents <p>1.14 deal promptly and effectively with problems within their control and report those that cannot be solved</p> <p>1.15 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 set and use a fly press for spring making activities
Assessment criteria
The learner can:
2.1 describe the specific safety precautions to be taken when setting up and using fly presses for bending, punching and forming operations (such as general workshop safety, appropriate Personal Protective Equipment, accident procedure; statutory requirements, risk assessment procedures and relevant requirements of HASAWA, COSHH and Work Equipment Regulations)
2.2 describe the importance of wearing the appropriate protective clothing and equipment (such as leather gloves, eye protection), and of keeping the work area clean and tidy
2.3 describe the hazards associated with setting and using fly presses for spring work (such as handling sheet components, using dangerous or badly maintained tools and equipment, moving parts of press), and how to minimise them and reduce any risks
2.4 describe the checks to be carried out to ensure that the fly press and its associated tooling are safe and are in a fit condition to use
2.5 describe the safe working practices and procedures required for operating the fly press
2.6 explain how to obtain the necessary drawings, specifications and job instructions
2.7 explain how to extract 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 fly press spring making operations in relation to the activities undertaken and types of spring produced
 - 2.10 explain how to set up the fly press to produce the required form (such as bends and forms)
 - 2.11 describe the methods and techniques that are used to obtain the required shape and size
 - 2.12 describe the ways of limiting distortion, marks and creases in the finished workpiece
 - 2.13 describe the preparations to be carried out on the materials, prior to bending them
 - 2.14 describe the basic characteristics of the materials with regard to the bending operations undertaken
 - 2.15 explain the need to take care of the bending, punching and forming tools and equipment, and how to recognise faulty or damaged tools
 - 2.16 explain how bending and forming tools should be stored
 - 2.17 describe the problems that can occur with the bending, punching and forming activities, and how they can be avoided
 - 2.18 describe the organisational quality control procedures that are used, and how to recognise defects in the components that they produce
 - 2.19 describe the inspection checks to be carried out, and the tools and equipment that are used for this
 - 2.20 describe the accuracy that can be achieved by the punching, bending and forming process
 - 2.21 describe the importance of completing all relevant documentation on conclusion of the spring making activities
 - 2.22 describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve.

Unit 425

Making strip spring components using shearing machines

UAN:	Y/600/5699
Level:	3
Credit value:	30
GLH:	91
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 136: Making Strip Spring Components using Shearing Machines (Level 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required for cutting and shaping materials used in the manufacture of strip springs, using guillotines or section cropping machines, in accordance with approved procedures. The learner will be required to select the appropriate equipment and machine settings to use, for the material, thickness and the accuracy to be achieved. Items to be cut and shaped may include ferrous and non-ferrous materials, and will include parallel cuts, square cuts, and cuts that are at an angle. These cuts will be achieved by working to marking out, and by setting the machine's backstop when multiple cutting is required.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the spring making activities undertaken, and to report any problems with the tools and equipment, materials or activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they produce.</p>

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying metal shearing procedures to strip springs. The learner will understand the shearing processes, the equipment and its application, and will know about the materials and shearing techniques, in adequate depth to provide a sound basis for carrying out the activities, correcting faults and for producing the spring components to the required specification.

The learner will understand the safety precautions required when working with the shearing machines, and with their associated tools and equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

Learning outcome
The learner will: 1. make strip spring components using shearing 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 carry out all of the following in preparation for the spring making activities: <ul style="list-style-type: none"> • obtain and interpret correctly the documentation for the type of spring being made (such as job instructions, spring drawings and quality 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 • check that the machine and cutting blades are in a safe and usable condition • set the cutting blades for the thickness of material being cut (where applicable) • set up back stops where multiple components are required • carry out the setting-up activities, following good practice/approved procedures • ensure that correctly adjusted machine guards/safety devices are in place, and that they operate correctly • leave the machine and work area in a safe and clean condition on completion of the setting-up activities 1.3 confirm that the machine is set up and ready for the machining activities to be carried out

- 1.4 cut materials for strip spring components, using one of the following types of shearing machine:
 - guillotine
 - cropping 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 cut strip spring components from two appropriate materials from the following:
 - mild steel
 - carbon steel
 - stainless steel
 - alloy steel
 - copper based alloy
 - nickel based alloys
 - titanium and other special material
- 1.8 cut materials using both of the following techniques:
 - to marking out
 - using machine backstop for multiple cutting
- 1.9 perform operations that produce straight and accurate cuts, which include two of the following:
 - parallel cuts
 - square cuts
 - cuts at an angle
- 1.10 carry out quality sampling checks at suitable intervals
- 1.11 produce strip spring components which meet all of the following quality and accuracy standards:
 - dimensional accuracy is within the tolerances specified on the drawing/specification
 - cut components are free from excessive distortion
 - cut edges are neat and free from false tool cuts and shearing slivers and burrs
- 1.12 complete all relevant documentation on completion of the strip spring making activities, to include one of the following:
 - job cards
 - quality control documentation
 - company-specific documentation
 - computer records
 - test documents
- 1.13 deal promptly and effectively with problems within their control and report those that cannot be solved
- 1.14 shut down the equipment to a safe condition on conclusion of the machining activities.

Learning outcome
The learner will: 2. know how to make strip spring components using shearing machines
Assessment criteria
The learner can: 2.1 describe the specific safety precautions to be taken when setting up shearing machines (such as general workshop safety, appropriate Personal Protective Equipment, accident procedure; statutory requirements, risk assessment procedures and relevant requirements of HASAWA, COSHH and Work Equipment Regulations) 2.2 describe the importance of wearing the appropriate protective clothing and equipment (such as leather gloves, eye protection), and of keeping the work area clean and tidy 2.3 describe the handling precautions and correct methods of moving or lifting sheet or plate materials, and the equipment to be used for this 2.4 describe the hazards associated with working on shearing machines (such as using moving parts of machinery, shearing blade malfunction, using dangerous or badly maintained tools and equipment, lifting and handling sheet materials), and how to minimise them and reduce any risks 2.5 describe the checks to be carried out to ensure that the shearing machine is in a safe and fit condition to use 2.6 describe the safety mechanisms on the machine, and the procedure for checking that they function correctly 2.7 explain how to start and stop the machine in normal and emergency situations 2.8 describe the importance of ensuring that the machine is isolated from the power supply before setting up the various operating mechanisms 2.9 explain how to check that the shearing machine blades are in a safe and serviceable condition, and their care and maintenance procedures 2.10 explain how to obtain the necessary drawings, specifications and job instructions 2.11 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 2.12 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing 2.13 describe the terminology used in shearing machines and shearing operations in relation to the activities undertaken and types of springs produced 2.14 explain how to interpret marking out conventions (cutting lines, centre lines, etc) 2.15 describe the various shearing machine cutting methods and techniques (such as cutting to marking out, using the machine backstops for multiple pieces and setting guides for angled cuts) 2.16 describe the material handling and preparation methods (such as

- degreasing, de-burring, straightening)
- 2.17 describe the method of setting and adjusting shearing blades for the material thickness
 - 2.18 describe the tool and equipment care and control procedures, and how to recognise when the cutting blades require changing
 - 2.19 describe the importance of using tools or equipment only for the purpose intended; the care that is required when using the tools or equipment; the proper way of preserving tools or equipment between operations
 - 2.20 describe the safety mechanisms and devices that are on the machine, and why they must always be used (such as machine guards, interlocks, safety operating devices)
 - 2.21 describe the things that can go wrong when shearing materials, and how these can be avoided
 - 2.22 describe the inspection techniques that can be applied to check that shape and dimensional accuracy are to specification and within acceptable limits
 - 2.23 describe the importance of completing all relevant documentation on conclusion of the spring making activities
 - 2.24 describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve.

Unit 426

Forming strip spring components using power rolling machines

UAN:	L/600/5702
Level:	3
Credit value:	30
GLH:	91
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 137: Forming Strip Spring Components using Power Rolling Machines (Level 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to form materials used in the manufacture of strip springs, using power-operated pinch or pyramid rolls, in accordance with approved procedures. The learner will be required to operate the power rolling machine, according to the operations to be performed and the thickness and size of the material to be rolled. Preparing the rolls will involve setting and adjusting the gap between feed and forming rolls to suit material thickness, positioning side roller(s) and adjusting to suit the required radius, checking and setting parallelism of rollers, and applying suitable pressure to rollers throughout the forming operation.</p> <p>The learner will be expected to carry out the rolling operation in a manner which ensures that the material is formed to the required profile, without flats or deformities. The learner will also need to ensure that all the required safety devices are operating correctly, and that the machine guards are in place and correctly adjusted. Items to be rolled will include mild steel, carbon steel, stainless steel, and alloys, and will involve operations such as flattening or straightening, producing curved profiles, rolling clock/power springs and tensator</p>

springs.

The learner's responsibilities will require them to comply with organisational policy and procedures for the spring making activities undertaken, and to report any problems with the equipment, materials, or rolling activities that they cannot resolve, or that are outside their 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 produce.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the required power rolling procedures for strip springs. The learner will understand the rolling processes, the equipment and its application, and will know about the materials and rolling techniques in adequate depth to provide a sound basis for carrying out the activities, correcting faults and for producing the spring components to the required specification.

