

# **Level 3 NVQ Diploma in Mechanical Manufacturing Engineering (Mechanical Overhaul and Test) (1712-36)**

September 2011 Version 1.0



## Qualification at a glance

<b>Subject area</b>	Mechanical Manufacturing Engineering
<b>City &amp; Guilds number</b>	1712
<b>Age group approved</b>	16+
<b>Entry requirements</b>	None
<b>Assessment</b>	Portfolio of evidence
<b>Automatic approval</b>	Available
<b>Support materials</b>	Centre handbook
<b>Registration and certification</b>	Consult the Walled Garden/Online Catalogue for last dates

<b>Title and level</b>	<b>City &amp; Guilds number</b>	<b>Accreditation number</b>
Level 3 NVQ Diploma in Mechanical Manufacturing Engineering – Mechanical Overhaul and Test	1712-36	501/1803/1



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# 1 Introduction

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

<b>Area</b>	<b>Description</b>
Who is the qualification for?	It is for candidates who work or want to work as mechanical manufacturing engineers – mechanical overhaul and test 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"><li>• Level 3 NVQ Extended Diploma in Mechanical Manufacturing Engineering</li></ul>

## Structure

To achieve the **Level 3 NVQ in Mechanical Engineering - Mechanical Overhaul and Test**), learners must achieve **15** credits from the mandatory units and a minimum of **48** credits from a minimum of 2 units from the optional units available in group A and a minimum of **70** credits from the optional units available from group B.

<b>Unit accreditation number</b>	<b>City &amp; Guilds unit number</b>	<b>Unit title</b>	<b>Credit value</b>
<b>Mandatory</b>			
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
<b>Optional group A</b>			
T/600/5600	Unit 389	Slinging, lifting and moving equipment, components or materials for overhauling activities	24
R/600/5605	Unit 390	Dismantling mechanical equipment in preparation for overhaul	49
H/600/5611	Unit 391	Checking mechanical components for serviceability during overhauling activities	24
A/600/5615	Unit 392	Carrying out non-destructive flaw detection on components during overhauling activities	24
R/600/5619	Unit 393	Restoring mechanical components to usable condition by repair	49
D/600/5624	Unit 394	Producing replacement components for overhauling activities	49
A/600/5629	Unit 395	Checking that overhauled mechanical assemblies comply with specification	30

### Optional group B

T/600/5631	Unit 396	Overhauling industrial power turbines by module replacement	86
R/600/5636	Unit 397	Overhauling industrial power turbine compressor assemblies	86
Y/600/5640	Unit 398	Overhauling industrial power turbine combustion assemblies	86
A/600/5646	Unit 399	Overhauling turbine assemblies from industrial power turbines	86
F/600/5650	Unit 400	Overhauling piston engines	86
Y/600/5654	Unit 401	Overhauling gearbox assemblies	86
K/600/5657	Unit 402	Overhauling industrial clutch and brake assemblies	77
F/600/5468	Unit 403	Overhauling pump assemblies	77
K/600/5478	Unit 404	Overhauling valve assemblies	77
J/600/5486	Unit 405	Overhauling components of hydraulic equipment	77
D/600/5493	Unit 406	Overhauling components of pneumatic, vacuum or compressed air equipment	77
K/600/5500	Unit 407	Carrying out tests on overhauled industrial power turbines	70
D/600/5512	Unit 408	Carrying out tests on overhauled piston engines (fixed dynamometer)	70



## 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 area[s] 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(s) take 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.

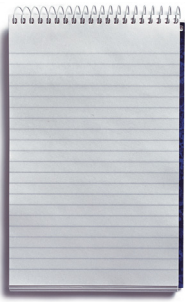
City & Guilds endorses several ePortfolio systems. Further details are available at: [www.cityandguilds.com/eportfolios](http://www.cityandguilds.com/eportfolios).

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

**Recording forms** are available on the City & Guilds website.

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

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



## 4 Assessment

### Assessment of the qualification

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

### Evidence requirements

#### Carrying Out Assessments

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

#### Minimum Performance Evidence Requirements

Performance evidence must be the main form of evidence gathered. In order to demonstrate consistent, competent performance for a unit, a minimum of 3 different examples of performance must be provided, and must be sufficient to show that the assessment criteria have been achieved to the prescribed standards. It is possible that some of the bulleted items in the assessment criteria may be covered more than once. The assessor and learner need to devise an assessment plan to ensure that performance evidence is sufficient to cover all the specified assessment criteria and which maximises the opportunities to gather evidence. Where applicable, performance evidence may be used for more than one unit.

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

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

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

Performance evidence must be a combination of:

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

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

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

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

### **Assessing knowledge and understanding**

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

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

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

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

### **Witness testimony**

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

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

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

### **Recognition of Prior Learning (RPL)**

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





## 5 Units

### Availability of units

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

### Structure of units

These units each have the following:

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

## Unit 201

# Complying with statutory regulations and organisational safety requirements

<b>UAN:</b>	A/601/5013
<b>Level:</b>	2
<b>Credit value:</b>	5
<b>GLH:</b>	35
<b>Relationship to NOS:</b>	This unit has been derived from Semta national occupational standard: Complying with statutory regulations and organisational safety requirements (Suite 2).
<b>Endorsement by a sector or other appropriate body:</b>	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
<b>Aim:</b>	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

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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.

<b>Learning outcome</b>
The learner will: 1. comply with statutory regulations and organisational safety requirements
<b>Assessment criteria</b>
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"><li>• applying in principle their duties and responsibilities as an individual under the Health and Safety at Work Act</li><li>• identifying, within their organisation, appropriate sources of information and guidance on health and safety issues, such as:<ul style="list-style-type: none"><li>- eye protection and Personal Protective Equipment (PPE)</li><li>- COSHH regulations</li><li>- risk assessments</li></ul></li><li>• identifying the warning signs and labels of the main groups of hazardous or dangerous substances</li><li>• complying with the appropriate statutory regulations at all times</li></ul> 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"> <li>• identifying the appropriate qualified first aiders and the location of first aid facilities</li> <li>• identifying the procedures to be followed in the event of injury to themselves or others</li> <li>• following organisational procedures in the event of fire and the evacuation of premises</li> <li>• identifying the procedures to be followed in the event of dangerous occurrences or hazardous malfunctions of equipment</li> </ul>
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"> <li>• their working environment</li> <li>• the equipment that they use</li> <li>• materials and substances (where appropriate) that they use</li> <li>• working practices that do not follow laid-down procedures</li> </ul>
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"> <li>• lifting alone</li> <li>• with assistance of others</li> <li>• with mechanical assistance</li> </ul>
1.10	apply safe working practices and procedures to include: <ul style="list-style-type: none"> <li>• maintaining a tidy workplace, with exits and gangways free from obstruction</li> <li>• using equipment safely and only for the purpose intended</li> <li>• observing organisational safety rules, signs and hazard warnings</li> <li>• taking measures to protect others from any harm resulting from the work that they are carrying out.</li> </ul>

<b>Learning outcome</b>	
The learner will:	
2.	know how to comply with statutory regulations and organisational safety requirements
<b>Assessment criteria</b>	
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

<b>UAN:</b>	Y/601/5102
<b>Level:</b>	2
<b>Credit value:</b>	5
<b>GLH:</b>	25
<b>Relationship to NOS:</b>	This unit has been derived from Semta national occupational standard: Using and interpreting engineering data and documentation (Suite 2).
<b>Endorsement by a sector or other appropriate body:</b>	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
<b>Aim:</b>	<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

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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.

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

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

<b>Learning outcome</b>	
The learner will:	
2. know how to use and interpret engineering data and documentation	
<b>Assessment criteria</b>	
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

<b>UAN:</b>	K/601/5055
<b>Level:</b>	3
<b>Credit value:</b>	5
<b>GLH:</b>	25
<b>Relationship to NOS:</b>	This unit has been derived from Semta national occupational standard: Working efficiently and effectively in engineering (Suite 3).
<b>Endorsement by a sector or other appropriate body:</b>	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
<b>Aim:</b>	<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>

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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.

<b>Learning outcome</b>
The learner will: 1. work efficiently and effectively in engineering
<b>Assessment criteria</b>
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"><li>• the work area is free from hazards and is suitably prepared for the activities to be undertaken</li><li>• any required safety procedures are implemented</li><li>• any necessary personal protection equipment is obtained and is in a usable condition</li><li>• tools and equipment required are obtained and checked that</li></ul>

- 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 389

# Slings, lifting and moving equipment, components or materials for overhauling activities

<b>UAN:</b>	T/600/5600
<b>Level:</b>	3
<b>Credit value:</b>	24
<b>GLH:</b>	89
<b>Relationship to NOS:</b>	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 100: Slings, Lifting and Moving Equipment, Components or Materials for Overhauling Activities (Level 3).
<b>Unit endorsed by a sector or regulatory body:</b>	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to move equipment, components or materials for mechanical overhaul activities, by slinging and lifting, in accordance with approved procedures. The learner will be required to use correctly specified items of lifting gear, which will include hand and/or power operated cranes and winches, and associated lifting accessories. The learner must check that the lifting equipment is within current authorisation dates, is undamaged and within the permitted safe working load (SWL). The learner will be expected to establish the weight of the load to be moved, and to attach the appropriate slings to suitable or designated lifting points on the load, in order to achieve a safe and balanced lift. The learner must check the area that the load will move through, to ensure that it is free from obstructions and is safe for the load to be moved.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the slinging and lifting activities undertaken, and to report any problems with the slinging and lifting activities or equipment that they cannot</p>



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personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the safety and integrity of the materials or items being moved.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying slinging, lifting and moving procedures within a mechanical overhaul environment. The learner will understand the slinging, lifting and moving techniques used, and their application, and will know about the lifting equipment and accessories for lifting, in adequate depth to provide a sound basis for carrying out the activities safely and correctly.

