

Level 3 NVQ Diploma in Mechanical Manufacturing Engineering (Fitting and Assembly) (1712-33)

September 2011 Version 1.0



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	City & Guilds number	Accreditation number
Level 3 NVQ Diploma in Mechanical Manufacturing Engineering – Fitting and Assembly	1712-33	501/1803/1



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1 Introduction

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

Area	Description
Who is the qualification for?	It is for candidates who work or want to work as mechanical manufacturing engineers – fitting and assembly 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">• Level 3 NVQ Extended Diploma in Mechanical Manufacturing Engineering

Structure

To achieve the **Level 3 NVQ Diploma in Mechanical Manufacturing Engineering (Fitting and Assembly)**, learners must achieve **15** credits from the mandatory units and a minimum of **150** credits from a minimum of 3 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			
A/600/5470	Unit 360	Producing components using hand fitting techniques	70
J/600/5472	Unit 361	Assembling mechanical products	70
H/600/5477	Unit 362	Producing components by manual machining	70
H/600/5480	Unit 363	Fitting fluid power components to mechanical assemblies	60
F/600/5485	Unit 364	Fitting pipework systems to mechanical assemblies	60
R/600/5488	Unit 365	Fitting electrical and electronic components to mechanical assemblies	60
Y/600/5492	Unit 366	Producing power turbine combustion assemblies	70

A/600/5498	Unit 367	Producing power turbine compressor assemblies	70
F/600/5504	Unit 368	Producing turbine assemblies	70
R/600/5510	Unit 369	Producing power turbine gearbox assemblies	70
M/600/5515	Unit 370	Producing power turbine major assemblies	70
J/600/5522	Unit 371	Producing piston engine assemblies	70
H/600/5527	Unit 372	Repairing and modifying mechanical assemblies	70
L/600/5537	Unit 373	Checking that completed assemblies comply with specification	30



2 Centre requirements

Approval

Centres currently offering the City & Guilds Level 3 NVQ in Mechanical Manufacturing Engineering (1682) will be automatically approved to run this new qualification.

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

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

Resource requirements

Centre staffing

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

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

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

Assessors and internal verifier

Assessor Requirements to Demonstrate Effective Assessment Practice

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

Assessor Technical Requirements

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

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

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

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

Verifier Requirements (internal and external)

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

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

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

Continuing Professional Development (CPD)

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

Candidate entry requirements

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

The SEMTA Engineering Manufacture apprenticeship framework suggests that:

Employers would be interested in candidates that:

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

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

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

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

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

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

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

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

Age restrictions

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

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



3 Delivering the qualification

Initial assessment and induction

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

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

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

Recommended delivery strategies

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

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

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

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

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

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

Recording documents

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

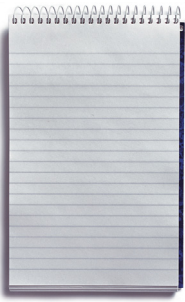
City & Guilds endorses several ePortfolio systems. Further details are available at: www.cityandguilds.com/eportfolios.

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

Recording forms are available on the City & Guilds website.

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

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



4 Assessment

Assessment of the qualification

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

Evidence requirements

Carrying Out Assessments

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

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

Minimum Performance Evidence Requirements

Performance evidence must be the main form of evidence gathered. In order to demonstrate consistent, competent performance for a unit, a minimum of 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 learners 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 learners competency. However, the witness must be technically competent in the process or skills that they are providing testimony for, to at least the same level of expertise as that required of the learner. It will be the responsibility of the assessor to make sure that any witness testimonies accepted as evidence of the learner's competency are reliable, auditable and technically valid.

Recognition of Prior Learning (RPL)

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



5 Units

Availability of units

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

Structure of units

These units each have the following:

- City & Guilds unit number
- Title
- Unit Accreditation Number (UAN)
- Level
- Credit value
- Recommended Guided Learning Hours (GLH)
- Relationship to 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 seven main groups of hazardous

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

- 2.4 explain how to locate relevant health and safety information for their tasks, and the sources of expert assistance when help is needed
- 2.5 explain what constitutes a hazard in the workplace (such as moving parts of machinery, electricity, slippery and uneven surfaces, poorly placed equipment, dust and fumes, handling and transporting, contaminants and irritants, material ejection, fire, working at height, environment, pressure/stored energy systems, volatile, flammable or toxic materials, unshielded processes, working in confined spaces)
- 2.6 describe their responsibilities for identifying and dealing with hazards and reducing risks in the workplace
- 2.7 describe the risks associated with their working environment (such as the tools, materials and equipment that they use, spillages of oil, chemicals and other substances, not reporting accidental breakages of tools or equipment and not following laid-down working practices and procedures)
- 2.8 describe the processes and procedures that are used to identify and rate the level of risk (such as safety inspections, the use of hazard checklists, carrying out risk assessments, COSHH assessments)
- 2.9 describe the first aid facilities that exist within their work area and within the organisation in general; the procedures to be followed in the case of accidents involving injury
- 2.10 explain what constitute dangerous occurrences and hazardous malfunctions, and why these must be reported even if no-one is injured
- 2.11 describe the procedures for sounding the emergency alarms, evacuation procedures and escape routes to be used, and the need to report their presence at the appropriate assembly point
- 2.12 describe the organisational policy with regard to fire fighting procedures; the common causes of fire and what they can do to help prevent them
- 2.13 describe the protective clothing and equipment that is available for their areas of activity
- 2.14 explain how to safely lift and carry loads, and the manual and mechanical aids available
- 2.15 explain how to prepare and maintain safe working areas; the standards and procedures to ensure good housekeeping
- 2.16 describe the importance of safe storage of tools, equipment, materials and products
- 2.17 describe the extent of their own authority, and to whom they should report in the event of problems that they cannot resolve.

Unit 202

Using and interpreting engineering data and documentation

UAN:	Y/601/5102
Level:	2
Credit value:	5
GLH:	25
Relationship to NOS:	This unit has been derived from 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 • national, international and organisational standards • health and safety standards relating to the activity (such as COSHH) • other specific related documentation
1.8	deal promptly and effectively with any problems within their control and report those which cannot be solved
1.9	report any inaccuracies or discrepancies in documentation and specifications.

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

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

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

Unit 303

Working efficiently and effectively in engineering

UAN:	K/601/5055
Level:	3
Credit value:	5
GLH:	25
Relationship to NOS:	This unit has been derived from Semta national occupational standard: Working efficiently and effectively in engineering (Suite 3).
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 360

Producing components using hand fitting techniques

UAN:	A/600/5470
Level:	3
Credit value:	70
GLH:	210
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 60: Producing Components using Hand Fitting Techniques (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 detail components using hand fitting techniques, in accordance with approved procedures. The learner will be required to select the appropriate equipment to use, based on the operations to be carried out and the accuracy required. In producing the components, the learner will be expected to use appropriate tools and equipment to mark out the material for a range of features to be produced, and then to use hand tools, portable power tools, 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, band sawing, filing, drilling, chiselling, threading, scraping, lapping and off-hand grinding. The components produced will have features that include flat, square, parallel and angular faces, radii and curved profiles, drilled holes, internal and external threads, and sliding or mating parts.</p> <p>Materials to be used will include ferrous, non-ferrous, non-metallic and composites, which may be in sheet form, bar sections (such as square/rectangular, round, hexagonal) or part-machined components.</p> <p>The learner's responsibilities will require them to comply with organisational policy</p>

and procedures for the cutting and shaping activities undertaken, and to report any problems with the equipment, materials or activities that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their 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 fitting procedures. The learner will understand the hand fitting techniques used, and their application, and will know about the tools, materials and equipment used, 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 using hand and power tools. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

Learning outcome
The learner will: 1. produce components using hand fitting techniques
Assessment criteria
The learner can: 1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 carry out all of the following activities during the hand fitting: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, drawings, quality control documentation)• adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work• follow safe practice/approved fitting procedures at all times• check that all cables, extension leads or air supply hoses are in a serviceable condition• check that all tools and measuring equipment are within current calibration/certification dates• return all tools and equipment to the correct location on completion of the fitting activities• leave the work area and machine in a safe and appropriate

condition on completion of the activities

- 1.3 follow relevant specifications for the component to be produced
- 1.4 mark out a range of material forms, to include five from the following:
 - forgings
 - machined items
 - castings
 - round/cylindrical sections
 - bar stock items
 - flat or sheet materials
 - channel sections
 - angle irons
 - joist sections
 - irregular shaped items
 - assemblies
 - other specific items
- 1.5 use marking-out methods and techniques which include two of the following:
 - direct marking using instruments
 - use of templates
 - tracing/transfer methods
- 1.6 mark out workpieces which include five of the following features:
 - datum/centre lines
 - square/rectangular profiles
 - angles/angular profiles
 - circles
 - radial profiles
 - linear hole positions
 - radial hole positions
 - allowances for bending
 - simple pattern development
- 1.7 obtain the appropriate tools and equipment for the shaping operations and check they are in a safe and usable condition
- 1.8 use a range of marking-out equipment, to include all of the following:
 - rules/tapes
 - dividers/trammels
 - scribes
 - punches
 - scribing blocks
 - squares
 - protractors
 - vernier instruments
- 1.9 shape the materials using appropriate methods and techniques
- 1.10 use a range of hand fitting methods to include seven from the following:
 - filing

- drilling
 - off hand grinding
 - power sawing
 - scraping
 - chiselling
 - threads external
 - threads internal
 - lapping
 - hand sawing
 - tapping
- 1.11 produce components which combine several features and cover eight from the following:
- flat datum faces
 - chamfers and radii
 - curved profiles
 - reamed holes
 - faces which are square to each other
 - faces which are parallel to each other
 - drilled holes (through, to a depth)
 - counterbores, countersinks, or spot face
 - internal threads
 - external threads
 - faces angled to each other
 - sliding or mating parts
- 1.12 cut and shape two different types of material from the following:
- low carbon steel
 - high carbon steel
 - stainless steel
 - aluminum
 - brass/bronze
 - plastic/synthetic
 - composite
- 1.13 check that all the required shaping operations have been completed to the required specification
- 1.14 produce components within all of the following standards, as applicable to the process:
- surface finish $63\mu\text{in}$ or $1.6\mu\text{m}$
 - screw threads to BS Medium fit
 - reamed and bored holes within H8
 - flatness and squareness 0.001 per inch or 0.025mm per 25mm
 - dimensional tolerance equivalent to BS 4500 or BS 1916 Grade 9
- 1.15 deal promptly and effectively with problems within their control and report those that cannot be solved.