The learner will understand the safety precautions required when working with power rolls, and the safeguards necessary for undertaking the activities safely and correctly. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

Learning outcome
The learner will: 1. form strip spring components using power rolling 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 carry out all of the following in preparation for the power rolling spring making activities: <ul style="list-style-type: none">• obtain and interpret correctly the documentation for the type of spring being made (such as job instructions, spring drawings and quality 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
- check that the machine and rolls are in a safe and usable condition (suitable diameter, free from damage)
 - set the rolls for the thickness of material being used, and the operations to be performed
 - ensure that equipment is in place for supporting the material at the start of the rolling operations
 - carry out the setting-up activities, following good practice/approved procedures
 - ensure that correctly adjusted machine guards/safety devices are in place and operate correctly
 - leave the machine and work area in a safe and clean condition on completion of the setting-up activities
- 1.3 confirm that the equipment is set up correctly and is ready for use
- 1.4 use one of the following types of power rolling machine:
- small rolls (hand adjusted)
 - large rolls (console adjusted)
 - variable rolls
- 1.5 manipulate the machine controls safely and correctly in line with operational procedures
- 1.6 produce components to the required specification
- 1.7 carry out rolling operations on two types of material from the following:
- mild steel
 - carbon steel
 - stainless steel
 - alloy steel
 - copper based alloy
 - nickel based alloys
 - titanium and other special material
- 1.8 perform rolling operations that produce two of the following shapes/spring components:
- curved sections
 - clock/power springs
 - spring rings
 - flattening or straightening material
 - constant force springs
- 1.9 carry out quality sampling checks at suitable intervals
- 1.10 produce rolled strip spring components which meet all of the following quality and accuracy standards:
- dimensional accuracy is within the tolerances specified on the drawing/specification
 - the rolled material conforms to best practice and/or specification, without deformation or cracking
 - the spring component conforms to the required shape/geometry
- 1.11 complete all relevant documentation on conclusion of the strip spring making activities, to include one of the following:
- job cards

<ul style="list-style-type: none"> • quality control documentation • company-specific documentation • computer records • test documents <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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<p>Learning outcome</p> <p>The learner will:</p> <p>2. know how to form strip spring components using power rolling machines</p>
<p>Assessment criteria</p> <p>The learner can:</p> <p>2.1 describe the specific safety precautions to be taken when setting up and operating power rolling machines (such as general workshop safety, appropriate Personal Protective Equipment, accident procedure; statutory requirements, risk assessment procedures and relevant requirements of HASAWA, COSHH and Work Equipment Regulations)</p> <p>2.2 describe the importance of wearing the appropriate protective clothing and equipment (such as leather gloves, eye protection), and of keeping the work area clean and tidy</p> <p>2.3 describe the handling precautions and correct methods of moving or lifting sheet or plate materials, and the equipment to be used for this</p> <p>2.4 describe the hazards associated with setting and using power rolling machines for spring work (such as handling sheet components, using dangerous or badly maintained tools and equipment, moving parts of power rolling machines), and how to minimise them and reduce any risks</p> <p>2.5 describe the checks to be carried out to ensure that the power rolls are safe and are in a fit condition to use</p> <p>2.6 describe the safety mechanisms on the machine, and the procedure for checking that they function correctly</p> <p>2.7 explain how to start and stop the machine in normal and emergency situations</p> <p>2.8 describe the importance of ensuring that the machine is isolated from the power supply before setting up the various operating mechanisms</p> <p>2.9 explain how to obtain the necessary drawings, specifications and job instructions</p> <p>2.10 explain how to extract 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>2.11 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing</p> <p>2.12 describe the terminology used in rolling machines and rolling operations in relation to the activities undertaken and types of</p>

spring produced

- 2.13 describe the marking out conventions used in spring making, and how to recognise the centre lines, bending, forming and cutting lines
- 2.14 describe the basic principle of operation of the power rolling machine used, and the type of work it can perform
- 2.15 explain how to set up the machine to produce the required form (such as curved forms, circles and straightening materials)
- 2.16 describe the techniques of rolling (including pre-setting plate edges, adjusting pressure throughout the rolling operations, checking the component for parallelism or form throughout the operations)
- 2.17 explain how to release the rolls and remove the workpiece when rolling cylindrical and conical sections
- 2.18 describe the ways of limiting distortion, marks, creases and flats in curved sections
- 2.19 explain how the materials need to be prepared prior to rolling, and the effects of raw material scale or burrs on the finished article
- 2.20 describe the material characteristics with regard to forming by using rolling machines
- 2.21 describe the care and maintenance procedures to be observed to ensure that the machines are in a serviceable condition
- 2.22 describe the organisational quality control procedures, and how to recognise rolling defects
- 2.23 describe the inspection checks to be carried out, and the tools and equipment that are used for this
- 2.24 describe the accuracy that can be achieved by rolling, and limitations of the rolling processes
- 2.25 describe the importance of completing all relevant documentation on conclusion of the spring making activities
- 2.26 describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve.

Unit 427

Bending strip spring components using press brakes

UAN:	Y/600/5704
Level:	3
Credit value:	30
GLH:	91
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 138: Bending Strip Spring Components using Press Brakes (Level 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required for bending and forming materials used in the manufacture of strip springs, using power operated equipment such as press brakes/bending machines, in accordance with approved procedures. The learner will be required to operate the appropriate bending and forming equipment in accordance with the instructions for the operations being performed. The learner will need to ensure that all the required safety devices are operating correctly, and that the machine guards are in place and correctly adjusted.</p> <p>Items to be bent and formed may include ferrous and non-ferrous materials, and tasks will include producing bends of various angles, setting plate ends for rolling operations, and producing curved sections. This will call for care in selecting the right tools, so as to avoid damage to the tools and danger to oneself.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the spring making activities undertaken, and to report any problems with the equipment, materials, tooling or bending activities that they cannot</p>

resolve, or that are outside their 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 be sufficient to provide a good understanding of their work, and will provide an informed approach to applying the required power pressing procedures. The learner will have an understanding of the bending processes, and will know about the equipment and its application, in adequate depth to provide a sound basis for carrying out the activities, correcting faults and for producing spring components to the required specification.

The learner will understand the safety precautions required when working with press brakes, and the safeguards necessary for undertaking the activities safely and correctly. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

Learning outcome
The learner will: 1. bend strip spring components using press brakes
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 in preparation for the power pressing/spring making activities: <ul style="list-style-type: none">• obtain and interpret correctly the documentation for the type of spring being made (such as job instructions, spring drawings and quality 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• check that the press brake/bending machine and tooling are in a safe and usable condition• ensure that the press brake settings are suitable for the material thickness and operations to be performed• ensure that equipment is in place for supporting the plate at the start of the pressing operations• carry out the setting-up activities, following good

- practice/approved procedures
- ensure that correctly adjusted machine guards/safety devices are in place and operate correctly
- leave the machine and work area in a safe and clean condition on completion of the setting-up activities
- 1.3 confirm that the equipment is set up correctly and is ready for use
- 1.4 use one of the following types of power operated bending equipment:
 - press brakes
 - powered bending machine
- 1.5 manipulate the machine controls safely and correctly in line with operational procedures
- 1.6 produce components to the required specification
- 1.7 bend and form strip spring components from two types of material from the following:
 - mild steel
 - carbon steel
 - stainless steel
 - alloy steel
 - copper based alloy
 - nickel based alloys
 - titanium and other special material
- 1.8 perform operations that produce three of the following:
 - bends at 90 degrees
 - bends of various angles
 - set plate ends for rolling
 - multi-bend platework
 - curved plates
- 1.9 carry out quality sampling checks at suitable intervals
- 1.10 produce pressed strip spring components which meet all of the following quality and accuracy standards:
 - bend position and dimensional accuracy is within the tolerances specified on the drawing/specification
 - the pressed spring components conform to best practice and or specification, without uncontrolled deformation or cracking
 - the spring component conforms to the required shape/geometry
- 1.11 complete all relevant documentation on conclusion of the strip spring making activities, to include one of the following:
 - job cards
 - quality control documentation
 - company-specific documentation
 - computer records
 - test documents
- 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 bend strip spring components using press brakes
Assessment criteria
The learner can: 2.1 describe the specific safety precautions to be taken when setting up and operating power-operated bending and forming equipment such as press brakes and/or bending machines (such as general workshop safety, appropriate Personal Protective Equipment, accident procedure; statutory requirements, risk assessment procedures and relevant requirements of HASAWA, COSHH and Work Equipment Regulations) 2.2 describe the importance of wearing the appropriate protective clothing and equipment (such as leather gloves, eye protection), and of keeping the work area clean and tidy 2.3 describe the handling precautions and correct methods of moving or lifting sheet or plate materials, and the equipment to be used for this 2.4 describe the hazards associated with setting and using press brakes and power bending machines for spring work (such as handling sheet components, using dangerous or badly maintained tools and equipment, moving parts of pressing/forming machines), and how to minimise them and reduce any risks 2.5 describe the checks to be carried out to ensure that the press brake/power bending machine and associated tooling are safe and are in a fit condition to use 2.6 describe the safety mechanisms on the machine, and the procedure for checking that they function correctly 2.7 explain how to start and stop the machine in normal and emergency situations 2.8 describe the importance of ensuring that the machine is isolated from the power supply before setting up the various operating mechanisms 2.9 describe the safe working practices and procedures required for operating press brakes and power bending machines 2.10 explain how to obtain the necessary drawings, specifications and job instructions 2.11 explain how to extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS, ISO or BSEN standards) in relation to work undertaken 2.12 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing 2.13 describe the terminology used in press brake operations in relation to the activities undertaken and types of spring produced 2.14 describe the marking out conventions used in spring making, and how to recognise the centre lines, bending, forming and cutting lines 2.15 describe the various types of power-operated bending machines that are used, and their typical applications 2.16 explain how to set up the machine to produce the required form (such as bends and forms) 2.17 describe the methods and techniques that are used to obtain the

required shape and size

- 2.18 describe the ways of limiting distortion, marks and creases in the finished workpiece
- 2.19 describe the preparations to be carried out on the materials, prior to bending them
- 2.20 describe the basic characteristics of the materials with regard to the bending operations undertaken
- 2.21 explain the need to take care of the bending tools and equipment, and how to recognise faulty or damaged forming tools
- 2.22 explain how bending and forming tools should be stored
- 2.23 describe the problems that can occur with the bending and forming activities, and how they can be avoided
- 2.24 describe the organisational quality control procedures that are used, and how to recognise defects in the bends that they produce
- 2.25 describe the inspection checks to be carried out, and the tools and equipment that are used for this
- 2.26 describe the accuracy that can be achieved by pressing, and limitations of the pressing processes
- 2.27 describe the importance of completing all relevant documentation on conclusion of the spring making activities
- 2.28 describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve.