The learner will understand the safety precautions required when slinging and lifting, and the safeguards that are necessary for undertaking the activities. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibilities they owe to themselves and others in the workplace.

<b>Learning outcome</b>
The learner will: 1. sling, lift and move equipment, components or materials for overhauling activities
<b>Assessment criteria</b>
The learner can: 1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 ensure that the lifting equipment to be used is suitable for the type of load being lifted and is in a safe and usable condition, by establishing all of the following: <ul style="list-style-type: none"><li>• the lifting equipment is certified and is compliant, within current test dates (such as LOLER regulations and health and safety requirements)</li><li>• all lifting equipment registers are up to date</li><li>• all slings are free from obvious defects</li><li>• the lifting equipment selected is suitable for the type of load to be lifted</li><li>• the identification number and SWL are clearly marked on the equipment selected</li><li>• where applicable, the equipment is correctly colour coded</li></ul> 1.3 before slinging, lifting or moving the load, ensure that all of the following, have been established/checked:

- weight of the load
  - the proposed route of the load is clear of obstructions
  - those affected by the activities have been informed
  - the final destination area is clear and ready to receive the load
  - the agreed code of verbal/hand signals is understood (where appropriate)
  - precautions are in place in case of spillage (where appropriate)
  - arrangements are made for securing/storing the load at its destination
- 1.4 position the moving equipment so that the weight of the load is evenly distributed
- 1.5 use two of the following lifting and moving methods and techniques:
- crane
  - winch
  - low loaders
  - capstan
  - lifting appliances
  - pulling appliances
  - multi-sheaved block combinations
  - powered lifting equipment
  - hand operated lifting equipment
  - jacks, skates and trolleys
- 1.6 attach the appropriate handling equipment securely to the load, using approved methods to eliminate slippage
- 1.7 use two of the following slinging methods:
- single leg slings
  - two-leg slings
  - three- and four-leg slings
  - lifting beams
  - spreaders
- 1.8 confirm that the load is secure before moving
- 1.9 move the load over the selected, suitable route
- 1.10 move two of the following types of load:
- components/equipment with evenly distributed weight
  - components/equipment with unevenly distributed weight
  - raw materials
  - liquid containers (such as drums)
  - hot/radiant/toxic/corrosive
  - access structures
  - irregularly shaped objects
  - fabricated units
  - sub-assemblies
  - fragile components
- 1.11 move loads safely and correctly, and re-position in two of the following conditions:
- to differing elevations

- as part of an assembly
- through complex rigging operations
- in the same elevation
- rotate a load
- transfer a load to a different location

1.12 position and release the load safely in its intended final location.

### **Learning outcome**

The learner will:

2. know how to sling, lift and move equipment, components or materials for overhauling activities

### **Assessment criteria**

The learner can:

- 2.1 describe the specific safety precautions to be taken when slinging and lifting loads, and the need for ensuring load security (general workshop and site safety, appropriate Personal Protective Equipment, protecting other workers during the lifting operations, accident procedures, statutory regulations, risk assessment procedures and COSHH regulations)
- 2.2 describe the hazards associated with slinging and lifting of loads, and how to minimise them and reduce the risks
- 2.3 describe the Approved Code of Practice (ACOP) for safe use of lifting equipment, and Lifting Operation and Lifting Equipment Regulations (LOLER)
- 2.4 describe the specific requirements for the marking of lifting equipment, and the specific method used in the organisation in which they are working
- 2.5 describe the range of equipment that is to be used for the lifting operations (such as hand and power operated cranes, winches, pulling equipment)
- 2.6 describe the lifting equipment accessories that are to be used (such as slings, chains, wire ropes, eye bolts)
- 2.7 describe the checks that should be made on the lifting equipment prior to use, and things that they should look for
- 2.8 explain how to carry out visual in-service inspections of the equipment, and what to do should any defective equipment be identified
- 2.9 describe the factors which affect the selection of the lifting equipment and lifting accessories (such as weight, type of load, operating environment)
- 2.10 explain how to identify the included angle when using multi-leg slings
- 2.11 explain how to check that the lifting equipment is capable of lifting the load to be moved
- 2.12 explain how to plan and prepare a route for moving loads, and the things that they will need to take into account
- 2.13 describe the specific requirements for the organisation of lifting operations
- 2.14 describe the signalling techniques used to communicate with crane drivers (to include both hand signals and verbal commands)
- 2.15 explain how lifting equipment should be stored and handled
- 2.16 describe the extent of their own responsibility and to whom they

should report if they have problems that they cannot resolve.

## Unit 390

# Dismantling mechanical equipment in preparation for overhaul

<b>UAN:</b>	R/600/5605
<b>Level:</b>	3
<b>Credit value:</b>	49
<b>GLH:</b>	161
<b>Relationship to NOS:</b>	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 101: Dismantling Mechanical Equipment in Preparation for Overhaul (Level 3).
<b>Endorsement by a sector or other appropriate body:</b>	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
<b>Aim:</b>	This unit covers the skills and knowledge needed to prove the competences required to dismantle mechanical equipment in preparation for complete overhaul, in accordance with approved procedures. This will involve dismantling equipment down to component or unit level, as applicable to the equipment being overhauled.

The learner's responsibilities will require them to comply with organisational policy and procedures for the dismantling of the mechanical equipment, and to report any problems with the dismantling activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner must ensure that all tools, equipment and materials used in the activities are removed from the work area on completion of the activities, and that all necessary job/task documentation is completed accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying

appropriate dismantling techniques to mechanical equipment. The learner will understand the dismantling methods and procedures used, and their application. The learner will know about the mechanical equipment being dismantled, in adequate depth to provide a sound basis for carrying out the dismantling activities to the required specification.

The learner will understand the safety precautions required when carrying out the dismantling activities, especially those for ensuring that stored energy is released safely. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

<b>Learning outcome</b>
The learner will: 1. dismantle mechanical equipment in preparation for overhaul
<b>Assessment criteria</b>
The learner can: 1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 establish and, where appropriate, mark component for re-assembly 1.3 ensure that any stored energy or substances are released safely and correctly 1.4 make all isolations and disconnections to the equipment, in line with approved procedures 1.5 carry out the dismantling to the agreed level, using correct tools and techniques 1.6 carry out all of the following during the dismantling of the mechanical equipment: <ul style="list-style-type: none"> <li>• plan the dismantling activities relevant to the mechanical equipment being overhauled</li> <li>• obtain and use the appropriate dismantling documentation (such as job instructions, drawings, manuals)</li> <li>• 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</li> <li>• provide and maintain safe access and working arrangements for the work area</li> <li>• follow good practice/approved dismantling procedures at all times</li> <li>• carry out the dismantling activities using the appropriate tools and equipment at all times</li> <li>• leave the work area and tools in a safe and appropriate</li> </ul>

- condition on completion of the activities
- 1.7 dismantle two of the following types of equipment:
- equipment with rotating parts
  - equipment with sliding or moving parts
  - equipment with oscillating or reciprocating parts
  - electro-mechanical equipment
  - fluid power/mechanical equipment
  - support structures
- 1.8 carry out ten of the following dismantling activities:
- removing outer casings/covers
  - cleaning parts prior to dismantling
  - carrying out pre-dismantling checks and tests
  - releasing stored energy safely prior to dismantling
  - draining/removing any remaining fluids
  - disconnecting and removing wires and cables
  - attaching suitable cable identification markers
  - disconnecting and removing pipework
  - disconnecting and removing levers and linkages
  - disconnecting and removing all peripheral devices
  - dismantling equipment to unit/sub-assembly level
  - dismantling units to component level
  - removing components having interference fits (such as by expansion, contraction, pressure)
  - proof-marking/labelling of components to aid reassembly
  - supporting the equipment to be removed
  - removing mechanical fastening devices
  - storing all components and peripheral units safely, ready for inspection and reassembly
- 1.9 dismantle and remove ten of the following components and assemblies:
- shafts
  - couplings
  - gears
  - clutches
  - valves and seats
  - pistons
  - brakes
  - splined components
  - bearings
  - pipes and hoses
  - seals and gaskets
  - keys
  - springs
  - diaphragms
  - cams and followers
  - chains and sprockets