Learning outcome
The learner will: 2. know how to produce components using hand fitting techniques
Assessment criteria
The learner can: 2.1 describe the health and safety requirements, and safe working practices and procedures required for the hand fitting activities undertaken 2.2 describe the importance of wearing appropriate protective clothing and equipment, and of keeping the work area safe and tidy 2.3 describe the hazards associated with the carrying out hand fitting techniques (such as use of power tools, trailing leads or hoses, damaged or badly maintained tools and equipment, using files with damaged or poor fitting handles), and how to minimise them and reduce any risks 2.4 describe the procedure for obtaining the required drawings, job instructions and other related specifications 2.5 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 2.6 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing 2.7 explain how to prepare the materials in readiness for the marking-out activities, in order to enhance clarity, accuracy and safety (such as visually checking for defects, cleaning the materials, removing burrs and sharp edges, applying a marking out medium) 2.8 explain how to select and establish suitable datums 2.9 describe the importance of ensuring that marking out is undertaken from the selected datums, and the possible effects of working from different datums 2.10 describe the methods of holding and supporting workpieces during the marking-out activities, and equipment that can be used (such as surface plates, angle plates, vee blocks and clamps parallel bars, screw jacks) 2.11 describe the use of marking out conventions when marking out the workpiece (such as datums, cutting guidelines, square and rectangular profiles, circular and radial profiles, angles, holes which are linearly positioned, boxed and on pitch circles) 2.12 describe the ways of laying out the marking-out shapes or patterns to maximise use of materials 2.13 describe the setting and adjusting tools, such as squares, protractors and verniers 2.14 describe the importance of using tools only for the purpose intended; the care that is required when using the equipment and tools; the proper way of storing tools and equipment between operations 2.15 describe the need for clear and dimensional accuracy in marking out to specification and drawing requirements 2.16 describe the cutting and shaping methods to be used, and the sequence in which the operations will need to be carried out

- 2.17 explain how to file flat, square and curved surfaces and achieve a smooth surface finish
- 2.18 explain how to cut external threads using hand dies, and the method of fixing and adjusting the dies to give the correct thread fit
- 2.19 explain how to determine the drill size for tapped holes, and the importance of using the taps in the correct sequence
- 2.20 explain how to produce a sliding or mating fit using filing, scraping and lapping techniques
- 2.21 explain how to select saw blades for different materials, and how to set the saw blades for different operations, such as cutting externally and internally
- 2.22 describe the various types of file that are available, and the cut of files for different applications
- 2.23 explain how to prepare the components for the filing operations (such as cleaning, de-burring, marking out)
- 2.24 describe the use of vice jaw plates to protect the workpiece from damage
- 2.25 describe the types and application of portable power tools that can be used for the hand fitting operations
- 2.26 describe the importance of ensuring file handles are secure and free from embedded foreign bodies or splits
- 2.27 explain how to check that portable power tools and extension cables are free from damage and in a safe usable condition
- 2.28 describe the problems that can occur with the cutting and shaping operations, and how can these be overcome
- 2.29 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 361

Assembling mechanical products

UAN:	J/600/5472
Level:	3
Credit value:	70
GLH:	210
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 61: Assembling Mechanical Products (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 assembly operations to produce mechanical assemblies, in accordance with approved procedures. The learner will be required to prepare the work area, and ensure it is safe and free from hazards. The learner will also be required to check the specified components are available and fit for purpose, to obtain all relevant and current documentation, to obtain the tools and equipment required for the assembly operations, and to check that they are in a safe and usable condition. In carrying out the assembly operations, the learner will be required to follow company procedures and specified assembly techniques, in order to assemble the mechanical product.</p> <p>The assembly activities will also include making all necessary checks and adjustments, to ensure the components are correctly orientated, positioned and aligned, that moving parts have the correct working clearances, all fasteners are tightened to the correct torque, and that the assembled parts are checked for completeness and function as per the specification.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the assembly activities undertaken, and to report any problems with the assembly activities, materials or</p>

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

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the assembly techniques and procedures. The learner will understand the mechanical product being assembled, and its application, and will know about the equipment, relevant components and joining techniques, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

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

Learning outcome
The learner will: 1. assemble mechanical products
Assessment criteria
The learner can: 1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 carry out all of the following during the assembly activities: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, drawings, quality control documentation)• adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work• follow safe practice/approved fitting procedures at all times• check that all cables, extension leads or air supply hoses are in a serviceable condition• check that all tools and measuring equipment are within current calibration/certification dates• use lifting and slinging equipment in accordance with health and safety guidelines and procedures• ensure that the components and pipes used are free from foreign objects, dirt or other contamination before assembling them• return all tools and equipment to the correct location on

- completion of the fitting activities
 - leave the work area and machine in a safe and appropriate condition on completion of the activities
- 1.3 follow the relevant instructions, assembly drawings and any other specifications
- 1.4 ensure that the specified components are available and that they are in a usable condition
- 1.5 use the appropriate methods and techniques to assemble the components in their correct positions
- 1.6 produce assemblies using four of the following methods and techniques:
 - assembling of components by expansion/contraction
 - fitting (such as filing, scraping, lapping or polishing)
 - securing using mechanical fasteners/threaded devices
 - applying sealants/adhesives
 - electrical bonding of components
 - assembling of products by pressure
 - setting working clearances
 - drilling
 - reaming
 - balancing components
 - applying bolt locking methods
 - shimming and packing
 - blue-bedding of components
 - aligning components
 - riveting
 - torque setting
 - soldering/brazing
 - fusion (non-critical joints)
- 1.7 assemble products to meet the required specification, using at least seven of the following components:
 - assembly structure (such as framework, support, casings, panels)
 - fabricated components
 - pre-machined components
 - levers/linkages
 - pipework/hoses
 - cams and followers
 - bearings
 - seals
 - bushes
 - gaskets
 - shafts
 - chains
 - couplings
 - sprockets
 - keys

<ul style="list-style-type: none"> • pulleys • gears • springs • belts • other
<p>1.8 assemble products using two of the following assembly aids and equipment:</p> <ul style="list-style-type: none"> • workholding devices • lifting and moving equipment • specialised assembly tools/equipment • jigs and fixtures • shims and packing • rollers or wedges • supporting equipment
<p>1.9 secure the components using the specified connectors and securing devices</p>
<p>1.10 check the completed assembly to ensure that all operations have been completed and the finished assembly meets the required specification</p>
<p>1.11 carry out the required quality checks, to include eight from the following, using appropriate equipment:</p> <ul style="list-style-type: none"> • positional accuracy • freedom of movement • component security • completeness • dimensions • orientation • alignment • function • bearing end float • operating/ working clearances • free from damage or foreign objects
<p>1.12 produce mechanical assemblies which comply with one of the following quality and accuracy standards:</p> <ul style="list-style-type: none"> • BS, ISO or BSEN standards and procedures • customer standards and requirements • company standards and procedures • specific system requirements
<p>1.13 deal promptly and effectively with problems within their control and report those that cannot be solved.</p>

Learning outcome
The learner will: 2. know how to assemble mechanical products
Assessment criteria
The learner can: 2.1 describe the specific safety precautions to be taken whilst carrying

- out the mechanical assembly, including any specific legislation, regulations or codes of practice relating to the activities, equipment or materials
- 2.2 describe the health and safety requirements of the work area in which they are carrying out the assembly activities, and the responsibility these requirements place on them
 - 2.3 describe the COSHH Regulations with regard to the substances used in the assembly process
 - 2.4 describe the hazards associated with producing mechanical assemblies, and how to minimise them and reduce any risks
 - 2.5 describe the personal protective equipment and clothing to be worn during the assembly activities
 - 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, workpiece reference points and system of tolerancing
 - 2.8 describe the general principles of mechanical assembly, and the purpose and function of the components and materials used, including component identification systems (such as codes and component orientation indicators)
 - 2.9 describe the preparations that need to be undertaken on the components prior to fitting them into the assembly
 - 2.10 describe the assembly/joining methods, techniques and procedures to be used, and the importance of adhering to these procedures
 - 2.11 explain how the components are to be aligned, adjusted and positioned prior to securing, and the tools and equipment that is used
 - 2.12 describe the importance of using the specified components and joining devices for the assembly, and why they must not use substitutes
 - 2.13 explain where appropriate, the application of sealants and adhesives within the assembly activities, and the precautions that must be taken when working with them
 - 2.14 describe the quality control procedures to be followed during the assembly operations
 - 2.15 explain how to conduct any necessary checks to ensure the accuracy, position, security, function and completeness of the assembly
 - 2.16 explain how to detect assembly defects, and what to do to rectify them (such as ineffective joining techniques, foreign objects, component damage)
 - 2.17 describe the methods and equipment used to transport, lift and handle components and assemblies
 - 2.18 explain how to check that the tools and equipment to be used are correctly calibrated and are in a safe and serviceable condition
 - 2.19 describe the importance of ensuring that all tools are used correctly and within their permitted operating range
 - 2.20 describe the importance of ensuring that all tools, equipment and components are accounted for and returned to their correct location on completion of the assembly activities
 - 2.21 describe the problems with the assembly operations, and the

importance of informing appropriate people of non-conformances
2.22 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 362

Producing components by manual machining

UAN:	H/600/5477
Level:	3
Credit value:	70
GLH:	210
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 62: Producing Components by Manual Machining (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 components using manual machining techniques, such as milling, turning, grinding, shaping/slotting, drilling/boring and spark/wire erosion, in accordance with approved procedures. The learner will be expected to produce components that require them to use a range of different machines, and this will involve setting up the workholding arrangements, workpiece and machine tooling. The workpieces produced will have a combination of features, such as diameters, lengths, threads, flat faces, square faces, slots, profiles or special forms.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the machining activities undertaken, and to report any problems with the machines, tooling, materials or activities that they cannot personally resolve, or 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 produce.</p> <p>The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying machining</p>

procedures and instructions. The learner will understand the machining processes, and their application, and will know about the machine, tooling, ancillary equipment, materials and consumables, in adequate depth to provide a sound basis for carrying out the machining 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 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. produce components by manual machining
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 machining activities: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, drawings, quality control documentation)• adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work• ensure that machine guards and safety devices are in place and correctly adjusted• hold components securely without distortion• maintain cutting tools in a safe and usable condition• apply safe working practices and appropriate machining techniques at all times• ensure that components produced meet specification• leave the work area and machine in a safe and appropriate condition on completion of the activities 1.3 confirm that the machine is set up and ready for the machining activities to be carried out 1.4 manipulate the machine tool controls safely and correctly in line with operational procedures 1.5 produce components to the required quality and within the specified dimensional accuracy 1.6 produce machined components using three of the following machining processes: <ul style="list-style-type: none">• turning• drilling

- milling
 - electro-discharge machining
 - grinding
 - shaping or slotting
- 1.7 use a range of workholding devices, to include five of the following:
- three jaw chucks
 - four jaw chucks
 - machine vices
 - vee blocks
 - clamping arrangements
 - angle plates
 - magnetic plates
 - indexing devices
 - face plates
 - special fixtures
 - collet chucks
- 1.8 produce machined components which cover seven of the following features:
- external diameters
 - internal diameters
 - lengths/depths
 - flat faces
 - parallel faces
 - threads
 - circular/curved/radial profiles
 - faces that are square to each other
 - angular/tapered surfaces
 - steps/shoulders
 - slots/recesses
 - drilled/bored/reamed holes
 - concave or convex forms
 - special forms
- 1.9 machine three different types of material from:
- low carbon steel
 - high carbon steel
 - stainless steel
 - cast iron
 - aluminium
 - composite
 - plastic/synthetic
 - special steels or alloys
 - brass
 - bronze
- 1.10 carry out quality sampling checks at suitable intervals
- 1.11 carry out the necessary checks during manufacture, for accuracy of five of the following:

<ul style="list-style-type: none"> • dimensions • angles • flatness/squareness • concentricity • thread size and fit • hole size/fit • profile • quality of surface finish <p>1.12 produce components within all of the following standards, as applicable to the operation performed:</p> <ul style="list-style-type: none"> • dimensional tolerance equivalent to BS 4500 or BS 1916 Grade 7 • flatness and squareness 0.001 per inch or 0.025mm per 25mm • reamed and bored holes within H8 • surface finish 63 μin or 1.6 μm <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>

Learning outcome
The learner will:
2. know how to produce components by manual machining
Assessment criteria
The learner can:
2.1 describe the safe working practices and procedures to be followed while operating machinery
2.2 describe the safety mechanisms on the machine, and the procedure for checking that they are operating correctly
2.3 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
2.4 describe the importance of wearing appropriate protective clothing and equipment, and of keeping the work area clean and tidy
2.5 describe the hazards associated with carrying out machining operations, and how to minimise them and reduce any risks
2.6 explain where to obtain the component drawings, specifications and/or job instructions required for the components to be machined
2.7 explain how to extract and use information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS, ISO or BSEN standards) in relation to work undertaken
2.8 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing
2.9 describe the basic concepts of material removal using machines (such as lathes, milling, grinding, drilling, shaping, slotting and electro-discharge machining)
2.10 describe the various machining techniques that can be used to produce the required shapes, and the types of tooling and cutters