Unit 428

Forming strip spring components using power presses

UAN:	M/600/5708
Level:	3
Credit value:	30
GLH:	91
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 139: Forming Strip Spring Components using Power Presses (Level 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to prepare, set up and use single and multi-action power presses and associated equipment, in accordance with approved procedures. This involves selecting the appropriate press tools, 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 set up and align all associated equipment, which will include material positioning mechanisms, workpiece ejection mechanisms, and all machine safety devices and guards.</p> <p>The learner will need to set up the machine operating parameters to produce the workpiece to the required specification. The learner must produce trial pressings and prove that 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 power press activities undertaken, and to report any</p>

problems with the power press, press tools, equipment or setting-up activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality 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 power press procedures used. The learner will understand the power press used, and its application, and will know about the workholding devices, press 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 that the spring components produced are to the required specification.

The learner will understand the safety precautions required when working with power operated presses and their associated tools and equipment, and the safeguards necessary for undertaking the activities safely and correctly. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

Learning outcome
The learner will: 1. form strip spring components using power presses
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 in preparation for the power pressing/spring making activities: <ul style="list-style-type: none">• obtain and interpret correctly the documentation for the type of spring being made (such as job instructions, spring drawings and quality 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• check that the machine selected is appropriate for the operation being performed (such as tonnage, open height,

- stroke)
- check that the power press tool setters safety clutch lock, brakes, and emergency stop facilities operate correctly
 - check that the press tooling is in a safe and usable condition
 - ensure that the press settings are suitable for the material thickness and operations to be performed
 - carry out the power press activities, following good practice/approved procedures
 - ensure that correctly adjusted machine guards/safety devices are in place and operate correctly
 - leave the machine and work area in a safe and clean condition on completion of the activities
- 1.3 confirm that the equipment is set up correctly and is ready for use
- 1.4 prepare, set up and use one of the following types of power press:
- single action
 - multiple action
- 1.5 select, prepare, mount and position press tools to the machine, to cover all of the following:
- preparing the press to receive the tooling
 - positioning, aligning and securing press tools
 - setting workpiece feed and ejection systems
 - ensuring the correct clamping of materials
 - fitting and adjusting guards, interlocks and other safety mechanisms (such as fixed guards, interlock guards, automatic guards)
 - setting up press operating parameters (such as stroke, stroke speed, material feed mechanisms)
 - carrying out tool tryouts of the complete cycle, using manual operation
- 1.6 manipulate the machine controls safely and correctly in line with operational procedures
- 1.7 produce components to the required specification
- 1.8 produce components from two of the following types of material:
- mild steel
 - carbon steel
 - stainless steel
 - alloy steel
 - copper based alloy
 - nickel based alloys
 - titanium and other special material
- 1.9 set up the press to carry out five of the following operations:
- blanking
 - piercing
 - cropping/shearing
 - bending/forming
 - securing/assembling
 - clipping
 - notching

<ul style="list-style-type: none"> • joggling • coiling/rolling • raising of first draw • forming of second draw • compound operations • progression tool • other operations <p>1.10 carry out quality sampling checks at suitable intervals</p> <p>1.11 produce pressed spring components which comply with all of the following quality and accuracy standards:</p> <ul style="list-style-type: none"> • dimensional accuracy is within the tolerances specified on the drawing/specification • the form or sharpness of the profile conforms to best practice and/or specification, without uncontrolled deformation or cracking • the spring components produced conform to specification without defects <p>1.12 complete all relevant documentation on completion of the pressing/spring making activities, to include one of the following:</p> <ul style="list-style-type: none"> • job cards • quality control documentation • company-specific documentation • computer records • test documents <p>1.13 deal promptly and effectively with problems within their control and report those that cannot be solved</p> <p>1.14 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 form strip spring components using power presses
Assessment criteria
The learner can: 2.1 describe the relevant parts of the power press regulations, and how they apply to them and the work they are undertaking 2.2 describe the specific safety precautions to be taken when setting up and operating power presses (such as general workshop safety, appropriate Personal Protective Equipment, accident procedure; statutory requirements, risk assessment procedures and relevant requirements of HASAWA, COSHH and Work Equipment Regulations) 2.3 describe the specific safety precautions to be taken when working with single and multiple action power presses and press tooling 2.4 describe the hazards associated with working with power presses (such as moving parts of machinery, material handling, material ejection, automatic processes, lifting and handling press tooling, using faulty or badly maintained equipment), and how to minimise them and reduce any risks 2.5 describe the importance of wearing the appropriate protective

- clothing and equipment (such as leather gloves, eye protection), and of keeping the work area clean and tidy
- 2.6 describe the checks to be carried out to ensure that the power press and associated tooling are safe and are in a fit condition to use
 - 2.7 describe the safety mechanisms on the machine, and the procedure for checking that they function correctly
 - 2.8 explain how to start and stop the power press in normal and emergency situations
 - 2.9 describe the importance of ensuring that the power press is isolated from the power supply before commencing work on setting up the various tooling and operating mechanisms
 - 2.10 describe the safe working practices and procedures required for operating press brakes and power bending machines
 - 2.11 describe the correct methods of lifting and moving press tooling, and the types of equipment used for this
 - 2.12 explain how to check that lifting equipment is within its current test dates
 - 2.13 explain how to obtain the necessary drawings, specifications and job instructions
 - 2.14 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
 - 2.15 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing
 - 2.16 describe the terminology used in power press operations in relation to the activities undertaken and types of spring components produced
 - 2.17 describe the various types of power press that are used, and their typical applications
 - 2.18 explain how to prepare and set up the power press and its tooling for a range of different applications
 - 2.19 describe the types of press tools that are used for the various operations, and how they are secured and set to the machine's tool holding device
 - 2.20 describe the preparations to be carried out on the materials prior to using them
 - 2.21 describe the basic characteristics of the materials with regard to the pressing operations undertaken
 - 2.22 explain the need to take care of the press tools and equipment; how to recognise faulty or damaged press tools; how bending and forming tools should be stored
 - 2.23 describe the problems that can occur with the power pressing activities, and how they can be avoided
 - 2.24 describe the organisational quality control procedures that are used, and how to recognise defects in the components that are produced
 - 2.25 describe the inspection checks to be carried out, and the tools and equipment that are used for this
 - 2.26 describe the accuracy that can be achieved by pressing, and limitations of the pressing processes
 - 2.27 describe the importance of completing all relevant documentation

on conclusion of the spring making activities

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

Unit 429

Drilling and finishing holes in strip spring components

UAN:	M/600/5711
Level:	3
Credit value:	16
GLH:	57
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 140: Drilling and Finishing Holes in Strip Spring Components (Level 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to drill and finish holes in spring components, using hand held and fixed drilling machines, in accordance with approved procedures. The learner will be required to select the appropriate drilling equipment to use, based on the operations to be performed and the size of the component worked on. The learner will be expected to use appropriate workholding methods and techniques to secure the workpiece for the drilling operations, and this will include the use of jigs, clamps, machine vice and other appropriate holding devices. In drilling and finishing the holes, the learner will need to position the drill bits accurately and use appropriate speeds and feeds to drill and finish the holes to the required specification. Drilling and finishing operations will include holes through the workpiece, blind holes, counterbored holes, countersunk holes, spot facing, reaming and tapping.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the drilling activities undertaken, and to report any problems with the equipment or drilling activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected</p>

to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the drilling and finishing procedures. The learner will understand the drilling equipment used and its application, together with the material characteristics and the appropriate tooling for carrying out the drilling and finishing process. The learner will know about the basic principles and requirements of securing the workpiece prior to carrying out the process, in adequate depth to provide a sound basis for carrying out the drilling activities safely and correctly, and for ensuring that the spring components produced are to the required specification.