<ul style="list-style-type: none"> <li>• pulleys and belts</li> <li>• levers and links</li> <li>• slides</li> <li>• rollers</li> <li>• housings</li> <li>• cables and wires</li> <li>• electrical/electronic units</li> <li>• fluid power components</li> <li>• actuating mechanisms</li> <li>• structural components</li> <li>• covers and casings</li> <li>• locking and retaining devices (such as circlips, pins)</li> <li>• other specific components</li> </ul> <p>1.10 dismantle mechanical equipment in compliance with one of the following:</p> <ul style="list-style-type: none"> <li>• company standards and procedures</li> <li>• customer (contractual) standards and requirements</li> <li>• specific equipment requirements/manufacturer's data</li> <li>• recognised compliance agency/body's standards</li> </ul> <p>1.11 store components for re-use in approved locations</p> <p>1.12 complete the relevant paperwork, to include one of the following, and pass it to the appropriate people:</p> <ul style="list-style-type: none"> <li>• job cards</li> <li>• dismantling/overhaul documentation</li> <li>• work authorisation documents</li> <li>• company-specific documentation</li> </ul> <p>1.13 dispose of unwanted components and substances in accordance with approved procedures</p> <p>1.14 deal promptly and effectively with problems within their control and report those that cannot be solved.</p>
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<b>Learning outcome</b>
The learner will: 2. know how to dismantle mechanical equipment in preparation for overhaul
<b>Assessment criteria</b>
The learner can: 2.1 describe the safe working practices and procedures and the specific safety precautions to be taken when dismantling mechanical equipment (to include wearing protective clothing and equipment; cleaning procedures for the components being dismantled; handling techniques; safe working practices, procedures and guidelines which satisfy current regulations such as HASAWA, COSHH and other work related legislation and guidelines) 2.2 describe the hazards associated with dismantling mechanical equipment, and the tools and equipment used, and how to minimise them and reduce any risks 2.3 describe the importance of wearing protective clothing and other appropriate safety equipment during the mechanical dismantling



activities

- 2.4 describe the health and safety requirements of the area in which the mechanical dismantling activity is to take place, and the responsibility these requirements place on you
- 2.5 describe the isolation procedure or permit-to-work procedure that applies to the dismantling activities (such as depressurisation of the system, draining fluids, placing warning notices)
- 2.6 explain how to use and extract information from drawings, manufacturers' manuals, history/maintenance reports, and other documents needed in the dismantling process
- 2.7 describe the basic principles of operation of the mechanical equipment being dismantled, and the function of the components within the equipment
- 2.8 describe the extent to which the equipment is to be dismantled for overhaul
- 2.9 describe the techniques used to dismantle the mechanical equipment (such as proof-marking components to aid reassembly, removing assemblies requiring pressure/force, removing mechanical locking and securing mechanisms/devices)
- 2.10 describe the methods of dismantling mechanical assemblies and sub-assemblies without causing damage to surrounding structures
- 2.11 describe the various mechanical fasteners that are used, and their methods of removal (such as threaded fasteners, taper pins and special securing devices)
- 2.12 describe the methods of supporting and lifting the components/equipment being removed
- 2.13 explain the need to ensure that lifting and handling equipment is within its current test dates
- 2.14 describe the tools and equipment used in the dismantling activities, and how to check that they are in a safe and usable condition
- 2.15 describe the good practice/approved procedures to be followed during the dismantling of the mechanical equipment
- 2.16 explain the need to clean and safely store all components ready for reassembly
- 2.17 describe the storage requirements of removed units and assemblies which are not part of the overhaul process
- 2.18 describe the procedure for the safe disposal of waste materials
- 2.19 describe the recording documentation to be completed for the dismantling activities undertaken and, where appropriate, the importance of identifying specific components in relation to the documentation
- 2.20 describe the problems that can occur during the dismantling activity, and how they can be overcome
- 2.21 describe the extent of your own authority and to whom you should report if you have a problem that you cannot resolve.

## Unit 391

# Checking mechanical components for serviceability during overhauling activities

<b>UAN:</b>	H/600/5611
<b>Level:</b>	3
<b>Credit value:</b>	24
<b>GLH:</b>	89
<b>Relationship to NOS:</b>	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 102: Checking Mechanical Components for Serviceability During Overhauling Activities (Level 3).
<b>Endorsement by a sector or other appropriate body:</b>	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to check mechanical components for serviceability during overhaul activities, in accordance with approved procedures. The learner will be required to obtain all relevant and current documentation, and to obtain the appropriate tools and equipment to carry out the required checks. The learner will select the appropriate inspection equipment, based on the features to be checked and the accuracy to be measured. This will involve checking that the appropriate equipment is within current test dates and, where necessary, setting up and calibrating the equipment ready for the inspection operations to be performed. In carrying out the inspection activities, the learner will be expected to check the components for obvious wear defects, damage, dimensional and geometrical accuracy.</p>

The learner's responsibilities will require them to comply with organisational policy and procedures for checking the mechanical components, and to report any problems with the activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to ensure that

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all tools and equipment used to inspect the components 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 accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying appropriate checking techniques and procedures to dismantled components from mechanical equipment. The learner will understand how to use the tools and equipment used to check the mechanical components, in adequate depth to provide a sound basis for carrying out the checking activities and identifying where components do not meet the required specification tolerances or serviceability requirements.

The learner will understand the safety precautions required when carrying out the checking 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.

<b>Learning outcome</b>
The learner will: 1. check mechanical components for serviceability during overhauling activities
<b>Assessment criteria</b>
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"><li>• obtain and use the correct overhaul documentation (such as company and/or manufacturer's drawings, job instructions and specifications)</li><li>• obtain and check the condition and calibration dates of tools, measuring instruments and equipment to be used</li><li>• 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</li><li>• provide and maintain safe access and working arrangements for the work area</li><li>• follow specified or appropriate checking procedures</li><li>• use the correct and appropriate tools and equipment at all</li></ul>

- times
- identify and record, in the appropriate format, any out-of-specification features
- leave the work area and tools in a safe and appropriate condition on completion of the activities
- 1.3 follow the correct specification for the product or equipment being inspected
- 1.4 use the correct equipment to carry out the inspection
- 1.5 use the relevant equipment to measure and check eight of the following features:
  - external diameters
  - internal diameters
  - length/linear dimensions
  - depth
  - internal tapers
  - external tapers
  - thread fit
  - thread form/profile
  - internal profiles/forms
  - fit/working clearance
  - external profiles/forms
  - angles
  - chamfers and radii
- 1.6 identify and confirm the inspection checks to be made and acceptance criteria to be used
- 1.7 carry out all required inspections as specified
- 1.8 check dismantled mechanical components for eight of the following:
  - visual signs of damage (such as wear, breaks, impact marks, cracks)
  - wear/out-of-tolerance dimensions
  - fit/working clearance
  - deterioration of surface finish
  - concentricity
  - eccentricity
  - parallelism
  - straightness
  - flatness
  - squareness
  - alignment
  - ovality/lobing
  - distortion
- 1.9 check/inspect mechanical components using six of the following:
  - external micrometer
  - internal micrometer
  - depth micrometer
  - specialist micrometers

<ul style="list-style-type: none"> <li>• length vernier</li> <li>• depth vernier</li> <li>• height vernier</li> <li>• straight edge</li> <li>• engineers' square</li> <li>• feeler gauge</li> <li>• hole gauge</li> <li>• thread gauge</li> <li>• slip gauge</li> <li>• dial test indicator</li> <li>• radius/profile gauges</li> <li>• vernier protractors</li> <li>• surface texture comparison plates</li> <li>• surface texture measuring machines</li> <li>• optical equipment (such as shadowgraphs, microscopes)</li> <li>• company-specific equipment</li> </ul> <p>1.10 identify any defects or variations from the specification</p> <p>1.11 record the results of the inspection in the appropriate format</p> <p>1.12 complete the overhaul inspection documentation, to include one from the following, and pass it to the appropriate people:</p> <ul style="list-style-type: none"> <li>• overhaul inspection report</li> <li>• job card</li> <li>• customer-specific documentation</li> <li>• company-specific documentation</li> </ul> <p>1.13 deal promptly and effectively with problems within their control and report those that cannot be solved.</p>
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<p><b>Learning outcome</b></p> <p>The learner will:</p> <p>2. know how to check mechanical components for serviceability during overhauling activities</p>
<p><b>Assessment criteria</b></p> <p>The learner can:</p> <p>2.1 describe the specific safety precautions to be taken when carrying out overhaul inspection activities on mechanical components (such as specific legislation or regulations governing the activities or work area, safe working practices and procedures to be adopted, general workshop safety practice)</p> <p>2.2 describe the COSHH regulations with regard to the substances used in the inspection process</p> <p>2.3 describe the hazards associated with carrying out inspection activities on components removed for overhaul activities, and how to minimise them and reduce any risks</p> <p>2.4 describe the appropriate Personal Protective Equipment (PPE) and clothing to be worn during the inspection activities</p> <p>2.5 explain how and where to obtain the required drawings and related specifications, and how to check that they are current and complete</p> <p>2.6 explain how to extract information from engineering drawings and</p>

- 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 in determining if components and products are fit for purpose
  - 2.9 describe the preparations to be undertaken before the components are inspected
  - 2.10 describe the effects that the environment may have on the measurements taken (in particular, where precision measurements are concerned)
  - 2.11 explain the need to select and use set datum faces, and the effects of taking readings from different datums (such as accumulation of limits leading to errors)
  - 2.12 describe the application and uses of the tools and equipment used to inspect mechanical products (such as micrometers, verniers, gauges, special measuring equipment)
  - 2.13 explain how to determine the correct equipment for the feature to be inspected, taking into account the tolerances to be achieved
  - 2.14 describe the importance of ensuring that tools and equipment are set up correctly and are in a safe and useable condition
  - 2.15 describe the procedure and methods used to check that tools and equipment are within calibration date
  - 2.16 describe the typical defects and variations that can be found on components removed for overhaul activities, and how to identify them
  - 2.17 explain the need to carry out the checks, and to record the results in the appropriate documentation
  - 2.18 describe the procedure to be followed when the inspected components have defects or are out of specification
  - 2.19 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

## Unit 392

# Carrying out non-destructive flaw detection on components during overhauling activities

<b>UAN:</b>	A/600/5615
<b>Level:</b>	3
<b>Credit value:</b>	24
<b>GLH:</b>	89
<b>Relationship to NOS:</b>	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 103: Carrying Out Non-Destructive Flaw Detection on Components During Overhauling Activities (Level 3).
<b>Endorsement by a sector or other appropriate body:</b>	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out dye penetrant or magnetic particle flaw detection tests, on ferrous and non-ferrous engineering components, materials or structures to be re-used in overhaul activities, in accordance with approved procedures. The learner will be required to prepare the components, materials or structures for the non-destructive testing activities and to check that the equipment complies with the specification requirements, and is safe to use and fit for purpose.</p>

The learner must ensure that the ambient conditions are satisfactory for the tests to proceed, and they will carry out the specified tests, using the correct procedures, and will observe and record the test indications. The learner will conclude the tests by completing all relevant documentation/NDT test report, which will contain the required test information along with their interpretation of the test indications. The learner will be expected to mark up the components, materials or structures to show where there are indications of surface defects. The completed documentation will be passed to the appropriate person, in accordance with

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organisational procedures.