- required (such as high-speed steel tools, solid carbide tools and interchangeable tipped tooling)
- 2.11 describe the types and applications of grinding wheels; methods of mounting; and why some wheels require balancing
 - 2.12 describe the types and application of electrodes used in spark erosion activities
 - 2.13 describe the methods that can be used to position the workpiece in relation to the cutting tools
 - 2.14 describe the effects of backlash in the machine slides and how this can be overcome
 - 2.15 explain how to handle and store cutters, grinding wheels and tools, safely and correctly
 - 2.16 describe the factors which effect the selection of cutting feeds and speeds, the application of roughing and finishing cuts and the depth of cut that can be taken (such as workpiece rigidity, machine condition, type of tooling being used, material type, finish and tolerance required)
 - 2.17 explain how the various types of material will affect the feeds and speeds that can be used
 - 2.18 describe the application of cutting fluids and dielectrics with regard to a range of different materials
 - 2.19 describe the effects of clamping the workpiece, and how material removal can cause warping/distortion in the finished workpiece
 - 2.20 describe the quality control procedures used, inspection checks to be carried out, and the equipment to be used
 - 2.21 describe the problems that can occur with the machining activities, and how these can be overcome
 - 2.22 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 363

Fitting fluid power components to mechanical assemblies

UAN:	H/600/5480
Level:	3
Credit value:	60
GLH:	161
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 63: Fitting Fluid Power Components to Mechanical Assemblies (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 assemble and fit fluid power equipment (pneumatic, hydraulic, or vacuum) to mechanical assemblies, in accordance with approved procedures. The learner will be required to prepare the work area, ensuring it is safe and free from hazards, check the specified components are available and fit for purpose, obtain all relevant and current documentation, and to obtain the tools and equipment required for the assembly operations, checking that they are in a safe and usable condition. In carrying out the fitting and assembly operations, the learner will be required to follow company procedures and specified assembly techniques, in order to assemble the mechanical product.</p>

The assembly activities will also include making all necessary checks and adjustments to ensure the fluid power components are correctly positioned, aligned, dimensionally accurate and secure; pipework is dimensionally accurate and free from ripples, creases and damage; joints are checked for security, with threaded devices tightened correctly; electrical components are checked for safety, position, security and continuity; and test procedures (leak or pressure) are carried out to confirm that the

fluid power assembly meets the operational performance required.

The learner's responsibilities will require them to comply with organisational policy and procedures for the assembly activities undertaken, and to report any problems with the assembly activities, materials or equipment that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to ensure that all tools, equipment and materials used in the assembly are correctly accounted for on completion of the activities, and to complete all necessary job/task documentation accurately and legibly. 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 fluid power assembly techniques and procedures. The learner will understand the mechanical product being assembled, and its application, and will know about the equipment, relevant components and joining techniques, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

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

Learning outcome
The learner will: 1. fit fluid power components to mechanical assemblies
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 assembly activities: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, drawings, quality control documentation)• adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant

- safety regulations and procedures to realise a safe system of work
- adhere to company specific contamination and control procedures at all times
 - apply safe and appropriate fitting and assembly techniques
 - check that all tools and measuring equipment are within current calibration/certification dates
 - use lifting and slinging equipment in accordance with health and safety guidelines and procedures
 - return all tools and equipment to the correct location on completion of the fitting activities
 - leave the work area and assembly in a safe and appropriate condition on completion of the activities
- 1.3 follow the relevant instructions, assembly drawings and any other specifications
- 1.4 ensure that the specified components are available and that they are in a usable condition
- 1.5 use the appropriate methods and techniques to assemble the components in their correct positions
- 1.6 assemble and fit one of the following types of fluid power systems:
- pneumatic
 - hydraulic
 - vacuum
 - electro fluid power systems
- 1.7 prepare, assemble and fit seven of the following components and materials:
- rigid pipe
 - flexible pipe
 - couplings
 - intensifiers
 - valves
 - compressors
 - regulators
 - manifolds
 - sensors
 - accumulators
 - gauges/indicators
 - clips / supports
 - lubricators
 - heaters/driers
 - coolers units
 - cables and wires
 - seals/gaskets
 - locking wire
 - actuators/cylinders
 - separation units
 - pumps
 - meters

<ul style="list-style-type: none"> • filters • motors • other • reservoirs/storage devices • electrical/electronic control systems
1.8 secure the components using the specified connectors and securing devices
1.9 check the completed assembly to ensure that all operations have been completed and the finished assembly meets the required specification
1.10 carry out the quality checks using appropriate equipment, to include eight from: <ul style="list-style-type: none"> • dimensions • positional accuracy • alignment • correct direction and flow • leak or pressure tests • component security • electrical continuity • completeness • function • pipework/hoses (such as free from ripple and creases)
1.11 produce fluid power assemblies which comply with one of the following quality and accuracy standards: <ul style="list-style-type: none"> • BSEN or ISO standards and procedures • customer standards and requirements • company standards and procedures • specific system requirements • organisational guidelines and codes of practice (such as BFPA guidance documentation)
1.12 deal promptly and effectively with problems within their control and report those that cannot be solved.

Learning outcome
The learner will: 2. know how to fit fluid power components to mechanical assemblies
Assessment criteria
The learner can: 2.1 describe the specific safety precautions to be taken while carrying out the fluid power assembly (including any specific legislation, regulations or codes of practice relating to the activities, equipment or materials) 2.2 describe the health and safety requirements of the work area in which they are carrying out the assembly activities, and the responsibility these requirements place on them 2.3 describe the COSHH Regulations with regard to the substances used in the assembly process 2.4 describe the hazards associated with producing fluid power assemblies (such as pressurising and purging of circuits), and how

- to minimise them and reduce any risks
- 2.5 describe the personal protective equipment and clothing to be worn during the assembly activities
 - 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, workpiece reference points and system of tolerancing
 - 2.8 explain how to extract the necessary information from data supplied in order to complete fluid power assemblies
 - 2.9 describe the general principles of fluid power, and the purpose and function of the components and materials used
 - 2.10 describe the preparations that need to be undertaken on the components prior to fitting them onto the assembly
 - 2.11 describe the fitting and assembly methods and procedures to be used, and the importance of adhering to these procedures
 - 2.12 explain how the components are to be aligned, adjusted and positioned prior to securing, and the tools and equipment that are used
 - 2.13 describe the importance of using the specified components for the assembly, and why they must not use substitutes
 - 2.14 describe the specific methods used for leak detection, and when they should be applied
 - 2.15 explain how to conduct any necessary checks to ensure the safety, accuracy, position, security, function and completeness of the assembly
 - 2.16 explain how to detect assembly defects/faults, and what to do to rectify them (such as ineffective joining techniques, foreign objects, component damage)
 - 2.17 describe the methods and equipment used to transport, lift and handle components and assemblies
 - 2.18 explain how to check that the tools and equipment to be used are correctly calibrated and are in a safe and serviceable condition
 - 2.19 describe the importance of ensuring that all tools are used correctly and within their permitted operating range
 - 2.20 describe the importance of ensuring that all tools, equipment and components are accounted for and returned to their correct location on completion of the assembly activities
 - 2.21 describe the problems with the assembly operations and the importance of informing appropriate people of non-conformances
 - 2.22 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 364

Fitting pipework systems to mechanical assemblies

UAN:	F/600/5485
Level:	3
Credit value:	60
GLH:	161
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 64: Fitting Pipework Systems to Mechanical Assemblies (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 assemble and fit pipework systems to mechanical assemblies, in accordance with approved procedures. The learner will be required to prepare the work area, ensuring it is safe and free from hazards, to check the specified components are available and fit for purpose, to obtain all relevant and current documentation, and to obtain the tools and equipment required for the assembly operations, checking that they are in a safe and usable condition. In carrying out the assembly operations, the learner will be required to follow company procedures and specified assembly techniques, in order to assemble the pipework and components and to fit them to the mechanical assembly.</p> <p>The assembly activities will also include making all necessary checks and adjustments to ensure that the pipework, when fitted to the assembly, is dimensionally accurate, is positioned and aligned correctly, is free from ripple, creases and damage, and that joints are correctly secured and checked for leaks using the appropriate equipment and procedures. The assembled pipework must be checked for completeness and that it functions as per the specification.</p> <p>The learner's responsibilities will require them to comply with organisational policy</p>

and procedures for the assembly activities undertaken, and to report any problems with the assembly activities, materials or equipment that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to ensure that all tools, equipment and materials used in the assembly are correctly accounted for on completion of the activities, and to complete all necessary job/task documentation accurately and legibly. 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 pipework fitting and assembly techniques and procedures. The learner will understand the mechanical product being assembled, and its application, and will know about the equipment, relevant components and joining techniques, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

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

Learning outcome
The learner will: 1. fit pipework systems to mechanical assemblies
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 assembly activities: <ul style="list-style-type: none"> • obtain and use the appropriate documentation (such as job instructions, drawings, quality control documentation) adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work • follow safe practice/approved fitting and assembly techniques at all times • check that all tools and measuring equipment are within current calibration/certification dates

- use lifting and slinging equipment in accordance with health and safety guidelines and procedures
 - ensure that the components and pipes used are free from foreign objects, dirt or other contamination before assembling them
 - return all tools and equipment to the correct location on completion of the fitting activities
 - leave the work area and assembly in a safe and appropriate condition on completion of the activities
- 1.3 follow the relevant instructions, assembly drawings and any other specifications
- 1.4 ensure that the specified components are available and that they are in a usable condition
- 1.5 use the appropriate methods and techniques to assemble the components in their correct positions
- 1.6 assemble pipework systems using two of the following types of pipe:
- steel pipe
 - copper pipe
 - plastic pipe
 - flexible hoses
- 1.7 produce pipework assemblies using two of the following methods:
- compression
 - bolting
 - screwing
 - brazing
 - push fit
 - soldering
 - cementing/bonding
- 1.8 assemble pipework systems using five of the following components:
- straight connectors
 - reduction pieces
 - straight sections
 - tee pieces
 - flanges
 - elbows
 - curved/profiled sections
 - pipe supports and clips
 - couplings
 - gaskets/seals
 - angular sections
 - other
- 1.9 secure the components using the specified connectors and securing devices
- 1.10 check the completed assembly to ensure that all operations have been completed and the finished assembly meets the required specification
- 1.11 carry out all of the following quality checks using appropriate

equipment, to include:

- dimensions
- alignment
- completeness
- function
- positional accuracy
- correct direction and flow
- component security
- component quality (free from ripple, creases)
- leak or pressure tests

1.12 produce pipework assemblies which comply with one of the following quality and accuracy standards:

- BS, ISO or BSEN standards and procedures
- customer standards and requirements
- company standards and procedures
- specific system requirements

1.13 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 fit pipework systems to mechanical assemblies

Assessment criteria

The learner can:

- 2.1 describe the specific safety precautions to be taken while carrying out the fitting of pipework systems to mechanical assemblies (including any specific legislation, regulations or codes of practice relating to the activities, equipment or materials)
- 2.2 describe the health and safety requirements of the work area in which they are carrying out the assembly activities, and the responsibility these requirements place on them
- 2.3 describe the COSHH Regulations with regard to the substances used in the assembly process
- 2.4 describe the hazards associated with fitting pipework systems to mechanical assemblies, and how to minimise them and reduce any risks
- 2.5 describe the personal protective equipment and clothing to be worn during the assembly activities
- 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, workpiece reference points and system of tolerancing
- 2.8 explain how to extract the necessary information in order to produce pipework assemblies
- 2.9 describe the general principles of producing pipework assemblies, and the purpose and function of the components and materials used (including identification systems, such as colour codes)