The learner will understand the safety precautions required when carrying out the drilling and finishing activities, and when using the associated tools and equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

Learning outcome
The learner will: 1. drill and finish holes in strip spring components
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 during the drilling and finishing of the spring components: <ul style="list-style-type: none">• obtain and interpret correctly the documentation for the type of spring being made (such as job instructions, spring drawings and quality 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• select the appropriate drilling equipment/machine for the operation being performed• ensure that machine guards and safety devices are in position and function correctly• check that drill bits and cutting tools are in a serviceable

- condition (such as sharp and free from damage or chips)
 - isolate the equipment from its power supply whilst changing drill bits
 - securely clamp/restrain the spring components during the drilling operations
 - leave the machine and work area in a safe and clean condition on completion of the drilling activities
- 1.3 confirm that the machine is set up and ready for the machining activities to be carried out
- 1.4 use two of the following drilling machines:
- hand held drilling machine
 - pillar/bench drill
 - radial arm drill
 - other (specify)
- 1.5 use two of the following workholding devices:
- jigs/fixtures
 - machine vice
 - clamps
 - other (specify)
- 1.6 manipulate the machine tool controls safely and correctly in line with operational procedures
- 1.7 produce components to the required quality and within the specified dimensional accuracy
- 1.8 produce drilled holes in two of the following material types:
- mild steel
 - carbon steel
 - stainless steel
 - alloy steel
 - copper based alloy
 - nickel based alloys
 - titanium and other special material
- 1.9 carry out three of the following drilling and finishing operations:
- centre drilling
 - drilling holes through the workpiece
 - drilling holes to a depth (blind)
 - countersinking holes
 - counterboring holes
 - trepanning holes
 - tapping holes
 - spot facing
 - de-burring
- 1.10 carry out all of the following during the production and finishing of the holes in the spring components:
- mark out, position and secure the item to be drilled, in accordance with company procedures
 - use the specified techniques and procedures to produce and finish the holes
 - select and use the correct drilling speeds

<ul style="list-style-type: none"> • use appropriate and adequate lubrication/coolant • check that positional accuracy complies with the specification • ensure that the machined features are free from excessive tool marks, burrs and sharp edges <p>1.11 carry out quality sampling checks at suitable intervals</p> <p>1.12 produce drilled and finished components which meet all of the following quality and accuracy standards:</p> <ul style="list-style-type: none"> • dimensional and positional accuracy is within specification tolerances • drilled holes are correctly formed and free from excessive tool marks • counterbores, countersinks and spot facings meet job requirements (where applicable) <p>1.13 complete all relevant documentation on completion of the drilling activities, to include one of the following:</p> <ul style="list-style-type: none"> • job cards • quality control documentation • company-specific documentation • computer records • test documents <p>1.14 deal promptly and effectively with problems within their control and report those that cannot be solved</p> <p>1.15 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 drill and finish holes in strip spring components
Assessment criteria
The learner can:
2.1 describe the specific safety precautions to be taken when setting up and operating drilling equipment (to include general workshop safety, accident procedures; risk assessment procedures and relevant requirements of HASAWA, COSHH and Work Equipment Regulations)
2.2 describe the importance of wearing the appropriate protective clothing and equipment (such as leather gloves, eye protection), and of keeping the work area clean and tidy
2.3 describe the hazards associated with carrying out drilling and hole finishing operations (such as revolving tools and spindles, using faulty or badly maintained equipment, insecure or poorly clamped workpieces, airborne metal particles, sharp edges and splinters), and how to minimise them and reduce any risks
2.4 describe the checks to be carried out to ensure that the drilling equipment and associated tooling is in a safe and fit condition to use
2.5 describe the safety mechanisms on the machine, and the procedure for checking that they function correctly (including how to start and stop the machine in normal and emergency situations)
2.6 describe the importance of ensuring that the drilling machine is isolated from the power supply before setting up the various

- tooling and operating mechanisms
- 2.7 explain how to obtain the necessary drawings, specifications and job instructions
 - 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 drilling and hole finishing operations in relation to the activities undertaken and types of spring components produced
 - 2.11 describe the various types and application of drilling machines (including portable power tools, bench and pedestal machines and radial arm machines)
 - 2.12 describe the range of drilling and hole finishing tools available (including twist drills, reamers, counterbore tools, countersink tools, spot facing tools)
 - 2.13 describe the methods of holding and securing the drills and finishing tools into the machine spindle (including chucks, taper shank sleeves, collet chucks)
 - 2.14 describe the methods of holding and securing workpieces for drilling (such as jigs and fixtures, machine vices, clamps and restraining devices)
 - 2.15 describe the methods used to align the drill with the workpiece, and the use of centre drills and pilot drills
 - 2.16 explain how to check that the drill hole is in the correct position before drilling to the full diameter
 - 2.17 explain how to correct a drill that has been started off centre
 - 2.18 describe the selection of speeds and feeds for drilling, reaming and finishing operations
 - 2.19 describe the selection of cutting fluids and compounds for drilling
 - 2.20 describe the care and control of tools and equipment; checking that portable power tool leads, plugs and sockets are in a safe and usable condition
 - 2.21 describe the importance of using tools or equipment only for the purpose intended; the care that is required when using the tools or equipment; the proper way of preserving tools or equipment between operations
 - 2.22 describe the things that can go wrong with drilling operations, and how these can be avoided
 - 2.23 describe the importance of completing all relevant documentation on conclusion of the spring making activities
 - 2.24 describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve.

Unit 430

Using heat to assist with the bending and forming of spring components

UAN:	L/600/5716
Level:	3
Credit value:	16
GLH:	57
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 141: Using Heat to Assist with the Bending and Forming of Spring Components (Level 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required for bending and forming strip and section materials used in the manufacture of strip and coil springs, in accordance with approved procedures. The learner will be required to interpret drawings, and to form the materials to the required shape by using the appropriate equipment and techniques. The operations carried out will include such things as producing leaf springs, forming bends and loops in strip materials for flat springs and the application of heat to assist with the forming of coil springs.</p>

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

The learner's knowledge will be sufficient to provide a good understanding of their work,

and will provide an informed approach to applying heat to assist with the spring forming activities required. The learner will have an understanding of the heating and forming process, and will know about the equipment used, and its application, in adequate depth to provide a sound basis for carrying out the activities, correcting faults and ensuring that the completed work is to the required specification.

The learner will understand the safety precautions required when working with heating and bending/forming equipment, and the safeguards necessary for undertaking the activities safely and correctly. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

Learning outcome
The learner will: 1. using heat to assist with the bending and forming of spring components
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 during the bending and forming of the spring components: <ul style="list-style-type: none">• obtain and interpret correctly the documentation for the type of spring being made (such as job instructions, spring drawings and quality 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• check that the heating equipment, tools and spring forming equipment to be used is in a safe and usable condition• carry out the heating and spring forming activities, following good practice/approved procedures• return all tools and equipment to the correct location on completion of the spring making activities• leave the work area in a clean and safe condition on completion of the activities 1.3 follow the correct component drawing and any other related specifications for the component to be produced 1.4 determine what has to be done and how this will be achieved 1.5 bend and form spring components, to include carrying out all of the following:

- setting up and securing the appropriate forming equipment (such as bending jigs, forming mandrels)
 - heating the spring material to the required temperature
 - using appropriate techniques and tools to bend and form the wire/strip to the correct shape
 - checking dimensions, shape and form using appropriate gauges/measuring equipment
 - allowing the springs to cool without distortion (where appropriate)
 - carrying out post bending heat treatment (where appropriate)
- 1.6 use the appropriate tools and equipment for the pressure shaping operations and check that they are in a safe and usable condition
- 1.7 shape the materials to the required specification using appropriate methods and techniques
- 1.8 use heat to assist with the bending and forming of two of the following materials:
- mild steel
 - carbon steel
 - stainless steel
 - alloy steel
 - copper based alloy
- 1.9 use one of the following methods to heat the material prior to forming:
- hand held heating equipment
 - furnace or heating oven
 - induction heating method
- 1.10 use heat to bend and form two of the following:
- coil compression springs
 - coil torsion springs
 - coil tension springs
 - other types of coil spring
 - other wire forms
 - strip/leaf springs
 - bends at 90 degrees
 - bends of various angles
 - loops on strip ends
 - multi-bend components
 - curved components
- 1.11 produce spring components which conform to all of the following:
- bend position and dimensional accuracy is within the tolerances specified on the drawing/specification
 - the spring components conform to best practice and or specification, without uncontrolled deformation or cracking
 - the spring component conforms to the required shape/geometry
- 1.12 check that all the required shaping operations have been completed to the required standard
- 1.13 complete all relevant documentation on conclusion of the spring making activities, to include one of the following:

- job cards
- quality control documentation
- company-specific documentation
- computer records
- inspection/test documentation

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 use heat to assist with the bending and forming of spring components

Assessment criteria

The learner can:

- 2.1 describe the specific safety precautions to be taken when working with heat and hot forming equipment and materials in a spring making environment (such as general workshop safety, appropriate Personal Protective Equipment, accident procedure; statutory regulations, risk assessment procedures and COSHH regulations)
- 2.2 describe the personal protective clothing and equipment to be worn when carrying out the spring making activities (such as leather aprons and gloves, eye protection)
- 2.3 describe the hazards associated with carrying out spring hand hot forming operations (such as operating heating equipment; handling hot materials; fumes and gases; using hand forming tools and equipment; using dangerous or badly maintained tools and equipment), and how to minimise them and reduce any risks
- 2.4 describe the checks to be carried out to ensure that the heating and bending/forming equipment is safe and in a fit condition to use
- 2.5 explain how to obtain the necessary drawings, specifications and job instructions
- 2.6 explain how to extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS, ISO or BSEN standards) in relation to work undertaken
- 2.7 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing
- 2.8 describe the terminology used in hot forming activities and types of spring produced
- 2.9 describe the basic principles of bending and forming using heating methods
- 2.10 describe the various types of heating equipment that is used, and their typical applications
- 2.11 describe the methods and techniques that are used to obtain the required profiles, shape and size of spring component
- 2.12 describe the ways of limiting distortion, marks and creases in the finished workpiece
- 2.13 describe the preparations to be carried out on the materials, prior to bending/forming them
- 2.14 explain how to prepare and set up the heating equipment
- 2.15 describe the basic characteristics of the materials with regard to

- the heating and forming operations undertaken
- 2.16 explain the need to take care of the bending/forming tools and equipment, and how to recognise faulty or damaged forming tools
 - 2.17 describe the problems that can occur with the heating, bending and forming activities, and how they can be avoided
 - 2.18 describe the organisational quality control procedures that are used, and how to recognise defects in the finished work
 - 2.19 describe the inspection checks to be carried out, and the tools and equipment that are used for this
 - 2.20 describe the accuracy that can be achieved by hot forming by hand, and limitations of the processes
 - 2.21 describe the importance of completing all relevant documentation on conclusion of the hot spring making activities
 - 2.22 describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve.