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

The learner's knowledge will show a good understanding of their work, and will provide an informed approach to the inspection of components, materials or structures using non-destructive flaw detection testing methods. The learner will have a working knowledge of the operating principles of the specific flaw detection equipment being used, and how any defects will be displayed. The learner's knowledge will include an appreciation of hazards and safe working practice, and they will understand the risks posed by material defects and the consequences of failure.

The learner will understand the safety precautions required when carrying out the dye penetrant or magnetic particle testing activities, and when using the associated tools and equipment. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

<b>Learning outcome</b>
The learner will: 3. carry out non-destructive flaw detection on components during overhauling activities
<b>Assessment criteria</b>
The learner can: 3.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 3.2 carry out all of the following during the non-destructive flaw detection activities: <ul style="list-style-type: none"><li>• obtain the required flaw detection testing equipment, and check that it is in a safe and usable condition</li><li>• 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</li></ul>



- work
  - provide and maintain safe access and working arrangements for the work area
  - follow good practice/approved testing procedures at all times
  - identify and record results of tests in the appropriate format
  - leave the work area and tools in a safe and appropriate condition on completion of the activities
- 3.3 check and confirm that all of the following ambient testing conditions are satisfactory:
  - temperature
  - humidity
  - free from vibration
  - free from pollutants
- 3.4 prepare the components, materials or structures for testing, to include carrying out all of the following:
  - identifying the test areas on the components
  - removing any contaminants from the test area (such as by degreasing)
  - where appropriate, preparing the test surface to the specified finish (such as by polishing)
- 3.5 follow the correct specification for the product or equipment being inspected
- 3.6 use the correct equipment to carry out the inspection
- 3.7 identify and confirm the inspection checks to be made and acceptance criteria to be used
- 3.8 carry out all required inspections as specified
- 3.9 carry out flaw detection activities using one of the following methods:
  - dye penetrant
  - magnetic particle
- 3.10 carry out one of the following, in accordance with instructions and procedures:
  - penetrant flaw detection: all of the following:
    - applying penetrant to the area under inspection
    - washing and drying the test area
    - applying a developer (where appropriate)
    - observing defect indications under correct lighting conditions (ambient light or ultra violet (UV))
    - recording conclusions of observations
    - restoring and cleaning the product on completion of the test
  - magnetic particle testing: all of the following:
    - checking condition and security of electrical cables, connections, mechanical functions and all safety devices
    - setting the equipment parameters to the appropriate levels
    - magnetising the components
    - applying the detecting medium (ink or powder) correctly
    - using magnetic flux indicators
    - observing defect indications under correct lighting conditions (ambient light or ultraviolet (UV))

<ul style="list-style-type: none"> <li>o recording conclusions of observations</li> <li>o demagnetising and cleaning the components on completion of the test</li> </ul> <p>3.11 identify any defects or variations from the specification</p> <p>3.12 record the results of the inspection in the appropriate format</p> <p>3.13 complete the inspection activities, to include carrying out all of the following:</p> <ul style="list-style-type: none"> <li>• marking up any defective components, materials or structures with all relevant information</li> <li>• recording all the required details of the inspection, in the appropriate format</li> <li>• handing over the inspection details to the appropriate people</li> </ul> <p>3.14 deal promptly and effectively with problems within their control and report those that cannot be solved.</p>
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<b>Learning outcome</b>
The learner will:
4. know how to carry out non-destructive flaw detection on components during overhauling activities
<b>Assessment criteria</b>
The learner can:
4.1 describe the specific safety precautions to be taken when carrying out dye penetrant or magnetic particle inspection activities on components, materials or structures
4.2 describe the hazards associated with carrying out the dye penetrant or magnetic particle inspection activities (such as electrical contact, toxic, inflammable and volatile materials, use of aerosol containers and safety in the use of sprays and powders), and how to minimise them and reduce any risks
4.3 describe the Personal Protective Equipment (PPE) to be used, and how to obtain it
4.4 describe the COSHH regulations relating to materials used during the inspection process
4.5 explain how to obtain the necessary job instructions and testing specifications, and how to interpret their information
4.6 describe the reasons why some components, materials or structures require non-destructive testing methods
4.7 explain why it is sometimes necessary to use a range of different non-destructive testing methods (such as magnetic particle, penetrant flaw detection, ultrasonic and radiography)
4.8 describe the basic concepts of non-destructive testing using dye penetrant or magnetic particle testing
4.9 describe the preparations to be carried out on the components, materials or structure test area (such as degreasing, polishing)
4.10 explain how to carry out magnetic particle testing activities (including the application of the magnetic field and the application of the detecting media)
4.11 explain how to carry out the penetrant flaw detection activities (including the application of the penetrant, removal of excess penetrant, contact time, drying of products, application of developer)
4.12 describe the conditions for viewing developed indications (such as

ambient light or ultra violet (UV) and cleaning of the products on completion of the testing activities)

- 4.13 describe the types of defect that are detectable using dye penetrant and magnetic particle detection methods
- 4.14 explain how to recognise defects in the components, materials or structures from the displayed indications, and how to identify false indication of effects, and their cause
- 4.15 describe the level of defects that are acceptable in the components, materials or structures; the influence of the defects on the service/performance of the components, materials or structures
- 4.16 describe the documentation to be completed on conclusion of the non-destructive testing activities
- 4.17 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot solve.

## Unit 393

## Restoring mechanical components to usable condition by repair

<b>UAN:</b>	R/600/5619
<b>Level:</b>	3
<b>Credit value:</b>	49
<b>GLH:</b>	161
<b>Relationship to NOS:</b>	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 104: Restoring Mechanical Components to Usable Condition by Repair (Level 3).
<b>Endorsement by a sector or other appropriate body:</b>	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to restore mechanical components to usable condition by repair, in accordance with approved procedures. The learner will be required to restore a range of mechanical components and equipment to operational condition, by repairing assemblies/sub-assemblies and components, by reforming, reworking the surface, replacing threads or the replacement of worn parts. The learner will also be required to select the appropriate equipment to use, based on the nature of the repair required, the operations that will need to be carried out and the accuracy required.</p>

In producing the components, the learner will be expected to use a range of hand tools, machine tools, portable power tools, and shaping and fitting techniques, appropriate to the type of material and repair being performed. These activities will include such things as sawing (hand, band), drilling, reaming, grinding (hand or machine), filing, scraping or lapping, threading internal, threading external, turning, milling and thermal processes. Materials to be used may include ferrous, non-ferrous, non-metallic and composites, which may be in sheet form, bar sections (such as square/rectangular, round, angle), and part-

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machined components.

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

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying repair procedures to mechanical components. The learner will understand the function and operating conditions of the components being repaired, in sufficient depth to determine a suitable repair sequence and to ensure that the repairs carried out are safe and practical in operation. The learner will also understand the organisational policy on repairing components, and its application.

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

<b>Learning outcome</b>
The learner will: 1. restore mechanical components to usable condition by repair
<b>Assessment criteria</b>
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 repair activity: <ul style="list-style-type: none"><li>• obtain and use the correct issue of company and/or manufacturer's drawings and overhaul documentation</li><li>• 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</li><li>• provide and maintain safe access and working arrangements</li></ul>

- for the work area
  - follow good practice/approved repair procedures at all times
  - record the repair in the appropriate documentation
  - dispose of waste items in a safe and environmentally acceptable manner
  - leave the work area and tools in a safe and appropriate condition on completion of the activities
- 1.3 follow the relevant specifications for the component to be repaired
- 1.4 prepare the component for repair
- 1.5 carry out the repairs within agreed timescales, using approved materials and components and methods and procedures
- 1.6 use appropriate techniques to carry out six of the following types of repair:
  - reforming the component surface by adding metal
  - recondition a unit by replacement of worn components
  - sleeving worn components
  - making stepped dowels, keys or studs
  - cutting new keyways
  - making a temporary fix
  - bushing worn holes
  - replacement of internal thread (thread inserts)
  - reworking the fit (shimming)
  - replacement/reworking of worn keys/keyways
  - replacing damaged or missing gear teeth
  - plugging holes
  - stopping cracks running, and filling them
  - other specific repair procedure
  - reworking the surface finish (using techniques such as filing, scraping, lapping, grinding)
- 1.7 use a range of methods and techniques to repair components, to include six of the following:
  - sawing (hand, band)
  - drilling
  - reaming
  - grinding (hand or machine)
  - filing
  - scraping or lapping
  - threading external
  - threading internal
  - turning
  - milling
  - thermal processes
- 1.8 repair components made from different types of material, to include two from the following:
  - low carbon steel
  - high carbon steel
  - cast iron