- 2.10 describe the application of different pipework assembly methods and techniques
- 2.11 describe the preparations that need to be undertaken on the pipework prior to fitting them to the assembly
- 2.12 describe the pipework assembly/joining methods and procedures to be used, and the importance of adhering to these procedures
- 2.13 explain how pipework is formed, aligned, adjusted and positioned prior to joining, and the tools and equipment that are used
- 2.14 describe the importance of using the specified pipework and fittings for the assembly, and why they must not use substitutes
- 2.15 describe the tests that can be applied to ensure that the pipework assembly is safe and leak free
- 2.16 describe the quality control procedures to be followed during the assembly operations
- 2.17 explain how to conduct any necessary checks to ensure the safety, accuracy, position, security, function and completeness of the pipework assembly
- 2.18 explain how to identify pipework assembly defects (such as ineffective joining techniques, component damage), and what to do to rectify them
- 2.19 explain how to check that the tools and equipment to be used are correctly calibrated and are in a safe and serviceable condition
- 2.20 describe the importance of ensuring that all tools are used correctly and within their permitted operating range
- 2.21 describe the importance of ensuring that all tools, equipment and components are accounted for and returned to their correct location on completion of the assembly activities
- 2.22 describe the problems with the assembly operations, and the importance of informing appropriate people of non-conformances
- 2.23 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 365

Fitting electrical and electronic components to mechanical assemblies

UAN:	R/600/5488
Level:	3
Credit value:	60
GLH:	161
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 65: Fitting Electrical and Electronic Components to Mechanical Assemblies (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 assemble and fit electrical and electronic components to mechanical assemblies, in accordance with approved procedures. The learner will be required to prepare the work area, ensuring it is safe and free from hazards, to check the specified components are available and fit for purpose, to obtain all relevant and current documentation, to obtain the tools and equipment required for the assembly operations, checking that they are in a safe and usable condition. In carrying out the assembly operations, the learner will be required to follow company procedures and specified assembly techniques, in order to fit electrical and electronic components to the mechanical assembly.</p>

The assembly activities will also include making all necessary checks and adjustments, to ensure that the electrical and electronic components, when fitted to the assembly, are checked for position, security, function, safety and completeness. The learner must also check that any cables and wires are routed correctly and are tidy in appearance, and that connections are mechanically sound and checked for electrical continuity.

The learner's responsibilities will require them to comply with organisational policy and procedures for the assembly activities undertaken, and to report any problems with the assembly activities, materials or equipment that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to ensure that all tools, equipment and materials used in the assembly are correctly accounted for on completion of the activities, and to complete all necessary job/task documentation accurately and legibly. 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 electrical and electronic fitting and assembly techniques and procedures. The learner will understand the mechanical product being assembled, and its application, and will know about the equipment, relevant components and joining techniques, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

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

Learning outcome
The learner will: 1. fit electrical and electronic components to mechanical assemblies
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 assembly activities: <ul style="list-style-type: none"> • obtain and use the appropriate documentation (such as job instructions, drawings, quality control documentation) • adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work • follow safe practice/approved fitting and assembly techniques

- at all times
 - check that all cables, extension leads or air supply hoses are in a serviceable condition
 - check that all tools and measuring/test equipment are within current calibration/certification dates
 - use lifting and slinging equipment in accordance with health and safety guidelines and procedures
 - ensure that the components used are free from damage, dirt or other contamination before assembling them
 - return all tools and equipment to the correct location on completion of the fitting activities
 - leave the work area and assembly in a safe and appropriate condition on completion of the activities
- 1.3 follow the relevant instructions, assembly drawings and any other specifications
- 1.4 ensure that the specified components are available and that they are in a usable condition
- 1.5 use the appropriate methods and techniques to assemble the components in their correct positions
- 1.6 fit electrical, electronic and electromechanical components, using all of following techniques:
- routing cables and wires
 - mounting/securing components
 - cable fixings and fasteners
- 1.7 terminate and join cables/wires to components using three of the following:
- screwed connections
 - clamped connections
 - soldering
 - crimping
 - cable protection devices (such as sleeving or grommets)
- 1.8 make connections to six of the following components on mechanical assemblies:
- cables and wires
 - circuit protection devices
 - plugs
 - sockets
 - programme logic control units
 - transformers
 - switches
 - sensors
 - motors
 - pumps
 - lamps/lighting
 - junction boxes
 - earthing devices
 - coils
 - chokes

<ul style="list-style-type: none"> • electronic modules • instrumentation • relays • other
1.9 secure the components using the specified connectors and securing devices
1.10 check the completed assembly to ensure that all operations have been completed and the finished assembly meets the required specification
1.11 carry out the required checks using the correct tools and equipment, to include eight of the following: <ul style="list-style-type: none"> • dimensions • position • alignment • completeness • free from damage or foreign objects • electronic inputs and outputs • electrical inputs and outputs • function • component security
1.12 produce mechanical assemblies which comply with one of the following standards: <ul style="list-style-type: none"> • BS, ISO or BSEN standards and procedures • customer standards and requirements • company standards and procedures • specific system requirements
1.13 deal promptly and effectively with problems within their control and report those that cannot be solved.

Learning outcome
The learner will: <ol style="list-style-type: none"> 2. know how to fit electrical and electronic components to mechanical assemblies
Assessment criteria
The learner can: <ol style="list-style-type: none"> 2.1 describe the specific safety precautions to be taken while carrying out the assembly (including any specific legislation, regulations or codes of practice relating to the activities, equipment or materials) 2.2 describe the health and safety requirements of the work area in which they are carrying out the assembly activities, and the responsibility these requirements place on them 2.3 describe the COSHH Regulations with regard to the substances used in the assembly process 2.4 describe the hazards associated with fitting electrical components to mechanical assemblies, and how to minimise them and reduce any risks 2.5 describe the personal protective equipment and clothing to be worn during the assembly activities 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, workpiece reference points and system of tolerancing
 - 2.8 explain how to extract the necessary information in order to fit electrical and electronic components to mechanical assemblies
 - 2.9 describe the general principles of electrical and electronic fitting techniques; the purpose and function of the components (including identification systems such as colour codes, manufacturer's specification)
 - 2.10 describe the preparations that need to be undertaken on the electrical and electronic components prior to fitting them into the assembly
 - 2.11 explain how to identify and use the correct component handling procedures (including relevant handling equipment)
 - 2.12 describe the assembly and securing methods and procedures to be used, and the importance of adhering to these procedures
 - 2.13 explain how the components are to be routed, aligned, adjusted and positioned prior to securing, and the tools and equipment that are to be used
 - 2.14 describe the importance of using the specified electrical and electronic components and securing devices for the assembly, and why they must not use substitutes
 - 2.15 describe the quality control procedures to be followed during the assembly operations
 - 2.16 explain how to conduct any necessary checks to ensure the accuracy, position, security, function, completeness and electrical continuity of the assembly
 - 2.17 explain how to detect assembly defects (such as ineffective joining techniques, component damage), and what to do to rectify them
 - 2.18 explain how to check that the tools and equipment to be used are correctly calibrated and are in a safe and serviceable condition
 - 2.19 describe the importance of ensuring that all tools are used correctly and within their permitted operating range
 - 2.20 describe the importance of ensuring that all tools, equipment and components are accounted for and returned to their correct location on completion of the assembly activities
 - 2.21 describe the problems with the assembly operations, and the importance of informing appropriate people of non-conformances
 - 2.22 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 366

Producing power turbine combustion assemblies

UAN:	Y/600/5492
Level:	3
Credit value:	70
GLH:	210
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 66: Producing Power Turbine Combustion Assemblies (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 assembly operations to produce turbine combustion assemblies, in accordance with approved procedures. The learner will be required to obtain all the required tools and equipment for the assembly operations, and to check that they are in a safe and usable condition. In carrying out the assembly operations, the learner will be required to follow laid-down procedures and specific assembly techniques, in order to assemble the various components and unit sub-assemblies into the combustor assembly.</p> <p>The assembly activities will also include making all necessary checks and adjustments, to ensure that components are correctly orientated, positioned and aligned, that moving parts have the correct working clearances, that all fasteners are tightened to the correct torque, and that the assembled parts function as per the specification.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the assembly activities undertaken, and to report any problems with the assembly activities, materials or equipment that they cannot personally resolve, or are outside their permitted</p>

authority, to the relevant people. The learner will be expected to ensure that all tools, equipment and materials used in the installation are correctly accounted for on completion of the activities, and to complete all necessary job/task documentation accurately and legibly. 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 assembly techniques and procedures. The learner will understand the turbine combustor being assembled, and its application, and will know about the equipment, relevant components and fastening devices, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

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

Learning outcome
The learner will: 1. produce power turbine combustion assemblies
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 assembly activities: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, engine/module drawings, quality control documentation, planning documentation)• adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work• follow safe practice/approved assembly techniques at all times• check that all cables, extension leads or air supply hoses are in a serviceable condition• check that all tools and measuring equipment are within current calibration/certification dates• use lifting and slinging equipment in accordance with health

- and safety guidelines and procedures
 - ensure that the components used are free from damage, foreign objects, dirt or other contamination before assembling them
 - return all tools and equipment to the correct location on completion of the assembly activities
 - leave the work area and assembly in a safe and appropriate condition on completion of the activities
- 1.3 follow the relevant instructions, assembly drawings and any other specifications
- 1.4 ensure that the specified components are available and that they are in a usable condition
- 1.5 use the appropriate methods and techniques to assemble the components in their correct positions
- 1.6 use six of the following assembly methods and techniques:
- assembly of components by pressure
 - assembly of components by expansion or contraction
 - aligning components
 - setting working clearances
 - torque setting of bolts, fasteners, clips, sub-assemblies
 - applying sealants/adhesives
 - drilling, reaming and riveting
 - electrical bonding of components
 - blue-bedding components
 - securing components using mechanical fasteners and threaded devices
 - applying bolt locking methods (split pins, wire locking, lock nuts, stiff nuts, swage nuts)
- 1.7 produce the power turbine combustion/module assemblies by fitting all of the following:
- combustion case
 - combustion cans/chambers
 - annular combustion chambers
 - nozzle guide vanes
 - outer guide vanes
 - seals and gaskets
 - shims and packings
 - locking devices
 - wire thread inserts
 - pipes and unions
- 1.8 secure the components using the specified connectors and securing devices
- 1.9 check the completed assembly to ensure that all operations have been completed and the finished assembly meets the required specification
- 1.10 carry out all the following checks for accuracy, using the correct inspection testing equipment:
- positional accuracy
 - freedom of movement

<ul style="list-style-type: none"> • component security • completeness • dimensions • orientation • alignment • function • bearing end float • operating/working clearances • freedom from damage or foreign objects <p>1.11 produce power turbine combustion assemblies which comply with one of the following quality and accuracy standards:</p> <ul style="list-style-type: none"> • BS, ISO or BSEN standards and procedures • customer standards and requirements • company standards and procedures • specific system requirements <p>1.12 deal promptly and effectively with problems within their control and report those that cannot be solved.</p>

Learning outcome
The learner will:
2. know how to produce power turbine combustion assemblies
Assessment criteria
The learner can:
2.1 describe the specific safety precautions to be taken while carrying out the engine combustor/module assembly (including any specific legislation, regulations or codes of practice relating to the activities, equipment or materials)
2.2 describe the health and safety requirements of the work area in which they are carrying out the assembly activities, and the responsibility these requirements place on them
2.3 describe the COSHH Regulations with regard to the substances used in the assembly process
2.4 describe the hazards associated with producing power turbine combustion/module assemblies, and how to minimise them and reduce any risks
2.5 describe the personal protective equipment and clothing to be worn during the assembly activities
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, workpiece reference points and system of tolerancing
2.8 explain how to identify the components to be used (such as component identification systems, codes and component orientation indicators)
2.9 describe the preparations to be undertaken on the components prior to fitting them into the assembly
2.10 describe the assembly methods and procedures to be used, and