Unit 431

Carrying out heat treatment of springs

UAN:	D/600/5719
Level:	3
Credit value:	30
GLH:	91
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 142: Carrying Out Heat Treatment of Springs (Level 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to apply specified heat treatment processes to coil springs, wire forms or flat/strip springs, in accordance with approved procedures. The learner will be required to select and prepare the appropriate equipment to use, based on the heat treatment process to be carried out and the types of material to be treated. The heat treatment activities will include hardening, tempering, annealing and normalising, as applicable to the task.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the spring heat treatment activities undertaken, and to report any problems with the tools and equipment, materials or activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.</p> <p>The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to safely applying appropriate heat treatment processes for coil springs, wire forms or flat/strip springs.</p>

The learner will understand the heat treatment processes, the equipment used and its application, and will know about the materials and heat treatment techniques in adequate depth to provide a sound basis for carrying out the heat treatment activities to the required specification.

The learner will understand the safety precautions required when carrying out the heat treatment operations, and when working with heat treatment furnaces, quenching mediums and when using the associated tools and equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

Learning outcome
The learner will: 1. carry out heat treatment of springs
Assessment criteria
The learner can: 1.1 work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines 1.2 carry out all of the following during the heat treatment activities: <ul style="list-style-type: none">• obtain and interpret correctly the documentation for the type of spring being heat treated (such as job instructions, spring specifications, heat treatment specifications and quality 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 the heat treatment equipment to be used is in a safe and usable condition• carry out the heat treatment activities, following good practice/approved procedures• ensure the safety of themselves and others while carrying out the heat treatment processes• return all tools and equipment to the correct location on completion of the heat treatment activities• dispose of waste and excess materials, in line with agreed organisational procedures• leave the work area in a clean and safe condition on completion of the activities 1.3 prepare the materials in readiness to receive the appropriate heat treatment 1.4 prepare springs for the heat treatment activities by carrying out two of the following:

- removing scale
 - pickling
 - degreasing/cleaning
 - drying
 - pre-heating
- 1.5 check that the heat treatment equipment is set up and maintained at satisfactory operating conditions
- 1.6 carry out the heat treatment process, using appropriate techniques and procedures
- 1.7 carry out two of the following heat treatment processes:
- hardening
 - austempering
 - temper (hot) setting
 - tempering
 - normalising/stress relieving
 - de-embrittling
- 1.8 apply heat treatments to two different types of spring material from the following:
- carbon/mild steel
 - spring steel
 - stainless steel
 - special alloy steels
 - brass
 - phosphor bronze
 - beryllium copper
 - aluminium
 - other specific material
- 1.9 use two of the following methods of heating the components:
- gas or electric furnace
 - controlled atmosphere furnace
 - tempering oven
 - stress relieving oven
 - air circulating oven
 - muffle oven
 - gas torches
 - salt/chemical baths
 - induction heating
- 1.10 use two of the following methods of quenching/cooling the springs:
- water
 - oil
 - air
 - sand
 - left in the furnace to cool
- 1.11 carry out the heat treatment activities, to include all of the following:
- starting/lighting up the furnace, using approved procedures
 - setting the equipment to maintain the correct conditions (such

<ul style="list-style-type: none"> as temperature, soak time) • checking that the springs are correctly prepared for the required heat treatment (such as dry, at the correct temperature) • checking that there is sufficient cooling medium so that it will not overheat or reach flash point • loading the springs safely into the heat source/solution • bringing the springs up to the correct temperature and maintaining this for the required time • removing the springs from the heat source/solution safely and correctly • cooling/quenching the springs, using the appropriate methods, depending on the heat treatment required <p>1.12 check that the finished material achieves the required characteristics and meets the heat treatment specification</p> <p>1.13 carry out checks on the heat treated springs, to include two of the following:</p> <ul style="list-style-type: none"> • visual checks for cracks or distortion • rate and load test • tensile tests • specific hardness tests (such as Vickers, Brinnell) <p>1.14 carry out heat treatment processes on springs, in compliance with all of the following requirements:</p> <ul style="list-style-type: none"> • the final heat treated springs are in line with the specification or job requirements • the heat treated springs are free from defects • the heat treatment process meets customer/company requirements <p>1.15 complete all relevant documentation on completion of the heat treatment activities, to include one of the following:</p> <ul style="list-style-type: none"> • job cards • quality control documentation • company-specific documentation • computer records • test documents <p>1.16 deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve</p> <p>1.17 shut down the heat treatment equipment to a safe condition on completion of the activities</p> <p>1.18 leave the work area in a safe condition on completion of the heat treatment activities.</p>

Learning outcome
The learner will: 2. know how to carry out heat treatment of springs
Assessment criteria
The learner can: 2.1 describe the specific health and safety precautions to be taken and safe working practices to be employed when carrying out heat

- treatment processes on springs (such as statutory regulations, risk assessment procedures, accident procedures and COSHH regulations; wearing protective clothing and protective equipment, using fume extraction equipment)
- 2.2 describe the hazards associated with carrying out heat treatment processes (such as handling hot materials, using heat treatment solutions, overheating quenching oils, handling quenching oils, fume inhalation, splashes from hot oil or liquids, fire and explosive mixtures), and how to minimise them and reduce any risks
 - 2.3 describe the Personal Protective Equipment (PPE) that should be used (such as leather aprons, eye protection, overalls, face masks, breathing equipment); how to obtain it and check that it is in a safe and usable condition
 - 2.4 describe the importance of ensuring that fume extraction equipment is operating effectively and that good housekeeping and fire prevention procedures are observed
 - 2.5 describe the importance of following job instructions and defined heat treatment procedures
 - 2.6 explain how to obtain the required information on heat treatment temperatures, soak times and quenching/cooling methods to be used
 - 2.7 describe the various types of spring material that can be flame hardened, case hardened, tempered, normalised and annealed
 - 2.8 describe the material preparation methods and techniques to be undertaken prior to applying the heat treatments (such as removing scale, oil and dirt; ensuring that springs are dry, have been pre-heated or are correctly masked up)
 - 2.9 describe the reasons for heat treating the springs
 - 2.10 describe the various heat treatment processes, methods and procedures that may be applied (such as hardening, tempering, normalizing, temper setting, de-embrittling)
 - 2.11 describe the basic principles of operation of the specific heat treatment process being carried out
 - 2.12 describe the types of equipment that can be used to carry out the various heat treatment processes (such as gas or electric furnaces, gas torches, tempering ovens, muffle oven, salt bath, vacuum furnace, induction heating)
 - 2.13 explain how to prepare the equipment for the heat treatment activities (such as setting furnace or salt bath controls to give the correct temperature; ensuring that suitable tongs/handling devices are available)
 - 2.14 describe the importance of making certain that all springs and jigs are completely free of water or other solvents prior to immersing them in a hot solution, and the potential consequences of failing to check this
 - 2.15 describe the methods used to hold/secure components in a heat treatment solution (such as wires, hooks, jigs)
 - 2.16 describe the importance of monitoring the equipment settings and solutions during the heat treatment process
 - 2.17 explain how to ensure that the components are heated to the correct temperature for the process being carried out (such as hardening temperatures for various carbon contents; soak times at set temperatures for carburising, annealing or normalising; temperatures for various tempering applications), and why these temperatures must be adhered to

- 2.18 describe the various cooling and quenching techniques that are applied to the processes (including water, oil, sand, air, gas fan cooling), and why it is important to use the correct process
- 2.19 describe the use of quenching oils, and the need to maintain the oil temperature below the oil flashpoint
- 2.20 describe the information sources on heat treatment temperatures, tempering colours, soak times required and quenching/cooling mediums to be used
- 2.21 explain how to check the finished work after heat treatment (such as visual checks for cracks or distortion; using simple file or spark tests to check for hardening or annealing has been achieved; the use of dye penetrant and magnetic particle tests; the use of specialised hardness tests such as vickers/brinnell)
- 2.22 describe the problems that can occur with the heat treatment operations, and how these can be overcome
- 2.23 describe the importance of completing all relevant documentation on conclusion of the spring heat treatment activities
- 2.24 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 432

Carrying out shot peening of springs

UAN:	H/600/5723
Level:	3
Credit value:	30
GLH:	91
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 143: Carrying Out Shot Peening of Springs (Level 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out the shot peening of springs, in accordance with approved procedures. The learner will carry out checks of the machine to ensure that it is safe to use, and that the substances used during the treatment operation are available and suitable for the intended purpose and type and size of spring being treated. The learner will be expected to operate the machine to control the treatment cycle and flow of abrasive substance onto the spring surfaces, in accordance with safe working practices and operating procedures. The learner will monitor the machine's performance to ensure consistent treatment of the springs and to check that adequate levels of abrasive substances are maintained within the machine.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the shot peening activities undertaken, and to report any problems with the machine, equipment, consumables or treatment activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of</p>

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 application of shot peening for the treatment of springs. The learner will understand the shot peening equipment used, and its application, and will know about the spring materials, shot peening consumables and equipment setting-up procedures, in adequate depth to provide a sound basis for carrying out the activities, correcting faults and ensuring that the springs output are to the required specification.