<ul style="list-style-type: none"> <li>• aluminium</li> <li>• brass/bronze</li> <li>• stainless steel</li> <li>• plastic/synthetic</li> <li>• composite</li> </ul> <p>1.9 ensure that the repaired component meets the specified operating conditions</p> <p>1.10 carry out repairs to mechanical equipment in compliance with one of the following:</p> <ul style="list-style-type: none"> <li>• BS, ISO or BSEN standards and procedures</li> <li>• other accepted international standards</li> <li>• customer (contractual) standards and requirements</li> <li>• company standards and procedures</li> </ul> <p>1.11 produce accurate and complete records of all repair work carried out.</p>
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<p><b>Learning outcome</b></p> <p>The learner will:</p> <p>2. know how to restore mechanical components to usable condition by repair</p>
<p><b>Assessment criteria</b></p> <p>The learner can:</p> <p>2.1 describe the health and safety requirements of the area in which the repairing activity is to take place, and the responsibility they place on them</p> <p>2.2 describe the isolation procedures or permit-to-work procedure that applies</p> <p>2.3 describe the specific health and safety precautions to be applied during the repairing procedure, and their effects on others</p> <p>2.4 describe the importance of wearing protective clothing and other appropriate safety equipment during the repair process</p> <p>2.5 describe the hazards associated with the operations being carried out (such as sawing: hand, band; drilling; reaming; grinding: hand or machine; filing; scraping or lapping; threading internal; threading external; turning; milling; and thermal processes), and how to minimise them and reduce any risks</p> <p>2.6 explain where to obtain, and how to interpret, drawings, specifications, manufacturers' manuals, maintenance schedules and other documents identifying parameters of the equipment being repaired</p> <p>2.7 explain how to carry out currency/issue checks on the specifications they are working with</p> <p>2.8 describe the methods and techniques to be followed for repairing mechanical equipment, in compliance with company procedures</p> <p>2.9 describe the types of repair that can be made to components in order to prolong their useful life (such as bushing worn holes, fitting thread inserts, building up surfaces by thermal process or metal spraying, making stepped keys, cutting new keyways, making stepped/oversize dowels or studs)</p> <p>2.10 describe the factors to be taken into account when deciding if a repair is practical and possible (such as replacement component</p>

- availability, cost of replacing, safety of repair, age and condition of equipment)
- 2.11 describe the need to liaise with other departments in order to have specialised operations carried out on the components (such as thermal processes, metal spraying)
  - 2.12 explain how to use filing, scraping and lapping to achieve the required surface finish (such as various types of files/scrapers, ensuring that file/scrapper handles are in good condition, selection and use of lapping mediums)
  - 2.13 explain how to cut internal and external threads (such as by using hand dies and taps, machine cutting)
  - 2.14 explain how to produce a sliding or mating fit, and the techniques to be adopted
  - 2.15 explain how to select saw blades for different materials and different operations
  - 2.16 describe the types and application of portable power tools that can be used for the repair operations
  - 2.17 explain how to check that portable power tools and extension cables are in a safe usable condition
  - 2.18 explain how to use hand power tools and specialist equipment (such as electrical, pneumatic, lifting equipment) correctly
  - 2.19 describe the operating requirements of the machine tools and accessories being used (such as guards, workholding devices, taper turning attachments, steadies, dividing heads, specific statutory regulations, abrasive wheels regulations)
  - 2.20 describe the various shapes and types of tooling that can be used (such as solid, high-speed tooling, brazed-tip tooling, interchangeable-tipped tooling)
  - 2.21 explain how to handle and store tools and equipment, safely and correctly
  - 2.22 describe the factors which affect the selection of cutting feeds and speeds, and the depth of cut that can be taken (such as workpiece rigidity, machine condition, type of tooling being used, material type, finish and tolerance required)
  - 2.23 describe the application of cutting fluids with regard to a range of different materials and processes
  - 2.24 describe the clamping of a workpiece in a chuck/workholding device (including safely secured for the process, not causing distortion in the finished components)
  - 2.25 explain how to recognise machining faults, and how to identify when tools need re-sharpening/dressing
  - 2.26 describe the operating requirements of the thermal processes and accessories being used (including any statutory regulations and quality standards to be observed, guards, workholding devices, fume extraction, gas storage)
  - 2.27 describe the company recording procedures to be used following a repair, and how to apply them
  - 2.28 describe the procedure for the safe disposal of waste materials
  - 2.29 describe the types of problem associated with repairs, and how to resolve them
  - 2.30 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.



## Unit 394

## Producing replacement components for overhauling activities

<b>UAN:</b>	D/600/5624
<b>Level:</b>	3
<b>Credit value:</b>	49
<b>GLH:</b>	161
<b>Relationship to NOS:</b>	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 105: Producing Replacement Components for Overhauling Activities (Level 3).
<b>Endorsement by a sector or other appropriate body:</b>	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to produce replacement components resulting from overhaul activities, in accordance with approved procedures. The learner will produce these components using machining techniques, such as milling, turning, grinding, shaping/slotting, drilling/boring, combined with hand fitting techniques. 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.</p>

The learner will also be expected to use a range of hand tools, portable power tools, and shaping and fitting techniques that are appropriate to the type of material and operations being performed. These activities will include such things as hand sawing, band sawing, filing, drilling, chiselling, threading and off-hand grinding. The components produced will, typically, be such things as shafts, bushes, sleeves, distance pieces/spacers, packings, plates, studs, slides, pulleys, gear blanks, handles, levers or linkages.

The learner's responsibilities will require

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

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying appropriate replacement component manufacturing procedures and instructions. The learner will understand the machining and fitting processes used, 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 activities, correcting faults and producing the components to the required specification.

The learner will understand the safety precautions required when working with the machines, and with their associated tools and equipment. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

<b>Learning outcome</b>
The learner will: 1. produce replacement components for overhauling activities
<b>Assessment criteria</b>
The learner can: 1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 carry out all of the following during the manufacturing activities: <ul style="list-style-type: none"><li>• obtain and use the correct drawing, sketch or sample/damaged component to be replaced</li><li>• 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</li><li>• check that machines used are in a safe and usable condition</li><li>• check that cutting tools and equipment are in a serviceable condition</li></ul>

- ensure that workpieces are held securely, without distortion
  - follow good practice/approved manufacturing techniques and procedures at all times
  - use correctly adjusted machine guards and safety devices
- 1.3 follow instructions and any relevant specifications to produce the component
- 1.4 produce the required components using appropriate manufacturing methods and techniques
- 1.5 produce replacement components, using a range of hand fitting methods, to include five from the following:
- hand sawing
  - drilling
  - reaming
  - counterboring
  - countersinking
  - band/power sawing
  - chiselling
  - scraping
  - lapping
  - bending/forming
  - filing
  - off-hand grinding
  - threading external
  - threading internal
- 1.6 produce replacement components, using two of the following machining processes:
- turning
  - drilling
  - milling
  - spark/wire erosion
  - grinding
  - welding
  - shaping or slotting
  - cutting/shearing
- 1.7 produce replacement components which cover five of the following features:
- external diameters
  - internal diameters
  - flat faces
  - parallel faces
  - steps/shoulders
  - faces that are square to each other
  - angular/tapered surfaces
  - threads
  - circular/curved/radial profiles
  - slots/recesses
  - drilled holes

<ul style="list-style-type: none"> <li>• bored holes</li> <li>• reamed holes</li> <li>• concave or convex form</li> <li>• special forms</li> </ul> <p>1.8 produce replacement components from two different types of material from:</p> <ul style="list-style-type: none"> <li>• low carbon steel</li> <li>• high carbon steel</li> <li>• stainless steel</li> <li>• cast iron</li> <li>• aluminium</li> <li>• brass</li> <li>• bronze</li> <li>• plastic/synthetic</li> <li>• composite</li> <li>• special steels or alloys</li> </ul> <p>1.9 check that the finished component meets the requirements and make any necessary adjustments</p> <p>1.10 produce components which comply with all of the following:</p> <ul style="list-style-type: none"> <li>• dimensional tolerances are to specification/replacement component requirements</li> <li>• the surface finish complies to replacement component requirements</li> <li>• components are free from false tool cuts, burrs and sharp edges</li> <li>• components are fit for purpose</li> </ul> <p>1.11 deal promptly and effectively with problems within their control and report those that cannot be solved.</p>
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<b>Learning outcome</b>
The learner will: 2. know how to produce replacement components for overhauling activities
<b>Assessment criteria</b>
The learner can: 2.1 describe the safe working practices and procedures to be followed whilst carrying out the machining activities 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 hazards associated with the operations being carried out (such as sawing: hand, band; drilling; reaming; grinding: hand or machine; filing; scraping or lapping; threading internal; threading external; turning; milling; and thermal processes), and how to minimise them and reduce any risks 2.5 describe the importance of wearing appropriate protective clothing and equipment, and of keeping the work area clean and tidy