- the importance of adhering to these procedures
- 2.11 explain how the components are to be aligned and positioned prior to securing, and the tools and equipment that are used including jigs and fixtures
 - 2.12 describe the various mechanical fasteners that will be used and their method of installation (such as bolts and nuts, rivets, threaded fasteners, special securing devices)
 - 2.13 describe the importance of using the specified mechanical fastening devices for the assembly, and why they must not use substitutes
 - 2.14 explain how to complete basic fitting practices, meeting company requirements (such as torque tightening, wire locking, fitting wire thread inserts, fitting o-ring seals, fitting lock nuts, blue-bedding and swage nuts)
 - 2.15 explain how to ensure outer guide vanes and nozzle guide vanes are properly seated and assembled to achieve fit, position and alignment
 - 2.16 explain how to deal with components or fastening devices incorrectly assembled, damaged or having other faults
 - 2.17 describe the application of sealants and adhesives within the assembly activities, and the precautions that must be taken when working with them
 - 2.18 describe the quality control procedures to be followed during the assembly operations
 - 2.19 explain how to conduct any necessary checks to ensure the accuracy and quality of the assemblies produced
 - 2.20 explain how to detect assembly defects, and what to do to rectify them (such as ineffective fasteners, foreign object damage)
 - 2.21 explain how to move large components and assemblies, the methods and equipment used to transport, handle and lift the components into position
 - 2.22 explain how to check that the tools and equipment to be used are correctly calibrated and are in a safe and serviceable condition
 - 2.23 describe the importance of ensuring that all tools are used correctly and within their permitted operating range
 - 2.24 describe the importance of ensuring that the completed assembly is free from dirt, swarf and foreign objects
 - 2.25 describe the importance of ensuring that all tools, equipment and components are accounted for and returned to their correct location on completion of the assembly activities
 - 2.26 describe the problems with the assembly operations, and the importance of informing appropriate people of non-conformances
 - 2.27 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 367

Producing power turbine compressor assemblies

UAN:	A/600/5498
Level:	3
Credit value:	70
GLH:	210
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 67: Producing Power Turbine Compressor Assemblies (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 assembly operations to produce turbine compressor assemblies, in accordance with approved procedures. The learner will be required to obtain all the appropriate tools and equipment for the assembly operations, and to check that they are in a safe and usable condition. In carrying out the assembly operations, the learner will be required to follow laid-down procedures and specific assembly techniques, in order to assemble the various components and unit sub-assemblies into the compressor assembly.</p> <p>The assembly activities will also include making all necessary checks and adjustments, to ensure that components are correctly orientated, positioned and aligned, that moving parts have the correct working clearances, that all fasteners are tightened to the correct torque, and that the assembled parts function as per the specification.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the assembly activities undertaken, and to report any problems with the assembly activities, materials or equipment that they cannot personally resolve, or are outside their permitted</p>

authority, to the relevant people. The learner will be expected to ensure that all tools, equipment and materials used in the installation are correctly accounted for on completion of the activities, and to complete all necessary job/task documentation accurately and legibly. 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 assembly techniques and procedures. The learner will understand the turbine compressor being assembled, and its application, and will know about the equipment, relevant components and fastening devices, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

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

Learning outcome
The learner will: 1. produce power turbine compressor assemblies
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 assembly activities: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, engine/module drawings, quality control documentation, planning documentation)• adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work• follow safe practice/approved assembly techniques at all times• check that all cables, extension leads or air supply hoses are in a serviceable condition• check that all tools and measuring equipment are within current calibration/certification dates• use lifting and slinging equipment in accordance with health

- and safety guidelines and procedures
 - ensure that the components used are free from damage, foreign objects, dirt or other contamination before assembling them
 - return all tools and equipment to the correct location on completion of the assembly activities
 - leave the work area in a safe and appropriate condition on completion of the activities
- 1.3 follow the relevant instructions, assembly drawings and any other specifications
- 1.4 ensure that the specified components are available and that they are in a usable condition
- 1.5 use the appropriate methods and techniques to assemble the components in their correct positions
- 1.6 use six of the following assembly methods and techniques:
- assembly of components by pressure
 - assembly of components by expansion or contraction
 - aligning components
 - setting working clearances
 - torque setting of bolts, clips, fasteners, sub-assemblies
 - balancing of components
 - applying sealant/adhesives
 - drilling, reaming and riveting
 - electrical bonding of components
 - blue-bedding components
 - securing components using mechanical fasteners and threaded devices
 - applying bolt locking methods (such as split pins, wire locking, lock nuts, stiff nuts, swage nuts)
- 1.7 produce the compressor/module assembly by fitting six of the following:
- compressor housing
 - compressor stators
 - compressor blades
 - curvic couplings
 - sub-assemblies
 - seals and gaskets
 - shims and packings
 - locking devices
 - wire thread inserts
 - pipes and unions
- 1.8 secure the components using the specified connectors and securing devices
- 1.9 check the completed assembly to ensure that all operations have been completed and the finished assembly meets the required specification
- 1.10 carry out all of the following checks for accuracy, using the correct inspection testing equipment:
- positional accuracy

<ul style="list-style-type: none"> • freedom of movement • component security • completeness • dimensions • orientation • alignment • function • bearing end float • operating/ working clearances • freedom from damage or foreign objects <p>1.11 produce turbine compressor assemblies which comply with one of the following quality and accuracy standards:</p> <ul style="list-style-type: none"> • BS, ISO or BSEN standards and procedures • customer standards and requirements • company standards and procedures • specific system requirements <p>1.12 deal promptly and effectively with problems within their control and report those that cannot be solved.</p>

Learning outcome
The learner will: 2. know how to produce power turbine compressor assemblies
Assessment criteria
The learner can: 2.1 describe the specific safety precautions to be taken while carrying out the engine compressor/module assembly (including any specific legislation, regulations or codes of practice relating to the activities, equipment or materials) 2.2 describe the health and safety requirements of the work area in which they are carrying out the assembly activities, and the responsibility these requirements place on them 2.3 describe the COSHH Regulations with regard to the substances used in the assembly process 2.4 describe the hazards associated with producing power turbine compressor assemblies, and how to minimise them and reduce any risks 2.5 describe the personal protective equipment and clothing to be worn during the assembly activities 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, workpiece reference points and system of tolerancing 2.8 explain how to identify the components to be used (such as component identification systems, codes and component orientation indicators) 2.9 describe the preparations to be undertaken on the components prior to fitting them into the assembly

- 2.10 describe the assembly methods and procedures to be used, and the importance of adhering to these procedures
- 2.11 explain how the components are to be aligned and positioned prior to securing, and the tools and equipment that are used (including jigs and fixtures)
- 2.12 describe the various mechanical fasteners that will be used and their method of installation (such as bolts, nuts, rivets, threaded fasteners, special securing devices)
- 2.13 describe the importance of using the specified mechanical fastening devices for the assembly, and why they must not use substitutes
- 2.14 explain how to complete basic fitting practices to meet company requirements (such as torque tightening, wire locking, fitting wire thread inserts, fitting o-ring seals, fitting lock nuts, blue-bedding and swage nuts)
- 2.15 explain how to deal with components or fastening devices incorrectly assembled, damaged, or having other faults
- 2.16 describe the application of sealants and adhesives within the assembly activities, and the precautions that must be taken when working with them
- 2.17 explain how to ensure that curvic couplings are properly seated and assembled to achieve fit and alignment
- 2.18 describe the quality control procedures to be followed during the assembly operations
- 2.19 explain how to conduct any necessary checks to ensure the accuracy and quality of the assemblies produced
- 2.20 explain how to detect assembly defects (such as ineffective fasteners, foreign object damage), and what to do to rectify them
- 2.21 explain how to move large components and assemblies; the methods and equipment used to transport, handle and lift the components into position
- 2.22 explain how to check that the tools and equipment to be used are correctly calibrated and are in a safe and serviceable condition
- 2.23 describe the importance of ensuring that all tools are used correctly and within their permitted operating range
- 2.24 describe the importance of ensuring that the completed assembly is free from dirt, swarf and foreign objects
- 2.25 describe the importance of ensuring that all tools, equipment and components are accounted for and returned to their correct location on completion of the assembly activities
- 2.26 describe the problems with the assembly operations, and the importance of informing appropriate people of non-conformances
- 2.27 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

UAN:	F/600/5504
Level:	3
Credit value:	70
GLH:	210
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 68: Producing Turbine Assemblies (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 assembly operations to produce turbine assemblies, in accordance with approved procedures. The learner will be required to obtain all the appropriate tools and equipment for the assembly operations, and to check that they are in a safe and usable condition. In carrying out the assembly operations, the learner will be required to follow laid-down procedures and specific assembly techniques, in order to assemble the various unit sub-assemblies and components into the turbine assembly.</p> <p>The assembly activities will also include making all necessary checks and adjustments to ensure that components are correctly orientated, positioned and aligned, that moving parts have the correct working clearances, that all fasteners are tightened to the correct torque, and that the assembled parts function as per the specification.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the assembly activities undertaken, and to report any problems with the assembly activities, materials or equipment that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to ensure that all tools, equipment and materials used in the</p>

installation are correctly accounted for on completion of the activities, and to complete all necessary job/task documentation accurately and legibly. 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 assembly techniques and procedures. The learner will understand the turbine assembly being assembled, and its application, and will know about the equipment, relevant components and fastening devices, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

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

Learning outcome
The learner will: 1. produce turbine assemblies
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 assembly activities: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, engine/module drawings, quality control documentation, planning documentation)• adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work• follow safe practice/approved assembly techniques at all times• check that all cables, extension leads or air supply hoses are in a serviceable condition• check that all tools and measuring equipment are within current calibration/certification dates• use lifting and slinging equipment in accordance with health and safety guidelines and procedures• ensure that the components used are free from damage, foreign objects, dirt or other contamination before assembling

them

- return all tools and equipment to the correct location on completion of the assembly activities
 - leave the work area and assembly in a safe and appropriate condition on completion of the activities
- 1.3 follow the relevant instructions, assembly drawings and any other specifications
- 1.4 ensure that the specified components are available and that they are in a usable condition
- 1.5 use the appropriate methods and techniques to assemble the components in their correct positions
- 1.6 use six of the following assembly methods and techniques:
- assembly of components by pressure
 - assembly of components by expansion or contraction
 - aligning components
 - setting working clearances
 - torque setting of bolts, fasteners, clips, sub-assemblies
 - balancing of components
 - applying sealant/adhesives
 - drilling, reaming and riveting
 - electrical bonding of components
 - blue-bedding components
 - securing components using mechanical fasteners and threaded devices
 - applying bolt locking methods (such as split pins, wire locking, lock nuts, stiff nuts, swage nuts)
- 1.7 produce the turbine assemblies by fitting six of the following:
- low pressure turbine
 - intermediate pressure turbine
 - high pressure turbine
 - turbine shafts
 - turbine discs
 - turbine blades
 - bearing races
 - bearings
 - seals and gaskets
 - shims and packings
 - wire thread inserts
 - locking devices
 - pipes and unions
- 1.8 secure the components using the specified connectors and securing devices
- 1.9 check the completed assembly to ensure that all operations have been completed and the finished assembly meets the required specification
- 1.10 carry out all of the following checks for accuracy, using the correct inspection testing equipment:
- dimensions