The learner will understand the safety precautions required when working with the shot peening equipment, and with its associated equipment and consumables. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

Learning outcome
The learner will: 1. carry out shot peening of springs
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 in preparation for the shot peening activities: <ul style="list-style-type: none">• obtain all necessary documents and job instructions for the shot peening operations being performed• ensure that the work area is clear of hazards• 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• check that all the machine controls are operating safely and correctly• ensure that all safety equipment is in place and in good working order (such as machine guards, shot protection screens, door closing catches/interlocks)• check that any lifting and handling equipment required is available and in good order• ensure that dust extraction and air filtering equipment is functioning correctly• ensure that any rolling tracks or carousels are operational

- check that consumables, such as shot, are at appropriate levels in the machine
- 1.3 ensure that material surfaces to be treated are suitably prepared for the finishing operations to be carried out
 - 1.4 check that the finishing equipment and treatment solutions are set up and maintained at satisfactory operating conditions and levels
 - 1.5 carry out the treatment process in accordance with operating procedures and the component specification requirements
 - 1.6 shot peen springs made from one of the following materials:
 - ferrous alloys
 - non-ferrous alloys
 - 1.7 use one of the following types of shot peening unit:
 - linear/longitudinal throughput
 - rotary throughput
 - air blast cabinet
 - batch barrel machines
 - hanger type machine
 - belt type machine
 - cycled rotary
 - ultrasonic
 - 1.8 use one of the following types of shot peening consumable:
 - cast steel
 - conditioned cut wire
 - glass
 - ceramic
 - shots/round medium
 - other specific
 - 1.9 shot peen springs using one of the following shot peening methods:
 - single application
 - dual shot peening
 - warm shot peening
 - stress peening
 - 1.10 carry out the shot peening activities on springs, to include all of the following:
 - loading of springs into the machine drum or into holding jigs/frames, as applicable to the machine/spring type
 - checking that the correct type and size of shot has been loaded into the machine
 - setting the machine operating parameters to give the required blasting conditions
 - controlling and monitoring the shot peening activity throughout its time cycle
 - maintaining the shot material at an appropriate level
 - producing Almen arc rise
 - checking that the springs have achieved the required properties/finish
 - unloading the springs from the shot peening drum or

frames/jigs
<ul style="list-style-type: none"> • carrying out corrosion protection activities after peening (where required)
1.11 ensure that the treated workpiece achieves the required characteristics and meets the finishing specification
1.12 complete visual inspection and segregation of the springs, to include carrying out both of the following: <ul style="list-style-type: none"> • placing acceptable springs in the approved containers • sorting springs requiring further treatment
1.13 complete all relevant documentation on conclusion of the shot peening activities, to include one of the following: <ul style="list-style-type: none"> • job cards • quality control documentation • company-specific documentation • computer records • test documents
1.14 deal promptly and effectively with problems within their control and report those that cannot be solved
1.15 dispose of waste and excess materials in line with agreed organisational procedures
1.16 shut down the finishing equipment to a safe condition on completion of the processing activities
1.17 complete all of the following operations at shutdown, where appropriate: <ul style="list-style-type: none"> • close down the equipment (such as extraction units, power supplies, air supplies, filtering equipment) to a safe level • check that all systems are failsafe • complete the relevant paperwork.

Learning outcome
The learner will:
2. know how to carry out shot peening of springs
Assessment criteria
The learner can:
2.1 describe the specific safety precautions to be taken when setting up and using shot peening equipment (such as general workshop safety, appropriate Personal Protective Equipment, accident procedure; statutory regulations, risk assessment procedures and COSHH regulations)
2.2 describe the hazards associated with working on shot peening equipment (such as handling shot/abrasive materials, moving parts of machinery, airborne particles, using dangerous or badly maintained tools and equipment), and how to minimise them and reduce any risks
2.3 describe the safety mechanisms on the equipment, and the procedure for checking that they function correctly
2.4 explain how to start and stop the equipment in normal and emergency situations
2.5 describe the checks to be made on the equipment to ensure that it is in a safe and usable condition
2.6 describe the importance of ensuring that the equipment is isolated

- from the power supply before cleaning it or setting up the various parts of the equipment
- 2.7 describe the importance of wearing the appropriate protective clothing and equipment, and of keeping the work area clean and tidy
 - 2.8 describe the basic principles of operation of the shot peening equipment being used
 - 2.9 explain why springs undergo the shot peening process, and the effect the process will have on the finished spring
 - 2.10 describe the characteristics of the various spring materials used with regard to the shot peening process
 - 2.11 explain how to obtain the necessary job instructions, and how to interpret their information
 - 2.12 describe the terminology used in relation to the shot peening equipment being used and the springs being treated
 - 2.13 describe the various types of shot peening consumables that are used, and their suitability for various applications
 - 2.14 explain the need to conduct trial runs, and to check that the equipment is set up correctly and producing springs to the required quality
 - 2.15 explain how to set up and use dust extraction equipment, and the importance of ensuring that the equipment is operating correctly
 - 2.16 describe the effect on spring quality of incorrectly treated springs
 - 2.17 describe the organisational quality control procedures, and the recognition of shot peening defects
 - 2.18 describe the importance of completing all relevant documentation on conclusion of the shot peening activities
 - 2.19 describe the problems that can occur with the shot peening activities, and what to do if they occur
 - 2.20 explain why it is important to keep the equipment clean and free from damage, to practice good housekeeping of tools and equipment, to maintain a clean working area and to carry out safe shutdown procedures
 - 2.21 describe the extent of their own responsibility and to whom they should report to if they have problems that they cannot resolve.

UAN:	M/600/5725
Level:	3
Credit value:	46
GLH:	150
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 144: Carrying Out Quality Control of Spring Making Activities (Level 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out quality control checks of spring making activities, in accordance with approved procedures. The learner will be required to obtain all relevant and current documentation, and to select the appropriate inspection equipment, based on the features to be checked and the accuracy to be measured. This will involve checking that the appropriate equipment is within current test dates and, where necessary, setting up and calibrating the equipment ready for the inspection operations to be performed. In carrying out the inspection activities, the learner will be expected to check the springs for dimensional and geometrical accuracy, load and rate. This may be required to be undertaken at various stages of manufacture, such as random sampling during production and final inspection. The types of spring will include compression, extension, torsion, wire forms, strip and flat springs.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the quality control activities being carried out, and to report any problems with the product they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to ensure that all tools and equipment used to check inspect the springs are returned to the</p>

correct location on completion of the activities. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying inspection techniques and procedures to springs and wire forms including, where appropriate, to British, European and interSemta National standards. The learner will understand how to use the tools and equipment used to inspect the springs, in adequate depth to provide a sound basis for carrying out the inspection activities and for identifying where features of the springs do not meet the required specification tolerances.

The learner will understand the safety precautions required when carrying out the inspection activities, and when using the associated tools and equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

Learning outcome
The learner will: 1. carry out quality control of spring making activities
Assessment criteria
The learner can: 1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 carry out all of the following during the spring quality control activities: <ul style="list-style-type: none">• obtain and interpret correctly the documentation for the type of spring being checked (such as job instructions, spring drawings, specifications and quality 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• obtain the tools, measuring instruments and equipment to be used, and check the condition and calibration dates• carry out the quality control activities, following good practice/approved inspection procedures• identify, and record in the appropriate format, any out-of-specification features

- investigate and, where appropriate, obtain a concession for out-of-specification springs
 - place the springs in the correct location on completion of the inspection activities (in and out of specification)
 - return all tools and equipment to the correct location on completion of the quality control activities
 - leave the work area in a safe and tidy condition on completion of the quality control activities
- 1.3 follow the correct specification for the product or equipment being inspected
- 1.4 use the correct equipment to carry out the inspection
- 1.5 use the relevant equipment to measure and check six of the following spring features:
- number of coils
 - material/wire gauge
 - external diameters
 - internal diameters
 - free length/linear dimensions
 - leg angles/tapers
 - form/profile
 - spring load and rate
 - coil pitch
 - length of leg extension
 - size and shape of hook/eye
 - physical properties (such as hardness)
 - holes (such as size and position)
 - slots (such as width, length, position,
 - bends (such as position, length, angle)
- 1.6 use appropriate equipment to check four of the following geometric features:
- flatness
 - alignment
 - squareness
 - straightness
 - parallelism
 - position/location
 - orientation
 - geometry
 - distortion
 - surface finish
- 1.7 identify and confirm the inspection checks to be made and acceptance criteria to be used
- 1.8 carry out all required inspections as specified
- 1.9 carry out quality control activities on four of the following types of spring:
- open ended right-hand helix
 - open ended left-hand helix
 - variable pitch

- conical
- hourglass
- extension spring
- barrel
- garter springs
- closed end right-hand helix
- closed end left-hand helix
- watch/power
- tension spring
- single torsion
- double torsion
- volute
- flat/strip springs
- other wire forms

1.10 carry out quality control activities on materials prior to making the springs, to include all of the following:

- checking that materials comply to works order/route card
- checking that materials comply with spring specification requirements
- checking the dimensional accuracy of materials
- checking the surface condition of materials (such as free from contaminants and surface scale)
- checking the condition of material and its suitability to coiling/forming (such as state of hardness/tempering)

1.11 carry out two of the following quality control procedures:

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

1.12 Inspect springs, using six of the following:

- rule or tape
 - external micrometer
 - length Vernier
 - height Vernier
 - straight edge
 - engineers' square
 - slip gauge
 - protractors
 - dial test indicator
 - radius/profile gauges
 - other specific equipment
- plus one more from the following:
- jigs/fixtures (such as mechanical, pneumatic)
 - electronic gauging methods
 - optical equipment (such as shadowgraphs, microscopes)

<ul style="list-style-type: none"> • hardness testing equipment (such as diamond pyramid indenter, ball impression testing) • spring load and rate testing equipment <p>1.13 identify any defects or variations from the specification</p> <p>1.14 record the results of the inspection in the appropriate format</p> <p>1.15 complete the quality control documentation, to include one from the following, and pass to the appropriate people:</p> <ul style="list-style-type: none"> • inspection/test report • concession report • job card • customer-specific documentation <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
The learner will:
2. know how to carry out quality control of spring making activities
Assessment criteria
The learner can:
2.1 describe the specific safety precautions to be taken when carrying out quality control activities in a spring making environment (such as specific legislation or regulations governing the activities or work area, safe working practices and procedures to be adopted, general workshop safety practice)
2.2 describe the health and safety requirements of the work area in which they are carrying out the quality control activities, and the responsibility these requirements place on them
2.3 describe the hazards associated with carrying out quality control checks on springs, and how to minimise them and reduce any risks
2.4 describe the appropriate Personal Protective Equipment (PPE) and clothing to be worn during the quality control activities
2.5 explain how and where to obtain the required drawings and related specifications, and how to check that they are current and complete
2.6 explain how to extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS, ISO or BSEN standards) in relation to work undertaken
2.7 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing
2.8 describe the use of British, European and interSemta National standards in determining if components and products are fit for purpose
2.9 describe the general principles of quality assurance systems and procedures
2.10 describe the preparations to be undertaken before the product is inspected
2.11 describe the effects that the environment may have on the measurements taken (such as where precision measurements are concerned)
2.12 explain the need to select and use set datum faces, and the effects

- of taking readings from different datums (such as accumulation of limits leading to errors)
- 2.13 describe the application and uses of the tools and equipment used to inspect spring and wire products (such as micrometers, verniers, gauges, special measuring equipment)
 - 2.14 explain how to determine the correct equipment for the feature to be inspected, taking into account tolerances to be achieved
 - 2.15 describe the importance of ensuring that tools and equipment are set up correctly and are in a safe and useable condition
 - 2.16 describe the procedure and methods used to check that tools and equipment are within calibration date
 - 2.17 explain why sampling is used, and when it is an effective means of quality assurance
 - 2.18 describe the typical defects and variations that can be found on springs and wire products, and how to identify them
 - 2.19 explain the need to carry out the checks and record the results on the appropriate documentation
 - 2.20 describe the procedure to be followed when inspected products are out of specification
 - 2.21 describe the importance of completing quality control documentation; what needs to be recorded and where records are kept
 - 2.22 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 434

Manufacturing one-off tooling for spring making activities

UAN:	M/600/5739
Level:	3
Credit value:	77
GLH:	161
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 145: Manufacturing One-Off Tooling for Spring Making Activities (Level 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to produce simple, one-off tooling for spring making activities, in accordance with approved procedures. The learner will produce the tooling using hand fitting, forming and machining techniques, such as milling, turning, grinding and drilling. The learner will be expected to produce tooling that requires them to use a range of different machines and equipment, and this will involve setting up the workholding arrangements, workpiece and machine tooling.</p> <p>The learner will also be expected to use a range of hand tools and shaping and fitting techniques that are appropriate to the type of material and operations being performed. These activities will include such things as hand sawing, filing, drilling, threading, and off-hand grinding. The tooling produced will, typically, be such things as mandrels, arbors, bushes, bending and forming tools, cropping tools, jigs and fly press tooling, gauges and other similar types of tooling.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the manufacturing activities undertaken, and to report any problems with the equipment, materials or activities that they cannot personally</p>

resolve, or that are outside their personal responsibilities, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying appropriate manufacturing procedures for one-off tooling used in spring making activities. The learner will understand the machining and fitting processes used, and their application, and will know about the machines, tooling, ancillary equipment, materials and consumables, in adequate depth to provide a sound basis for carrying out the activities, correcting faults and producing the components to the required specification.

The learner will understand the safety precautions required when working with the machines, and with 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. manufacture one-off tooling for spring making activities
Assessment criteria
The learner can: 1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 carry out all of the following during the manufacturing activities: <ul style="list-style-type: none">• determine the design of the tooling/component from similar existing tooling/components, and the drawing of the spring that has to be made• 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• check that the machines and equipment to be used are in a safe and usable condition• check that cutting tools and ancillary equipment are in a serviceable condition• ensure that workpieces are held securely, without damage or distortion

- apply safe and appropriate manufacturing techniques at all times
 - use correctly adjusted machine guards and safety devices
 - leave the machine and work area in a safe and clean condition on completion of the activities
- 1.3 follow instructions and any relevant specifications to produce the component
- 1.4 produce the required components using appropriate manufacturing methods and techniques
- 1.5 produce one-off tooling components for spring manufacture, made from two of the following materials:
- low carbon steel
 - high carbon steel
 - special tool/alloy steel
 - non-ferrous
- 1.6 produce one-off tooling for three of the following types of spring:
- open ended right-hand helix
 - open ended left-hand helix
 - closed end right-hand helix
 - closed end left-hand helix
 - extension
 - single torsion
 - double torsion
 - conical
 - hourglass
 - tension
 - variable pitch
 - barrel
 - garter spring
 - clock
 - power
 - scroll/spiral
 - volute
 - other wire forms
- 1.7 produce three of the following types of spring making tooling:
- coiling mandrels
 - coiling fingers
 - bending tools
 - coiling wire guide bushes
 - forming tools
 - cropping tools
 - coil/pitch setting tools
 - gauges
 - bending sides
 - jigs/fixtures
 - punches
 - dies

- other specific components
- 1.8 produce spring tooling using a range of hand forming and finishing methods, to include four from the following:
 - hand sawing
 - band/power sawing
 - drilling
 - filing
 - grinding
 - polishing
 - countersinking/counterboring
 - bending/forming
 - threading external
 - threading internal
 - hardening and tempering
 - other specific technique
- 1.9 produce replacement components using two of the following machining processes:
 - turning
 - milling
 - shaping/slotting
 - drilling
 - grinding
 - electro-discharge machining
- 1.10 produce one-off tooling for springs which include six of the following features:
 - external diameters
 - internal diameters
 - flat faces
 - parallel faces
 - steps/shoulders
 - faces that are square to each other
 - angular/tapered surfaces
 - circular/curved/radial profiles
 - threads
 - drilled holes
 - reamed/bored holes
 - bends
 - concave or convex form
 - special forms
- 1.11 check that the finished component meets the requirements and make any necessary adjustments
- 1.12 produce one-off tooling components for spring manufacturing activities, in compliance with all of the following quality and accuracy standards:
 - dimensional tolerances are suitable for the work to be carried out
 - the surface finish is suitable for the tooling application

<ul style="list-style-type: none"> • tooling components are free from false tool cuts, burrs and sharp edges • tooling components are fit for purpose <p>1.13 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 manufacture one-off tooling for spring making activities</p>
<p>Assessment criteria</p> <p>The learner can:</p> <p>2.1 describe the safe working practices and procedures and the specific safety precautions to be taken when manufacturing one-off tooling for spring making activities (to include wearing protective clothing and equipment; using machinery and cutting tools; safe working practices, procedures and guidelines which satisfy current regulations such as HASAWA, COSHH and other work related legislation and guidelines)</p> <p>2.2 describe the hazards associated with the manufacture of one-off tooling for springs (such as moving parts of machinery, sharp tools, airborne particles, use of cutting fluids/compounds), and how to minimise them and reduce any risks</p> <p>2.3 describe the safety mechanisms on the machines, and the procedure for checking that they are operating correctly</p> <p>2.4 explain how to operate all the machine controls, in both hand and power modes, and how to stop the machine in case of an emergency</p> <p>2.5 describe the importance of wearing appropriate protective clothing and equipment, and of keeping the work area clean and tidy</p> <p>2.6 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>2.7 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, work reference points and system of tolerancing</p> <p>2.8 explain how to determine the design of components from existing/similar components, sketches, spring data and other relevant information</p> <p>2.9 explain how to take measurements and produce working sketches of parts to be made, where no drawings are available</p> <p>2.10 describe the terminology used in spring toolmaking activities</p> <p>2.11 describe the basic principles of operation of the tooling being manufactured, and the performance characteristics that the tooling will need to have</p> <p>2.12 describe the various hand forming/finishing methods and techniques that can be used to produce or hand finish the required components (such as filing, drilling, grinding, bending and threading)</p> <p>2.13 explain how to determine the drill size for tapped holes, and the importance of using the taps in the correct sequence</p> <p>2.14 explain how to cut external threads using hand dies, and the method of fixing and adjusting the dies to give the correct thread fit</p>

- 2.15 explain how to select saw blades (for different materials and different operations)
- 2.16 describe the use of vice jaw plates to protect the workpiece from damage
- 2.17 describe the various machining methods and techniques that can be used to manufacture the replacement components (such as turning, milling, grinding)
- 2.18 describe the good practice/approved procedures to be followed during the manufacturing of the tooling components
- 2.19 describe the operating requirements of the machine tools and accessories being used (such as guards, workholding devices, indexing devices)
- 2.20 describe the various shapes and types of tooling that can be used (such as high-speed tooling, tipped tooling)
- 2.21 explain how to handle and store tools and equipment, safely and correctly
- 2.22 describe the factors which affect the selection of cutting feeds and speeds, and the depth of cut that can be taken (workpiece rigidity, machine condition, type of tooling being used, material type, finish and tolerance required)
- 2.23 describe the application of cutting fluids with regard to a range of different materials and processes
- 2.24 describe the techniques and implications of clamping a workpiece in a chuck/workholding device (such as safely secured for the process, not causing distortion in the finished components)
- 2.25 explain how to recognise machining faults, and how to identify when tools need re-sharpening
- 2.26 describe the problems that can occur with the machining and fitting activities, and how these can be overcome
- 2.27 describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve.