- 2.6 explain how to obtain and interpret drawings, specifications, manufacturers' manuals and other documents needed in the manufacturing process
- 2.7 explain how to take measurements and produce working sketches of parts to be made, where no drawings are available
- 2.8 explain how to use filing, scraping and lapping to achieve the required surface finish (such as the various types of files/scrapers, checking that file/scrapper handles are in good condition, types of lapping mediums)
- 2.9 explain how to cut external threads using hand dies, and the method of fixing and adjusting the dies to give the correct thread fit
- 2.10 explain how to determine the drill size for tapped holes and the importance of using the taps in the correct sequence
- 2.11 explain how to produce a sliding or mating fit
- 2.12 explain how to select saw blades (such as for different materials and different operations)
- 2.13 describe the use of vice jaw plates to protect the workpiece from damage
- 2.14 explain how to use hand power tools and specialist equipment correctly (such as electrical, pneumatic, lifting equipment)
- 2.15 explain how to check that portable power tools, extension cables and air hoses are free from damage and are in a safe, usable condition
- 2.16 describe the operating requirements of the machine tools and accessories being used (such as guards, workholding devices, taper turning attachments, steadies, dividing heads, specific statutory regulations)
- 2.17 describe the various shapes and types of tooling that can be used (such as solid high-speed tooling, brazed tip tooling, interchangeable tipped tooling)
- 2.18 explain how to handle and store tools and equipment, safely and correctly
- 2.19 describe the factors which affect the selection of cutting feeds and speeds, and the depth of cut that can be taken (such as workpiece rigidity, machine condition, type of tooling being used, material type, finish and tolerance required)
- 2.20 describe the application of cutting fluids with regard to a range of different materials and processes
- 2.21 describe the techniques and implications of clamping a workpiece in a chuck/workholding device (such as safely secured for the process, not causing distortion in the finished components)
- 2.22 explain how to recognise machining faults, and how to identify when tools need re-sharpening/dressing
- 2.23 describe the types and applications of grinding wheels, and methods of mounting, and why some wheels require balancing (abrasive wheels regulations)
- 2.24 describe the methods that can be used to position the workpiece in relation to the cutting tools
- 2.25 describe the effects of backlash in the machine slides, and how this can be overcome
- 2.26 describe the problems that can occur with the machining and fitting activities, and how these can be overcome
- 2.27 describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve.

## Unit 395

# Checking that overhauled mechanical assemblies comply with specification

<b>UAN:</b>	A/600/5629
<b>Level:</b>	3
<b>Credit value:</b>	30
<b>GLH:</b>	91
<b>Relationship to NOS:</b>	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 106: Checking that Overhauled Mechanical Assemblies Comply with Specification (Level 3).
<b>Endorsement by a sector or other appropriate body:</b>	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out checks on mechanical assemblies on completion of overhaul activities, in accordance with approved procedures. The learner will be required to prepare the work area, ensuring that it is safe and free from hazards, obtaining all relevant and current documentation, and obtaining the tools and equipment required for checking the mechanical assemblies, and making sure that they are calibrated and in a safe and usable condition.</p> <p>The learner will be expected to conduct ongoing trials, manual checks and operational checks throughout the overhaul re-assembly operations, and to check component parts and sub-assemblies, where appropriate. The learner will be responsible for confirming that the overhauled assembly is complete, fit for purpose, and meets the operational performance required by the specification. In carrying out checks on the mechanical assemblies, the learner will also be required to complete any relevant documentation accurately and legibly.</p> <p>The learner's responsibilities will require them to comply with organisational policy</p>

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and procedures for checking the overhauled mechanical assembly, and to report any problems with the re-assembly they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to ensure that all tools and equipment used in checking the re-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 overhauled and re-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 re-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 re-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.

<b>Learning outcome</b>
The learner will: 1. check that overhauled mechanical assemblies comply with specification
<b>Assessment criteria</b>
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 of the overhauled assembly: <ul style="list-style-type: none"><li>• obtain and use the correct issue of drawings, job instructions and specifications</li></ul>

- 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
  - provide and maintain safe access and working arrangements for the work area
  - check the calibration dates of tools and measuring instruments to be used
  - follow good practice/approved checking procedures at all times
  - ensure that all exposed openings are kept free from foreign objects, dirt or other contamination
  - use appropriate and safe inspection and checking techniques at all times
  - leave the work area and equipment 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 a useable condition
- 1.5 check the overhauled mechanical assembly, using six of the following instruments and gauges:
- rule or tape
  - levels
  - straight edges
  - micrometers
  - vernier instruments
  - feeler gauges
  - dial test indicator
  - squares
  - gauges
  - slip gauges
  - torque wrench
  - protractors
  - pressure gauges
  - flow meters
  - temperature gauges
  - optical equipment
  - electrical measuring equipment
  - other specific equipment
- 1.6 carry out the checks, in an appropriate sequence, using approved methods and procedures
- 1.7 use the relevant equipment to measure and check four 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 overhauled mechanical assembly, to include eight 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 (water, gas, air, electrical supply)
- 1.9 ensure that the completed assembly meets the specification, using two of the following checks:
- trial
  - under power
  - fully operational
  - manual check
- 1.10 check that the overhauled mechanical assemblies comply with one of the following:
- BS, ISO or BSEN standards and procedures
  - customer standards and requirements
  - company standards and procedures
  - specific equipment requirements
- 1.11 identify and assess any defects or variations from the specification,

<p>and take appropriate action</p> <p>1.12 report completion of compliance activities, in line with organisational procedures.</p>
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<p><b>Learning outcome</b></p>
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<p>The learner will:</p> <p>2. know how to check that overhauled mechanical assemblies comply with specification</p>
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<p><b>Assessment criteria</b></p>
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<p>The learner can:</p> <p>2.1 describe the specific safety precautions to be taken while carrying out the mechanical re-assembly checks (including any specific legislation, regulations or codes of practice relating to the activities, equipment or materials)</p> <p>2.2 describe the health and safety requirements of the work area in which they are carrying out the re-assembly checking activities, and the responsibility these requirements place on them</p> <p>2.3 describe the COSHH regulations with regard to the substances used in the re-assembly process</p> <p>2.4 describe the hazards associated with checking mechanical assemblies, and how to minimise them and reduce any risks</p> <p>2.5 describe the Personal Protective Equipment (PPE) and clothing to be worn during the re-assembly checking activities</p> <p>2.6 explain how to use and extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS, ISO or BSEN standards) in relation to work undertaken</p> <p>2.7 explain how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing</p> <p>2.8 describe the use of British, European and international standards in determining if components and products are fit for purpose</p> <p>2.9 describe the general principles of quality assurance systems and procedures</p> <p>2.10 describe the various stages when the overhauled re-assembly should be checked, and to what level</p> <p>2.11 describe the preparations to be undertaken before the re-assembly is checked</p> <p>2.12 describe the application of the various tools and equipment used to check the re-assembly</p> <p>2.13 describe the importance of ensuring that tools and equipment are set up correctly and are in a safe and useable condition</p> <p>2.14 describe the procedure and methods used to check that tools and equipment are within calibration date</p> <p>2.15 explain how to conduct any necessary checks to ensure the safety, accuracy, position, security, function and completeness of the re-assembly</p> <p>2.16 describe the types of defect that can be found on overhauled mechanical assemblies, and why they occur</p> <p>2.17 explain how to detect assembly defects, and what to do to rectify them</p> <p>2.18 describe the documentation to be completed to confirm that the overhauled assembly has been properly checked</p>
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- 2.19 describe the importance of ensuring that all tools and equipment are returned to their correct location on completion of the re-assembly checking activities
- 2.20 describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

## Unit 396

# Overhauling industrial power turbines by module replacement

<b>UAN:</b>	T/600/5631
<b>Level:</b>	3
<b>Credit value:</b>	86
<b>GLH:</b>	210
<b>Relationship to NOS:</b>	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 107: Overhauling Industrial Power Turbines by Module Replacement (Level 3).
<b>Endorsement by a sector or other appropriate body:</b>	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
<b>Aim:</b>	This unit covers the skills and knowledge needed to prove the competences required to carry out a complete overhaul of an industrial power turbine, in accordance with approved procedures. The power turbine to be overhauled will have been isolated, disconnected and removed from its normal operating environment, and the overhauling activities may take place in a maintenance environment or manufacturer's workshop.

In carrying out the overhauling operations, the learner will be required to follow laid-down procedures and use specific dismantling and rebuilding techniques. The overhauling activities will involve removing any protective outer casing, removing all ancillary equipment and components and dismantling the power turbine down to the various sub-assembly/modules, such as fan case, front fan, compressor module, combustor module, turbine module and gear box.

The learner will then be expected to rebuild the power turbine, which will involve fitting replacement or overhauled sub-assembly/modules (such as compressor, combustor, and turbine) and the replacement of all damaged, worn and 'lived' components. The overhauling activities will

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include making all necessary checks and adjustments to ensure that components are correctly replaced, positioned, aligned, adjusted, torque loaded, locked and fastened, and that the correct sealants are used.

The learner's responsibilities will require them to comply with organisational policy and procedures for the overhaul of the power turbine, and to report any problems with the overhauling activities or with the tools and equipment used that they cannot personally resolve, or that are outside their permitted authority, to the relevant people.

The learner must ensure that all tools, equipment and materials used in the overhauling activities are removed from the work area on completion of the activities, and that all necessary job/task documentation is completed accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying appropriate overhauling techniques and procedures to power turbines. The learner will understand the dismantling and reassembly methods and procedures used, and their application. The learner will know how the power turbine functions, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the overhauling activities to the required specification. In addition, the learner will have sufficient knowledge of these components to ensure that they are fit for purpose and meet the specifications, thus providing a sound basis for carrying out the re-assembly.