<ul style="list-style-type: none"> • positional accuracy • freedom of movement • bearing end float • orientation • alignment • operating/working clearance • completeness • freedom from damage or foreign objects <p>1.11 produce turbine assemblies which comply with one of the following standards:</p> <ul style="list-style-type: none"> • BS, ISO or BSEN standards and procedures • customer standards and requirements • company standards and procedures • specific system requirements <p>1.12 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 produce turbine assemblies
Assessment criteria
The learner can: 2.1 describe the specific safety precautions to be taken while carrying out the turbine assembly (including any specific legislation, regulations or codes of practice relating to the activities, equipment or materials) 2.2 describe the health and safety requirements of the work area in which they are carrying out the assembly activities, and the responsibility these requirements place on them 2.3 describe the COSHH Regulations with regard to the substances used in the assembly process 2.4 describe the hazards associated with producing power turbine assemblies, and how to minimise them and reduce any risks 2.5 describe the personal protective equipment and clothing to be worn during the assembly activities 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, workpiece reference points and system of tolerancing 2.8 explain how to identify the components to be used (such as component identification systems, codes and component orientation indicators) 2.9 describe the preparations to be undertaken on the components prior to fitting them into the assembly 2.10 describe the assembly methods and procedures to be used, and the importance of adhering to these procedures 2.11 explain how the components are to be aligned and positioned prior to securing, and the tools and equipment that are used including

jigs and fixtures

- 2.12 describe the various mechanical fasteners that will be used, and their method of installation (such as bolts, nuts, rivets, threaded fasteners, special securing devices)
- 2.13 describe the importance of using the specified mechanical fastening devices for the assembly, and why they must not use substitutes
- 2.14 explain how to complete basic fitting practices meeting company requirements (such as torque tightening, wire locking, fitting wire thread inserts, fitting o-ring seals, fitting lock nuts, blue-bedding and swage nuts)
- 2.15 explain how to deal with components or fastening devices incorrectly assembled, damaged, or having other faults
- 2.16 explain how to assemble and fit turbine shafts and discs into the module assembly
- 2.17 explain how to ensure that curvic couplings are properly seated and assembled to achieve fit and alignment
- 2.18 describe the application of sealants and adhesives within the assembly activities, and the precautions that must be taken when working with them
- 2.19 describe the quality control procedures to be followed during the assembly operations
- 2.20 explain how to conduct any necessary checks to ensure the accuracy and quality of the assemblies produced
- 2.21 explain how to detect assembly defects (such as ineffective fasteners, foreign object damage), and what to do to rectify them
- 2.22 explain how to move large components and assemblies; the methods and equipment used to transport, handle and lift the components into position; and how to check that the equipment is within its current certification dates
- 2.23 explain how to check that the tools and equipment to be used are correctly calibrated and are in a safe and serviceable condition
- 2.24 describe the importance of ensuring that all tools are used correctly and within their permitted operating range
- 2.25 describe the importance of ensuring that the completed assembly is free from dirt, swarf and foreign objects
- 2.26 describe the importance of ensuring that all tools, equipment and components are accounted for and returned to their correct location on completion of the assembly activities
- 2.27 describe the problems with the assembly operations, and the importance of informing appropriate people of non-conformances
- 2.28 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 369

Producing power turbine gearbox assemblies

UAN:	R/600/5510
Level:	3
Credit value:	70
GLH:	210
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 69: Producing Power Turbine Gearbox Assemblies (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 assembly operations to produce turbine gearbox assemblies, in accordance with approved procedures. The learner will be required to obtain all the appropriate tools and equipment for the assembly operations, and to check that they are in a safe and usable condition. In carrying out the assembly operations, the learner will be required to follow laid-down procedures and specific assembly techniques, in order to assemble the various components and unit sub-assemblies into the gearbox assembly.</p> <p>The assembly activities will also include making all necessary checks and adjustments, to ensure that components are correctly orientated, positioned and aligned, that moving parts have the correct working clearances, that all fasteners are tightened to the correct torque, and that the assembled parts function as per the specification.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the assembly activities undertaken, and to report any problems with the assembly activities, materials or equipment that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner</p>

will be expected to ensure that all tools, equipment and materials used in the installation are correctly accounted for on completion of the activities, and to complete all necessary job/task documentation accurately and legibly. 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 assembly techniques and procedures. The learner will understand the turbine gearbox being assembled, and its application, and will know about the equipment, relevant components and fastening devices, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

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

Learning outcome
The learner will: 1. produce power turbine gearbox assemblies
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 assembly activities: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, engine/module drawings, quality control documentation, planning documentation)• adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work• follow safe practice/approved assembly techniques at all times• check that all cables, extension leads or air supply hoses are in a serviceable condition• check that all tools and measuring equipment are within current calibration/certification dates• use lifting and slinging equipment in accordance with health and safety guidelines and procedures

- ensure that the components used are free from damage, foreign objects, dirt or other contamination before assembling them
 - return all tools and equipment to the correct location on completion of the assembly activities
 - leave the work area and assembly in a safe and appropriate condition on completion of the activities
- 1.3 follow the relevant instructions, assembly drawings and any other specifications
- 1.4 ensure that the specified components are available and that they are in a usable condition
- 1.5 use the appropriate methods and techniques to assemble the components in their correct positions
- 1.6 use six of the following assembly methods and techniques:
- assembly of components by pressure
 - assembly of components by expansion or contraction
 - aligning components
 - setting working clearances
 - torque setting of bolts, fasteners, clips, sub-assemblies
 - balancing of components
 - applying sealant/adhesives
 - drilling, reaming and riveting
 - electrical bonding of components
 - blue-bedding components
 - securing components using mechanical fasteners and threaded devices
 - applying bolt locking methods (such as split pins, wire locking, lock nuts, stiff nuts, swage nuts)
- 1.7 produce the turbine gearbox assemblies by fitting six of the following:
- gear housings
 - lay shafts
 - temperature sensors
 - bearings
 - torque converters
 - locking devices
 - seals and gaskets
 - starter units
 - wire thread inserts
 - drive shafts
 - levers and linkages
 - shims and packings
 - gear trains/sub-assemblies
 - pipes and unions
- 1.8 secure the components using the specified connectors and securing devices
- 1.9 check the completed assembly to ensure that all operations have been completed and the finished assembly meets the required specification

- 1.10 carry out all of the following checks for accuracy, using the correct inspection testing equipment:
- positional accuracy
 - freedom of movement
 - component security
 - completeness
 - dimensions
 - orientation
 - alignment
 - function
 - bearing end float
 - operating/ working clearances
 - freedom from damage or foreign objects
- 1.11 produce turbine gearbox assemblies which comply with one of the following quality and accuracy standards:
- BS, ISO or BSEN standards and procedures
 - customer standards and requirements
 - company standards and procedures
 - specific system requirements
- 1.12 deal promptly and effectively with problems within their control and report those that cannot be solved.

Learning outcome
The learner will: 2. know how to produce power turbine gearbox assemblies
Assessment criteria
The learner can: 2.1 describe the specific safety precautions to be taken while carrying out the engine gearbox assembly (including any specific legislation, regulations or codes of practice relating to the activities, equipment or materials) 2.2 describe the health and safety requirements of the work area in which they are carrying out the assembly activities, and the responsibility these requirements place on them 2.3 describe the COSHH Regulations with regard to the substances used in the assembly process 2.4 describe the hazards associated with producing power turbine gearbox assemblies, and how to minimise them and reduce any risks 2.5 describe the personal protective equipment and clothing to be worn during the assembly activities 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, workpiece reference points and system of tolerancing 2.8 explain how to identify the components to be used (such as component identification systems, codes and component

- orientation indicators)
- 2.9 describe the preparations to be undertaken on the components prior to fitting them into the assembly
 - 2.10 describe the assembly methods and procedures to be used, and the importance of adhering to these procedures
 - 2.11 explain how the components are to be aligned and positioned prior to securing, and the tools and equipment that are used, including jigs and fixtures
 - 2.12 describe the various mechanical fasteners that will be used, and their method of installation (such as bolts, nuts, rivets, threaded fasteners, special securing devices)
 - 2.13 describe the importance of using the specified mechanical fastening devices for the assembly, and why they must not use substitutes
 - 2.14 explain how to complete basic fitting practices meeting regulatory and organisational requirements (such as torque tightening, wire locking, fitting wire thread inserts, fitting o-ring seals, fitting lock nuts, blue-bedding and swage nuts)
 - 2.15 explain how to deal with components or fastening devices incorrectly assembled, damaged, or having other faults
 - 2.16 describe the application of sealants and adhesives within the assembly activities and the precautions that must be taken when working with them
 - 2.17 describe the quality control procedures to be followed during the assembly operations
 - 2.18 explain how to conduct any necessary checks to ensure the accuracy and quality of the assemblies produced
 - 2.19 explain how to detect assembly defects (such as ineffective fasteners, foreign object damage), and what to do to rectify them
 - 2.20 explain how to move large components and assemblies; the methods and equipment used to transport, handle and lift the components into position; and how to check that the equipment is within its current certification dates
 - 2.21 explain how to check that the tools and equipment to be used are correctly calibrated and are in a safe and serviceable condition
 - 2.22 describe the importance of ensuring that all tools are used correctly and within their permitted operating range
 - 2.23 describe the importance of ensuring that the completed assembly is free from dirt, swarf and foreign objects
 - 2.24 describe the importance of ensuring that all tools, equipment and components are accounted for and returned to their correct location on completion of the assembly activities
 - 2.25 describe the problems with the assembly operations, and the importance of informing appropriate people of non-conformances
 - 2.26 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 370

Producing power turbine major assemblies

UAN:	M/600/5515
Level:	3
Credit value:	70
GLH:	210
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 70: Producing Power Turbine Major Assemblies (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 assembly operations to produce major assemblies of power turbines, in accordance with approved procedures. This unit covers the assembly of modules into part and final assemblies. The learner will be required to obtain all the appropriate tools and equipment for the assembly operations, and to check that they are in a safe and usable condition. In carrying out the assembly operations, the learner will be required to follow laid-down procedures and specific assembly techniques, in order to assemble the various sub-assembly units and components into the major assembly.</p> <p>The assembly activities will also include making all necessary checks and adjustments, to ensure that components are correctly orientated, positioned and aligned, that moving parts have the correct working clearances, that all fasteners are tightened to the correct torque, and that the assembled parts function as per the specification.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the assembly activities undertaken, and to report any problems with the assembly activities, materials or equipment that they cannot personally</p>

resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to ensure that all tools, equipment and materials used in the installation are correctly accounted for on completion of the activities, and to complete all necessary job/task documentation accurately and legibly. 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 assembly techniques and procedures. The learner will understand the turbine being assembled, and its application, and will know about the equipment, relevant components and fastening devices, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

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

Learning outcome
The learner will: 1. produce power turbine major assemblies
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 assembly activities: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, engine/module drawings, quality control documentation, planning documentation)• adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work• follow safe practice/approved assembly techniques at all times• check that all cables, extension leads or air supply hoses are in a serviceable condition• check that all tools and measuring equipment are within current calibration/certification dates• use lifting and slinging equipment in accordance with health