Unit 435

Setting and operating CNC laser profiling machines for strip spring making

UAN:	A/600/5744
Level:	3
Credit value:	77
GLH:	161
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 146: Setting and Operating CNC Laser Profiling Machines for Strip Spring Making (Level 3).
Endorsement by a sector or other appropriate body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to prepare CNC laser cutting and profiling machines for the cutting and shaping of components used in strip/flat spring manufacturing activities, in accordance with approved procedures. This will involve producing and loading the machine operating program, setting up the laser cutting parameters and then following correct procedures for calling up the machine-operating program, dealing with any error messages, and executing the program activities safely and correctly.</p> <p>The spring components produced will have a number of different features, including square and rectangular profiles, angular profiles, curved profiles, circles, slots and holes. The learner will be required to monitor the laser cutting operations continuously, making any necessary adjustments to machine parameters to maintain the spring components within specification requirements. 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 producing, loading and proving the laser cutting programs, and to report any problems with these activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the CNC laser cutting machine programming and operating procedures used. The learner will understand the CNC laser cutting and profiling machine used in the process and its application, and will know about the programming, editing, proving process, associated setting-up procedures, materials and consumables, in adequate depth to provide a sound basis for carrying out the activities, correcting faults and ensuring that the machine controller is set up to produce the spring components to the required specification.

The learner will understand the safety precautions required when working on the CNC laser cutting machine, and with its associated equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

Learning outcome
The learner will: 1. set and operate CNC laser profiling machines for strip spring making
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 during the CNC laser cutting and profiling machine programming and operating activities: <ul style="list-style-type: none">• obtain and correctly interpret documentation for the type of spring being made (such as job instructions, spring drawings, and quality 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 the laser lens is clean and in a suitable condition
 - check that all safety equipment and guards are in place and are functioning correctly
 - ensure that materials are correctly positioned and held securely, without distortion
 - check that the operating program is at the correct start point
 - observe safe working practices and procedures at all times
 - ensure that machine settings are adjusted, as necessary, to maintain accuracy
 - leave the machine and work area in a safe and clean condition on completion of the activities
- 1.3 use the correct control program and ensure that it is correctly loaded into the machine controller
- 1.4 follow the correct procedures for calling up the program and for dealing with any error messages or faults
- 1.5 confirm the program integrity
- 1.6 develop laser cutting and profiling programs, which contain all of the following:
- all necessary positional information
 - appropriate programming codes to suit the type of machine controller
 - preparatory commands and machine management/auxiliary functions
 - repetitive programs (such as sub-routines, canned cycles, labels)
 - absolute or incremental systems of measurement
 - appropriate start of cutting points (in waste material, where appropriate)
 - appropriate cutting head rest points (away from the finished workpiece)
- 1.7 prove the laser cutting and profiling program, to include using six of the following:
- preparing the machine controller to accept the operating program
 - inputting/loading the prepared program into the controller, safely and correctly
 - using search and edit facilities
 - running through the program using single block run
 - running through the program using full dry run
 - operating program override controls (such as laser intensity, cutting speed)
 - saving programs safely and correctly, in the appropriate format
 - storing completed program media, safely away from contaminants or electromagnetic sources
- 1.8 adjust the equipment and program operating parameters to optimise the outcomes to be achieved
- 1.9 load and correctly set up all associated equipment
- 1.10 produce CNC laser cutting and profiling programs, using one of the following methods:

- written
 - entered directly into the machine controller
 - using computer software
- 1.11 produce laser cut and shaped spring components which cover five of the following features:
- square/rectangular profiles
 - angular profiles
 - curved profiles
 - circles
 - ellipses
 - holes
 - slots and apertures
 - other specific features
- 1.12 carry out laser cutting activities on one of the following types of spring material:
- mild steel
 - carbon steel
 - stainless steel
 - alloy steel
 - copper based alloy
 - nickel based alloys
 - titanium and other special material
- 1.13 complete all relevant documentation on completion of the spring making activities, to include one of the following:
- job cards
 - quality control documentation
 - company-specific documentation
 - computer records
 - test documents
- 1.14 check that all safety mechanisms are in place and that the equipment is set correctly for the required operations
- 1.15 monitor the computer process and ensure that the production output is to the required specification
- 1.16 produce laser cut spring components which meet all of the following quality and accuracy standards:
- customer standards and job requirements
 - company standards and procedures
 - dimensional accuracy is within the tolerances specified on the drawing/specification
 - angled/profiles are within specification requirements
 - cuts are clean and smooth
 - components are free from distortion, burrs and sharp edges
- 1.17 deal promptly and effectively with problems within their control and report those that cannot be solved
- 1.18 shut down the equipment to a safe condition on conclusion of the activities.

Learning outcome

The learner will:

2. know how to set and operate CNC laser profiling machines for strip spring making

Assessment criteria

The learner can:

- 2.1 describe the safe working practices and procedures to be observed when loading and proving operating programs on CNC laser cutting and profiling machines (to include care when working with high power laser beams; machine guards; ventilation and fume extraction; machine safety devices)
- 2.2 explain how to start and stop the machine in normal and emergency situations, and how to close the machine down on completion of the activities
- 2.3 describe the importance of ensuring that the machine is isolated from the power supply before working with the machinery; and the care needed, particularly when working with laser beams
- 2.4 describe the hazards associated with working on laser cutting and profiling machines (such as dangers from the laser beam; live electrical components; moving parts of machinery), and how to minimise them and reduce any risks
- 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 principles and operation of laser cutting and profiling machines; laser focusing; terminology used
- 2.7 describe the range of workholding methods and devices that are used on the laser cutting machines
- 2.8 describe the methods of mounting and setting the materials in the correct relationship to the machine's reference points, and the tools and equipment that are to be used for this
- 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 explain how the various types of spring material will affect the laser cutting feeds and speeds that can be used
- 2.12 explain how to read the machine's visual display, and how to understand the various messages displayed
- 2.13 describe the function of error messages, and what to do when an error message is displayed
- 2.14 explain how to find the correct restart point in the program when the machine has been stopped before completion of the program
- 2.15 describe the operation of the various hand and automatic modes of machine control (such as hand wheels, joysticks, program operating and control buttons)
- 2.16 explain the need to conduct trial runs, and to check that the machine is set up and running safely and correctly
- 2.17 explain how to operate the machine using single block run, full program run and speed override controls
- 2.18 explain how to make adjustments to machine-operating programs to take account of out-of-specification components

- 2.19 describe the care of equipment and operating programs (including safe storage of material away from electromagnetic forces)
- 2.20 explain how to monitor the machine during the cutting process; recognition of problems and action to be taken
- 2.21 describe the problems that can occur during the laser cutting activities, and how to prevent them
- 2.22 describe the organisational quality systems (such as standards to be achieved; production records to be kept)
- 2.23 describe the importance of completing all relevant documentation on conclusion of the laser cutting and profiling activities
- 2.24 describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve.



Appendix 1 Relationships to other qualifications

Links to other qualifications

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

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

This qualification has connections to the Level 3 NVQ in Mechanical Manufacturing Engineering.

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 2 Sources of general information

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

Centre Manual - Supporting Customer Excellence contains detailed information about the processes which must be followed and requirements which must be met for a centre to achieve 'approved centre' status, or to offer a particular qualification, as well as updates and good practice exemplars for City & Guilds assessment and policy issues. Specifically, the document includes sections on:

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

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

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

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

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

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

- **Walled Garden:** how to register and certificate candidates on line
- **Events:** dates and information on the latest Centre events
- **Online assessment:** how to register for e-assessments

Useful contacts

UK learners General qualification information	T: +44 (0)844 543 0033 E: learnersupport@cityandguilds.com
InterSemta National 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
InterSemta National awards Results, Entries, Enrolments, Invoices, Missing or late exam materials, Nominal roll reports	T: +44 (0)844 543 0000 F: +44 (0)20 7294 2413 E: intops@cityandguilds.com
Walled Garden Re-issue of password or username, Technical problems, Entries, Results, e-assessment, Navigation, User/menu option, Problems	T: +44 (0)844 543 0000 F: +44 (0)20 7294 2413 E: walledgarden@cityandguilds.com
Employer Employer solutions, Mapping, Accreditation, Development Skills, Consultancy	T: +44 (0)121 503 8993 E: business@cityandguilds.com
Publications Logbooks, Centre documents, Forms, Free literature	T: +44 (0)844 543 0000 F: +44 (0)20 7294 2413

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

City & Guilds Group

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

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