The learner will understand the safety precautions required when carrying out the overhauling activities associated with power turbines, especially those for lifting, handling and supporting the equipment being removed and replaced. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary

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safeguards to protect themselves and others in the workplace.

<b>Learning outcome</b>
The learner will: 1. overhaul industrial power turbines by module replacement
<b>Assessment criteria</b>
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 overhaul of the power turbine: <ul style="list-style-type: none"><li>• obtain and use the appropriate dismantling documentation (such as job instructions, drawings, manuals)</li><li>• 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</li><li>• provide and maintain safe access and working arrangements for the work area</li><li>• ensure that any remaining oil, fluids and fuel have been drained/removed before breaking into the system</li><li>• ensure that the power turbine is suitably supported, and that appropriate lifting and handling equipment is available</li><li>• carry out the overhauling activities, following good practice/approved procedures</li><li>• ensure that components and surrounding structures are maintained free from damage and foreign objects</li><li>• return all tools and equipment to the correct location on completion of the activities</li><li>• leave the work area in a clean and safe condition on completion of the activities</li><li>• leave the power turbine in a condition ready for testing</li></ul> 1.3 follow the relevant overhauling schedules to carry out the required work 1.4 establish the components to be removed and, where appropriate, mark components to aid re-assembly 1.5 ensure that any stored energy or substances are released, safely and correctly 1.6 ensure that all removed components are correctly identified and stored in the correct location 1.7 dismantle a power turbine, to include removing four of the following sub-assemblies/modules: <ul style="list-style-type: none"><li>• outer casings</li><li>• front fan and fan case</li><li>• exhaust/reheat assembly</li><li>• compressor module</li><li>• combustor module</li><li>• air intake ducts</li><li>• turbine</li></ul>

- gear box
- 1.8 carry out the overhaul to the agreed level, using the correct tools and techniques
- 1.9 carry out all of the following activities on the power turbine being overhauled:
- carrying out pre-disassembly checks
  - removing turbine covers/casing
  - disconnecting and removing wires/cables, and attaching suitable cable identification markers
  - disconnecting and removing pipework
  - removing all ancillary components
  - dismantling equipment to unit/sub-assembly level
  - dismantling units to component level
  - removing and replacing components having interference fits (such as by expansion, contraction, pressure)
  - proof-marking/labelling of components to aid reassembly
  - checking components for wear and serviceability
  - replacing all 'lified' items (such as seals, bearings, gaskets)
  - applying gaskets and sealant/adhesives
  - replacing all damaged or defective sub-assemblies and components
  - re-assembling components to sub-assembly level
  - re-assembling sub-assemblies to unit level
  - setting and adjusting replaced components
  - refitting all ancillary components
  - reconnecting all pipework
  - refitting cable harnesses
  - refitting electrical units and connecting to cables
  - electrical bonding of components
  - tightening fastenings to the required torque
  - securing components using mechanical fasteners and threaded devices (such as nuts, bolts, circlips, pins)
  - applying bolt locking methods (such as split pins, wire locking, lock nuts, stiff nuts, swage nuts)
- 1.10 replace/refit a range of power turbine components and sub-assemblies, to include four of the following engine modules:
- front fan and fan case
  - compressor module
  - exhaust/reheat assembly
  - combustor module
  - turbine
  - gear box
  - air intake ducts
  - outer casings
- plus eight of the following types of component:
- curvic couplings
  - bearings

<ul style="list-style-type: none"> <li>• static seals/gaskets</li> <li>• dynamic seals</li> <li>• shims and packing</li> <li>• mechanical securing devices</li> <li>• locking devices</li> <li>• wire thread inserts</li> <li>• pipes and unions</li> <li>• mechanical controls (such as plungers, springs, rollers)</li> <li>• electrical units and controls (such as solenoids, motors, switches)</li> <li>• other specific components</li> </ul> <p>1.11 carry out checks and tests on the overhauled power turbine, to include all of the following:</p> <ul style="list-style-type: none"> <li>• visual inspection for completeness of all operations</li> <li>• visual inspection for freedom from damage or foreign objects</li> <li>• applying protection to openings to prevent entry of contaminating debris</li> <li>• carrying out any 'special-to-type' test rig checks</li> </ul> <p>1.12 overhaul a power turbine in compliance with one of the following:</p> <ul style="list-style-type: none"> <li>• BS, ISO or BSEN standards and procedures</li> <li>• customer standards and requirements</li> <li>• company standards and procedures</li> <li>• turbine manufacturer's requirements</li> </ul> <p>1.13 report any instances where the overhauling activities cannot be fully met, or where there are identified defects outside the planned overhauling schedule</p> <p>1.14 complete the relevant documentation, in accordance with organisational requirements</p> <p>1.15 complete paperwork which includes one of the following, and pass it to the appropriate people:</p> <ul style="list-style-type: none"> <li>• job cards</li> <li>• computer records</li> <li>• turbine overhaul logs or documents</li> <li>• work authorisation documents</li> <li>• company-specific documentation</li> </ul> <p>1.16 dispose of unwanted components, waste materials and substances, in accordance with safe working practices and approved procedures</p> <p>1.17 deal promptly and effectively with problems within their control and report those that cannot be solved.</p>
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<b>Learning outcome</b>
The learner will: 2. know how to overhaul industrial power turbines by module replacement
<b>Assessment criteria</b>
The learner can: 2.1 describe the specific safety practices and procedures that they



- need to observe when overhauling industrial power turbines (including any specific legislation, regulations/codes of practice for the activities, equipment or materials)
- 2.2 describe the health and safety requirements of the area in which the overhauling activity is to take place, and the responsibility these requirements place on them
  - 2.3 describe the hazards associated with overhauling power turbines (such as handling oils, greases, aviation fuel, stored pressure/force, use of power tools, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down overhauling procedures, lifting and moving large and heavy components), and how to minimise them and reduce any risks
  - 2.4 describe the importance of wearing protective clothing and other appropriate safety equipment during the overhauling activities
  - 2.5 explain how to obtain and interpret drawings, specifications, manufacturers' manuals, history/maintenance reports, and other documents needed in the overhauling process
  - 2.6 explain how to carry out currency/issue checks on the specifications they are working with
  - 2.7 describe the quality control procedures to be followed during the overhauling operations
  - 2.8 describe the procedure for obtaining replacement parts, materials and other consumables necessary for the overhaul
  - 2.9 describe the company policy on the repair/replacement of components during the overhauling process
  - 2.10 describe the terminology used in power turbines and turbine modules
  - 2.11 describe the basic principles of how the turbine functions, its operating sequence, the working purpose of individual units/components and how they interact
  - 2.12 describe the extent to which the equipment is to be dismantled for overhaul
  - 2.13 describe the sequence to be adopted for the dismantling/reassembling of various types of turbine assemblies
  - 2.14 describe the techniques used to dismantle the power turbine without damage to the components or surrounding structure (such as release of pressures/force, draining of fluids, making electrical disconnections, proof-marking components to aid reassembly, removing assemblies requiring pressure/force, removing mechanical locking and securing mechanisms/devices); and the need to protect the system integrity by ensuring that exposed components are correctly covered/protected
  - 2.15 explain how to lift and move large components and assemblies; the methods and equipment used to transport, handle and lift the components during the overhauling activities
  - 2.16 explain the need to ensure that lifting and handling equipment is within its current certification dates
  - 2.17 describe the methods of checking that components are fit for purpose, how to identify defects and wear characteristics, and the need to replace 'lifer' items (such as seals, bearings and gaskets)
  - 2.18 describe the uses of measuring equipment (such as micrometers, verniers, expansion indicators and other measuring devices)
  - 2.19 describe the methods of reassembling the power turbine, using new or previously overhauled modules (such as replacing assemblies requiring pressure/force, ensuring correct orientation

and alignment of modules, replacing mechanical locking and securing mechanisms/devices, reconnecting pipes and electrical connectors)

- 2.20 explain how to make adjustments to replaced components/assemblies to ensure that they function correctly (such as checking alignment, balancing of rotating components such as turbines, setting working clearance, setting travel, and pre-loading bearings)
- 2.21 describe the various mechanical fasteners that are used, and their method of removal and replacement (such as bolts, nuts, rivets, threaded fasteners, special securing devices)
- 2.22 describe the various types of electrical connector that are used, methods of unlocking, orientation indicators, and locating and locking in of the connections
- 2.23 describe the tools and equipment used in the overhauling activities, and how to check that they are in a safe and usable 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 all tools, equipment and components are accounted for and returned to their correct location on completion of the overhauling activities
- 2.26 describe the procedure for the safe disposal of waste materials
- 2.27 explain the need to complete overhaul documentation and/or reports following the overhauling activity
- 2.28 describe the problems that can occur during the overhauling activity, and how they can be overcome
- 2.29 describe the extent of their own authority and to whom they should report if they have a problem that they cannot resolve.