- and safety guidelines and procedures
 - ensure that all modules/units to be assembled are free from damage, foreign objects, dirt or other contamination before assembling them
 - return all tools and equipment to the correct location on completion of the assembly activities
 - leave the work area and assembly in a safe and appropriate condition on completion of the activities
- 1.3 follow the relevant instructions, assembly drawings and any other specifications
- 1.4 ensure that the specified components are available and that they are in a usable condition
- 1.5 use the appropriate methods and techniques to assemble the components in their correct positions
- 1.6 use five of the following assembly methods and techniques:
 - assembly of components by pressure
 - assembly of components by expansion or contraction
 - aligning components
 - setting working clearances
 - torque setting of bolts, fasteners, clips, sub-assemblies
 - applying sealants/adhesives
 - drilling and riveting
 - electrical bonding of components
 - aligning auxiliary equipment
 - securing components using mechanical fasteners and threaded devices:
 - applying bolt locking methods (split pins, wire locking, lock nuts, stiff nuts)
- 1.7 produce the assembly by fitting four of the following:
 - front fan and fan case
 - compressor module
 - combustor module
 - turbine
 - gear box
 - outer casings
 - air intake ducts
 - exhaust systems
- 1.8 secure the components using the specified connectors and securing devices
- 1.9 check the completed assembly to ensure that all operations have been completed and the finished assembly meets the required specification
- 1.10 carry out all of the following checks for accuracy, using the correct inspection testing equipment:
 - positional accuracy
 - freedom of movement
 - component security
 - completeness
 - dimensions

<ul style="list-style-type: none"> • orientation • alignment • function • bearing end float • operating/ working clearances • free from damage or foreign objects <p>1.11 produce power turbine assemblies which comply with one of the following quality and accuracy standards:</p> <ul style="list-style-type: none"> • BS, ISO or BSEN standards and procedures • customer standards and requirements • company standards and procedures • specific system requirements <p>1.12 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 produce power turbine major assemblies
Assessment criteria
The learner can:
2.1 describe the specific safety precautions to be taken while carrying out the assembly (including any specific legislation, regulations or codes of practice relating to the activities, equipment or materials)
2.2 describe the health and safety requirements of the work area in which they are carrying out the assembly activities, and the responsibility these requirements place on them
2.3 describe the COSHH Regulations with regard to the substances used in the assembly process
2.4 describe the hazards associated with producing power turbine major assemblies, and how to minimise them and reduce any risks
2.5 describe the personal protective equipment and clothing to be worn during the assembly activities
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, workpiece reference points and system of tolerancing
2.8 explain how to identify the components to be used (such as component identification systems, codes and component orientation indicators)
2.9 describe the preparations to be undertaken on the components prior to fitting them into the assembly
2.10 describe the assembly methods and procedures to be used, and the importance of adhering to these procedures
2.11 explain how the components are to be aligned and positioned prior to securing, and the tools and equipment that are used, including jigs and fixtures
2.12 describe the various mechanical fasteners that will be used and their method of installation (such as bolts, nuts, rivets, threaded

- fasteners, special securing devices)
- 2.13 describe the importance of using the specified mechanical fastening devices for the assembly, and why they must not use substitutes
 - 2.14 explain how to complete basic fitting practices meeting regulatory and organisational requirements (such as torque tightening, wire locking, fitting wire thread inserts, fitting o-ring seals, fitting lock nuts, blue-bedding, 'corrujoint' seals, tab washers, cup washers and swage nuts)
 - 2.15 explain how to deal with components or fastening devices incorrectly assembled, damaged, or having other faults
 - 2.16 describe the application of sealants and adhesives within the assembly activities, and the precautions that must be taken when working with them
 - 2.17 describe the quality control procedures to be followed during the assembly operations
 - 2.18 explain how to conduct any necessary checks to ensure the accuracy and quality of the assemblies produced
 - 2.19 explain how to detect assembly defects (such as ineffective fasteners, foreign object damage), and what to do to rectify them
 - 2.20 explain how to move large components sub-assemblies and assemblies; the methods and equipment used to transport, handle and lift the components into position
 - 2.21 explain how to check that the tools and equipment to be used are correctly calibrated and are in a safe and serviceable condition
 - 2.22 describe the importance of ensuring that all tools are used correctly and within their permitted operating range
 - 2.23 describe the importance of ensuring that the completed assembly is free from dirt, swarf and foreign objects
 - 2.24 describe the importance of ensuring that all tools, equipment and components are accounted for and returned to their correct location on completion of the assembly activities
 - 2.25 describe the problems with the assembly operations, and the importance of informing appropriate people of non-conformances
 - 2.26 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 371

Producing piston engine assemblies

UAN:	J/600/5522
Level:	3
Credit value:	70
GLH:	210
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 71: Producing Piston Engine Assemblies (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 assembly operations to produce piston engine assemblies, in accordance with approved procedures. The learner will be required to obtain all the appropriate tools and equipment for the assembly operations, and to check that they are in a safe and usable condition. In carrying out the assembly operations, the learner will be required to follow laid-down procedures and specific assembly techniques, in order to assemble the various components and unit sub-assemblies into the piston engine assembly.</p> <p>The assembly activities will also include making all necessary checks and adjustments, to ensure that components are correctly orientated, positioned and aligned, that moving parts have the correct working clearances, that all fasteners are tightened to the correct torque, and that the assembled parts function as per the specification.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the assembly activities undertaken, and to report any problems with the assembly activities, materials or equipment that they cannot personally resolve, or are outside their permitted</p>

authority, to the relevant people. The learner will be expected to ensure that all tools, equipment and materials used in the installation are correctly accounted for on completion of the activities, and to complete all necessary job/task documentation accurately and legibly. 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 assembly techniques and procedures. The learner will understand the piston engine being assembled, and its application, and will know about the equipment, relevant components and fastening devices, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

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

Learning outcome
The learner will: 1. produce piston engine assemblies
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 assembly activities: <ul style="list-style-type: none">• obtain and use the appropriate documentation (such as job instructions, engine/sub-assembly drawings, quality control documentation, planning documentation)• adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work• follow safe practice/approved assembly techniques at all times• check that all cables, extension leads or air supply hoses are in a serviceable condition• check that all tools and measuring equipment are within current calibration/certification dates• use lifting and slinging equipment in accordance with health

- and safety guidelines and procedures
 - ensure that all components to be assembled are free from damage, foreign objects, dirt or other contamination before assembling them
 - return all tools and equipment to the correct location on completion of the assembly activities
 - leave the work area and assembly in a safe and appropriate condition on completion of the activities
- 1.3 follow the relevant instructions, assembly drawings and any other specifications
- 1.4 ensure that the specified components are available and that they are in a usable condition
- 1.5 use the appropriate methods and techniques to assemble the components in their correct positions
- 1.6 use five of the following assembly methods and techniques:
- assembly of components by pressure
 - assembly of components by expansion or contraction
 - aligning components
 - setting working clearances
 - torque setting of bolts, fasteners, clips, sub-assemblies
 - balancing of components
 - applying sealants/adhesives
 - drilling, reaming and riveting
 - electrical bonding of components
 - blue-bedding components
 - securing components using mechanical fasteners and threaded devices
 - applying bolt locking methods (such as split pins, wire locking, lock nuts, stiff nuts, swage nuts)
- 1.7 produce the piston engine assembly by fitting twelve of the following:
- cylinder block
 - cylinder heads
 - fly wheel
 - torque converters
 - piston assemblies
 - crank shafts
 - camshaft assemblies
 - timing mechanisms
 - valve mechanisms
 - oil pumps
 - bearings
 - seals and gaskets
 - pulleys and sprockets
 - belts and chains
 - levers and linkages
 - injector mechanisms
 - sensing devices

<ul style="list-style-type: none"> • manifolds • sump pans • exhaust systems • pipes and unions • fuel pumps • other components <p>1.8 secure the components using the specified connectors and securing devices</p> <p>1.9 check the completed assembly to ensure that all operations have been completed and the finished assembly meets the required specification</p> <p>1.10 carry out all of the following checks for accuracy, using the correct inspection testing equipment:</p> <ul style="list-style-type: none"> • dimensions • positional accuracy/timing • freedom of movement • operating/working clearance • bearing end float • orientation • alignment • completeness • freedom from damage or foreign objects <p>1.11 produce piston engine assemblies which comply with one of the following quality and accuracy standards:</p> <ul style="list-style-type: none"> • BS, ISO or BSEN standards and procedures • customer standards and requirements • company standards and procedures • specific system requirements <p>1.12 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 produce piston engine assemblies
Assessment criteria
The learner can:
2.1 describe the specific safety precautions to be taken while carrying out the piston engine/sub-unit assembly (including any specific legislation, regulations or codes of practice relating to the activities, equipment or materials)
2.2 describe the health and safety requirements of the work area in which they are carrying out the assembly activities, and the responsibility these requirements place on them
2.3 describe the COSHH regulations with regard to the substances used in the assembly process
2.4 describe the hazards associated with producing piston engine assemblies, and how to minimise them and reduce any risks
2.5 describe the personal protective equipment and clothing to be worn during the assembly activities

- 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, workpiece reference points and system of tolerancing
- 2.8 explain how to identify the components to be used (such as component identification systems, codes and component orientation indicators)
- 2.9 describe the preparations to be undertaken on the components prior to fitting them into the assembly
- 2.10 describe the assembly methods and procedures to be used, and the importance of adhering to these procedures
- 2.11 explain how to complete basic fitting practices meeting company requirements (such as torque tightening, wire locking, fitting wire thread inserts, fitting o-ring seals, fitting lock nuts, blue-bedding and swage nuts)
- 2.12 explain how the components are to be aligned and positioned prior to securing, and the tools and equipment that are used, including jigs and fixtures
- 2.13 describe the various mechanical fasteners that will be used and their method of installation (such as bolts, nuts, rivets, threaded fasteners, special securing devices)
- 2.14 describe the importance of using the specified mechanical fastening devices for the assembly, and why they must not use substitutes
- 2.15 explain how to deal with components or fastening devices incorrectly assembled, damaged, or having other faults
- 2.16 describe the application of sealants and adhesives within the assembly activities, and the precautions that must be taken when working with them
- 2.17 describe the quality control procedures to be followed during the assembly operations
- 2.18 explain how to conduct any necessary checks to ensure the accuracy and quality of the assemblies produced
- 2.19 explain how to detect assembly defects (such as ineffective fasteners, foreign object damage), and what to do to rectify them
- 2.20 explain how to move large components and assemblies; the methods and equipment used to transport, handle and lift the components into position; and how to check that the equipment is within its current certification dates.
- 2.21 explain how to check that the tools and equipment to be used are correctly calibrated and are in a safe and serviceable condition
- 2.22 describe the importance of ensuring that all tools are used correctly and within their permitted operating range
- 2.23 describe the importance of ensuring that the completed assembly is free from dirt, swarf and foreign objects
- 2.24 describe the importance of ensuring that all tools, equipment and components are accounted for and returned to their correct location on completion of the assembly activities
- 2.25 describe the problems with the assembly operations, and the importance of informing appropriate people of non-conformances
- 2.26 describe the extent of their own responsibility and to whom they

should report if they have problems that they cannot resolve.

Unit 372

Repairing and modifying mechanical assemblies

UAN:	H/600/5527
Level:	3
Credit value:	70
GLH:	210
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 72: Repairing and Modifying Mechanical Assemblies (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 modifications on mechanical assemblies, in accordance with approved procedures. The assembly may have to be modified for a number of reasons, which could include performance out of specification, inherent design problems, changes to customer specification, or assembly problems. The learner will be required to prepare the work area, ensuring it is safe and free from hazards, to check the correct component parts requiring modification are available, to obtain all relevant and current documentation, and to obtain the tools and equipment required for the modification, checking that they are in a safe and usable condition. In carrying out the modification, the learner will be required to follow the appropriate company procedures and specified techniques.</p> <p>The assembly and its components could be modified using a number of methods and techniques including, where appropriate, adjusting, removing and replacing, or repairing, or by manufacturing new components by machining, welding, fabricating or bonding. Component parts that are modified must be checked for accuracy, security, completeness, and that they function as per the specification.</p>

The learner's responsibilities will require them to comply with organisational policy and procedures for the modification activities undertaken, and to report any problems with the modification activities, materials or equipment that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to ensure that all tools, equipment and materials used in the modification are correctly accounted for on completion of the activities, and to complete all necessary job/task documentation accurately and legibly. 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 modification methods, techniques and procedures. The learner will understand the mechanical product being modified, including its application and reason for the modification, and will know about the tools and equipment required, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

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

Learning outcome
The learner will: 1. repair and modify mechanical assemblies
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 modification activities: <ul style="list-style-type: none"> • obtain and use the appropriate documentation (such as job instructions, modification drawings, quality control documentation, planning documentation) • adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of

- work
 - follow safe practice/approved modification and repair techniques at all times
 - check that all cables, extension leads or air supply hoses are in a serviceable condition
 - check that all tools and measuring equipment are within current calibration/certification dates
 - use lifting and slinging equipment in accordance with health and safety guidelines and procedures
 - ensure that all components to be assembled are free from damage, foreign objects, dirt or other contamination before assembling them
 - return all tools and equipment to the correct location on completion of the assembly activities
 - leave the work area and assembly in a safe and appropriate condition on completion of the activities
- 1.3 obtain the relevant specification and job instructions for the modification being performed
- 1.4 confirm and agree what modification is to be carried out to meet the specification
- 1.5 determine how the product and/or asset will be prepared for the modification
- 1.6 check that any materials and equipment required are available and that they are suitable for the work to be carried out
- 1.7 carry out the modification to achieve the required changes, in line with agreed instructions and specifications
- 1.8 carry out the modification, using two of the following methods:
- adjustment
 - remove and replace with new components
 - modify existing components
 - manufacture of new components
- 1.9 complete the modification, using two of the following techniques:
- dismantling and re-assembling
 - hand fitting
 - electrical fitting and assembly
 - fluid power fitting and assembly
 - bonding
 - adjusting
 - welding
 - fabrication
 - machining
- 1.10 carry out modifications on one of the following parts of the assembly:
- holding mechanism
 - operating system
 - control mechanism
 - drive mechanism
 - fluid power system
 - delivery system

<ul style="list-style-type: none"> • transfer system • pipework system • safety mechanism • assembly structure (such as framework, casings, panels) • other <p>1.11 carry out the quality checks, to include eight from the following, using appropriate equipment:</p> <ul style="list-style-type: none"> • dimensions • positional accuracy • freedom of movement • operating/working clearances • orientation • alignment • completeness • component security • bearing end float • function • earth bonding and electrical continuity • free from damage or foreign objects <p>1.12 ensure that the repairs and modifications comply with one of the following quality and accuracy standards:</p> <ul style="list-style-type: none"> • BS, ISO or BSEN standards and procedures • customer standards and requirements • company standards and procedures • specific system requirements <p>1.13 complete the relevant documentation in accordance with organisational requirements</p> <p>1.14 deal promptly and effectively with problems within their control and report those that cannot be solved.</p>

Learning outcome
The learner will:
2. know how to repair and modify mechanical assemblies
Assessment criteria
The learner can:
2.1 describe the specific safety precautions to be taken while carrying out modifications on mechanical assemblies (including any specific legislation, regulations or codes of practice relating to the activities, equipment or materials)
2.2 describe the health and safety requirements of the work area in which they are carrying out the modification activities, and the responsibility these requirements place on them
2.3 describe the COSHH Regulations with regard to the substances used in the modification process
2.4 describe the hazards associated with modifying mechanical assemblies, and how to minimise them and reduce any risks
2.5 describe the personal protective equipment and clothing to be worn during the modification activities
2.6 describe the various types of drawing and specifications that are

- used during the modification
- 2.7 explain how to extract and use information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS, ISO or BSEN standards) in relation to work undertaken
 - 2.8 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing
 - 2.9 describe the reasons why mechanical assemblies may require modification
 - 2.10 describe the preparations to be undertaken on the components prior to carrying out the modification
 - 2.11 describe the various methods that could be used to modify assemblies (such as adjust, remove and replace, repair, modify or manufacture new parts)
 - 2.12 describe the basic concepts and techniques that can be used, where appropriate, to modify the assembly (such as machining, welding, fabrication, bonding, mechanical fitting, electrical and electronic fitting)
 - 2.13 describe the quality control procedures to be followed during the modification, and the importance of adhering to them
 - 2.14 explain how to conduct any necessary checks to ensure the accuracy, position, security, function and completeness of the modification
 - 2.15 describe the methods and equipment used to transport, lift and handle components and assemblies
 - 2.16 explain how to check that the tools and equipment to be used are correctly calibrated and are in a safe and serviceable condition
 - 2.17 describe the importance of ensuring that all tools are used correctly and within their permitted operating range
 - 2.18 describe the importance of ensuring that all tools, equipment and components are accounted for and returned to their correct location on completion of the modification activities
 - 2.19 describe the problems associated with carrying out modifications on mechanical assemblies, and the importance of informing appropriate people of non-conformances
 - 2.20 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 373

Checking that completed assemblies comply with specification

UAN:	L/600/5537
Level:	3
Credit value:	30
GLH:	91
Relationship to NOS:	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 73: Checking that Completed Assemblies Comply with Specification (Level 3).
Endorsement by a sector or regulatory body:	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
Aim:	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out checks on mechanical assemblies, in accordance with approved procedures. The learner will be required to prepare the work area, ensuring it is safe and free from hazards, to obtain all relevant and current documentation, and to obtain the tools and equipment required for the checking of mechanical assemblies, making sure that they are calibrated and in a safe and usable condition.</p>

The learner will be expected to conduct ongoing trials, manual checks and operational checks throughout the assembly operations, and checks on component parts and sub-assemblies will also be carried out, where appropriate. The learner will be responsible for confirming the assembly is complete, fit for purpose, and meets the operational performance required by the specification. In carrying out checks on mechanical assemblies, the learner will also be required to complete any relevant documentation accurately and legibly.

The learner's responsibilities will require them to comply with organisational policy and procedures for checking the mechanical assembly, and to report any problems with

the assembly they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to ensure that all tools and equipment used in checking the assembly are correctly accounted for on completion of the activities and returned to the correct location. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the 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 quality control techniques and procedures including, where appropriate, British, European and International standards. The learner will understand the mechanical product being assembled, and its application, and will know about the tools and equipment used to check the assembly, in adequate depth to provide a sound basis for carrying out the activities to the required specification. The learner will understand the types of defect that can be found on the assembly, and how critical these defects are in determining the satisfactory performance of the completed product.

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

Learning outcome
The learner will: 1. check that completed assemblies comply with specification
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 checking activities: <ul style="list-style-type: none"> • obtain and use the appropriate documentation (such as job instructions, drawings, quality control documentation, specifications) • adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work

- follow safe practice/approved inspection and checking techniques at all times
 - check that all tools and measuring equipment are within current calibration/certification dates
 - use lifting and slinging equipment in accordance with health and safety guidelines and procedures
 - ensure that all exposed openings are maintained free from foreign objects, dirt or other contamination
 - return all tools and equipment to the correct location on completion of the inspection activities
 - leave the work area in a safe and appropriate condition on completion of the activities
- 1.3 follow and make appropriate use of the specifications for the product or asset being checked
- 1.4 use all the correct tools and inspection equipment and check that they are in useable condition
- 1.5 carry out the checks in an appropriate sequence using approved methods and procedures
- 1.6 check the mechanical assembly using twelve of the following instruments and gauges:
- rule or tape
 - levels
 - straight edges
 - micrometers
 - feeler gauges
 - gauges
 - vernier gauges
 - slip gauges
 - torque wrench
 - protractors
 - squares
 - flow meters
 - dial test indicator
 - temperature gauges
 - optical equipment
 - electrical measuring equipment
 - pressure gauges
 - other specific equipment
- 1.7 use the relevant equipment to measure and check seven of the following features:
- flatness
 - squareness
 - concentricity
 - alignment
 - level
 - verticality
 - fit/working clearance
 - angles

- dimensions
 - parallelism
 - position/location
 - bonding strength
 - distortion
 - torque
- 1.8 check the operational functions of the mechanical assembly, to include ten of the following:
- rotation
 - direction
 - sliding
 - timing
 - speed
 - pressure
 - flow
 - reciprocation
 - movement
 - balance
 - vibration
 - temperature
 - tension
 - electrical in/outputs
 - fluid power in/outputs
 - safety mechanisms
 - sequence
 - distance/travel
 - noise
 - leakage
 - power
 - service supplies (such as water, gas, air, electrical supply)
- 1.9 identify and assess any defects or variations from the specification and take appropriate action
- 1.10 ensure that the completed assembly meets the specification, using two of the following checks:
- trial
 - under power
 - fully operational
 - manual check
- 1.11 check that mechanical assemblies comply with one of the following quality and accuracy standards:
- BS, ISO or BSEN standards and procedures
 - customer standards and requirements
 - company standards and procedures
 - specific system requirements
- 1.12 report completion of compliance activities in line with organisational procedures.

Learning outcome
The learner will: 2. know how to check that completed assemblies comply with specification
Assessment criteria
The learner can: 2.1 describe the specific safety precautions to be taken while carrying out the mechanical assembly checks (including any specific legislation, regulations or codes of practice relating to the activities, equipment or materials) 2.2 describe the health and safety requirements of the work area in which they are carrying out the assembly checking activities, and the responsibility these requirements place on them 2.3 describe the COSHH Regulations with regard to the substances used in the assembly process 2.4 describe the hazards associated with checking mechanical assemblies, and how to minimise them and reduce any risks 2.5 describe the personal protective equipment and clothing to be worn during the assembly checking activities 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, workpiece reference points and system of tolerancing 2.8 describe the use of British, European and international standards used 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 various stages when the assembly should be checked, and to what level 2.11 describe the preparations to be undertaken before the assembly is checked 2.12 describe the application of the various tools and equipment used to check the assembly 2.13 describe the importance of ensuring that tools and equipment are set up correctly and are in a safe and useable condition 2.14 describe the procedure and methods used to check that tools and equipment are within calibration date 2.15 describe the quality control procedures to be followed when checking the assembly 2.16 explain how to conduct any necessary checks to ensure the safety, accuracy, position, security, function and completeness of the assembly 2.17 describe the types of defect that can be found on mechanical assemblies, and why they occur 2.18 explain how to detect assembly defects, and what to do to rectify them 2.19 describe the factors to be considered when determining if assembly components or products should be scrapped or modified 2.20 describe the documentation to be completed to confirm that the assembly has been properly checked

- 2.21 describe the importance of ensuring that all tools and equipment are returned to their correct location on completion of the assembly checking activities
- 2.22 describe the extent of their own responsibility 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 2 NVQ in Mechanical Manufacturing Engineering (1682)

Literacy, language, numeracy and ICT skills development

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

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



Appendix 2 Sources of general information

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

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

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

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

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

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

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

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

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

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www.cityandguilds.com

Useful contacts

UK learners

General qualification information

T: +44 (0)844 543 0033

E: learnersupport@cityandguilds.com

International learners

General qualification information

T: +44 (0)844 543 0033

F: +44 (0)20 7294 2413

E: intcg@cityandguilds.com

Centres

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

T: +44 (0)844 543 0000

F: +44 (0)20 7294 2413

E: centresupport@cityandguilds.com

Single subject qualifications

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

T: +44 (0)844 543 0000

F: +44 (0)20 7294 2413

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

E: singlesubjects@cityandguilds.com

International awards

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

T: +44 (0)844 543 0000

F: +44 (0)20 7294 2413

E: intops@cityandguilds.com

Walled Garden

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

T: +44 (0)844 543 0000

F: +44 (0)20 7294 2413

E: walledgarden@cityandguilds.com

Employer

Employer solutions, Mapping,
Accreditation, Development Skills,
Consultancy

T: +44 (0)121 503 8993

E: business@cityandguilds.com

Publications

Logbooks, Centre documents,
Forms, Free literature

T: +44 (0)844 543 0000

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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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