## Unit 397

# Overhauling industrial power turbine compressor assemblies

<b>UAN:</b>	R/600/5636
<b>Level:</b>	3
<b>Credit value:</b>	86
<b>GLH:</b>	210
<b>Relationship to NOS:</b>	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 108: Overhauling Industrial Power Turbine Compressor Assemblies (Level 3).
<b>Endorsement by a sector or other appropriate body:</b>	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out a complete overhaul of an industrial power turbine compressor assembly, in accordance with approved procedures. The compressor assembly to be overhauled will have been removed from the turbine assembly, and the overhauling activities may take place in a maintenance or manufacturer's workshop.</p>

In carrying out the overhauling operations, the learner will be required to follow laid-down procedures and to use specific dismantling and rebuilding techniques. The overhauling activities will involve removing all ancillary components and subassemblies, removing the compressor blades, stators, bearings and seals, and stripping the compressor housing of all its components. The learner will then be required to inspect the components for damage and wear, and to make decisions on which components can be re-used and which will need replacing.

The learner will then rebuild the compressor assembly, which will involve fitting replacement or overhauled sub-assembly units (such as compressor housing, stators, compressor blades) and the replacement of all damaged, worn and 'lified' components.

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The overhauling activities will include making all necessary checks and adjustments to ensure that components are correctly replaced, positioned, aligned, adjusted, torque loaded, locked and fastened, and that the correct sealants are used.

The learner's responsibilities will require them to comply with organisational policy and procedures for the overhauling of the power turbine compressor assembly, and to report any problems with the overhauling activities, or with the tools and equipment used that they cannot personally resolve or that are outside their permitted authority, to the relevant people. The learner must ensure that all tools, equipment and materials used in the overhauling activities are removed from the work area on completion of the activities, and that all necessary job/task documentation is completed accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying appropriate overhauling techniques and procedures to power turbine compressor assemblies. The learner will understand the dismantling and reassembly methods and procedures used, and their application. The learner will know how the compressor assembly functions, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the overhauling activities to the required specification. In addition, the learner will have sufficient knowledge of these components to ensure that they are fit for purpose and meet the specifications, thus providing a sound basis for carrying out the reassembly.

The learner will understand the safety precautions required when carrying out the overhauling activities associated with power turbine compressor assemblies, especially those for lifting, handling and supporting the equipment being removed and replaced. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves

<b>Learning outcome</b>
The learner will: 1. overhaul industrial power turbine compressor assemblies
<b>Assessment criteria</b>
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 overhaul of the power turbine compressor assembly: <ul style="list-style-type: none"><li>• obtain and use the appropriate documentation for the overhaul activities (such as job instructions, drawings, manuals)</li><li>• 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</li><li>• provide and maintain safe access and working arrangements for the work area</li><li>• ensure that the compressor assembly is suitably supported, and that appropriate lifting and handling equipment is available</li><li>• carry out the overhauling activities, following good practice/approved procedures</li><li>• ensure that components and surrounding structures are maintained free from damage and foreign objects</li><li>• return all tools and equipment to the correct location on completion of the activities</li><li>• leave the work area in a clean and safe condition on completion of the activities</li></ul> 1.3 follow the relevant overhauling schedules to carry out the required work 1.4 establish the components to be removed and, where appropriate, mark components to aid re-assembly 1.5 ensure that any stored energy or substances are released, safely and correctly 1.6 ensure that all removed components are correctly identified and stored in the correct location 1.7 dismantle the power turbine compressor assembly, to include removing all of the following: <ul style="list-style-type: none"><li>• compressor housing</li><li>• compressor stators</li><li>• compressor blades</li><li>• curvic couplings</li><li>• bearings</li><li>• sub-assemblies</li><li>• seals and gaskets</li><li>• shims and packing</li><li>• locking devices</li></ul>

- wire thread inserts
  - pipes and unions
- 1.8 carry out the overhaul to the agreed level, using the correct tools and techniques
- 1.9 carry out all of the following activities on the equipment being overhauled:
- cleaning parts prior to dismantling
  - pre-disassembly checks and tests
  - releasing stored energy (where applicable)
  - draining/removing any remaining fluids
  - dismantling equipment to unit/sub-assembly level
  - dismantling units to component level
  - removing and replacing components having interference fits (such as by expansion, contraction, pressure)
  - proof-marking/labelling of components to aid reassembly
  - checking components for wear and serviceability (such as visual, measurement, NDT, use of probes/scopes)
  - replacing all damaged or defective sub-assemblies and components
  - replacing all 'lived' items (such as seals, bearings, gaskets)
  - reassembling the compressor
  - balancing components (where applicable)
  - 'blue bedding' components
  - making mechanical connections
  - drilling, reaming and riveting (where appropriate)
  - setting and adjusting replaced components
  - tightening fastenings to the required torque
  - electrical bonding of components
  - applying correct lubrication during assembly
  - applying gaskets and sealant/adhesives
  - securing components using mechanical fasteners and threaded devices (such as nuts, bolts, circlips, pins)
  - applying locking and retaining devices (such as circlips, pins, wire locking, lock nuts, stiff nuts, swage nuts)
  - applying protection to openings to prevent entry of contaminating debris
- 1.10 replace/refit a range of compressor assembly components, to include ten of the following:
- compressor housing
  - compressor stators
  - compressor blades
  - curvic couplings
  - bearings
  - static seals/gaskets
  - dynamic seals
  - shims and packing
  - mechanical securing devices

<ul style="list-style-type: none"> <li>• locking devices</li> <li>• wire thread inserts</li> <li>• pipes and unions</li> <li>• mechanical controls (such as plungers, springs, rollers)</li> <li>• electrical controls (such as solenoids, motors, switches)</li> <li>• other specific components</li> </ul> <p>1.11 carry out checks and tests on the overhauled equipment, to include all of the following:</p> <ul style="list-style-type: none"> <li>• visual inspection for completeness of all operations</li> <li>• visual inspection for freedom from damage or foreign objects</li> <li>• applying protection to openings to prevent entry of contaminating debris</li> <li>• carrying out any 'special-to-type' test rig checks</li> </ul> <p>1.12 overhaul power turbine compressor assemblies in compliance with one of the following:</p> <ul style="list-style-type: none"> <li>• BS, ISO or BSEN standards and procedures</li> <li>• customer standards and requirements</li> <li>• company standards and procedures</li> <li>• turbine manufacturer's requirements</li> </ul> <p>1.13 report any instances where the overhauling activities cannot be fully met, or where there are identified defects outside the planned overhauling schedule</p> <p>1.14 complete the relevant documentation, in accordance with organisational requirements</p> <p>1.15 complete paperwork which includes one of the following, and pass it to the appropriate people:</p> <ul style="list-style-type: none"> <li>• job cards</li> <li>• computer records</li> <li>• turbine compressor assembly overhaul logs or reports</li> <li>• work authorisation documents</li> <li>• company-specific documentation</li> </ul> <p>1.16 dispose of unwanted components, waste materials and substances, in accordance with safe working practices and approved procedures</p> <p>1.17 deal promptly and effectively with problems within their control and report those that cannot be solved.</p>
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<b>Learning outcome</b>
The learner will: 2. know how to overhaul industrial power turbine compressor assemblies
<b>Assessment criteria</b>
The learner can: 2.1 describe the specific safety practices and procedures that they need to observe when overhauling industrial power turbine compressor assemblies (including any specific legislation, regulations/codes of practice for the activities, equipment or materials) 2.2 describe the health and safety requirements of the area in which

the overhauling activity is to take place, and the responsibility these requirements place on them

- 2.3 describe the hazards associated with overhauling power turbine compressor assemblies (such as handling oils, greases, stored pressure/force, use of power tools, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down overhauling procedures, lifting and moving large and heavy components), and how to minimise them to reduce any risk
- 2.4 describe the importance of wearing protective clothing and other appropriate safety equipment during the overhaul
- 2.5 explain how to obtain and interpret drawings, specifications, manufacturers' manuals, history/maintenance reports, and other documents needed in the overhauling process
- 2.6 explain how to carry out currency/issue checks on the specifications they are working with
- 2.7 describe the quality control procedures to be followed during the overhauling operations
- 2.8 describe the procedure for obtaining replacement parts, materials and other consumables necessary for the overhaul
- 2.9 describe the company policy on the repair/replacement of components during the overhauling process
- 2.10 describe the terminology used in power turbine compressor assemblies
- 2.11 describe the basic principles of how the compressor assembly functions, its operating sequence, the working purpose of individual units/components and how they interact
- 2.12 describe the extent to which the equipment is to be dismantled for overhaul
- 2.13 describe the sequence to be adopted for the dismantling/reassembling of the compressor assembly
- 2.14 describe the techniques used to dismantle the power turbine compressor assembly, without damage to the components or surrounding structure (such as release of energy/pressures/force; making mechanical disconnections; proof-marking components to aid reassembly; removing assemblies having interference fits (such as expansion, contraction, and the use of presses and extractors); removing mechanical locking and securing mechanisms/devices); and the need to protect the system integrity by ensuring that exposed components are correctly covered/protected
- 2.15 explain how to lift and move large components and assemblies; the methods and equipment used to transport, handle and lift the components during the overhauling activities
- 2.16 explain the need to ensure that lifting and handling equipment is within its current certification dates
- 2.17 describe the methods of checking that components are fit for purpose, how to identify defects and wear characteristics, and the need to replace 'lifer' items (such as seals, bearings and gaskets)
- 2.18 describe the uses of measuring equipment (such as micrometers, verniers, expansion indicators and other measuring devices)
- 2.19 describe the methods of reassembling the power turbine compressor assembly, using new or previously overhauled components (such as replacing assemblies requiring pressure/force, ensuring correct orientation, bedding in bearings and components, fitting o-ring seals, replacing mechanical locking and securing mechanisms/devices, torque setting components)



- 2.20 explain how to make adjustments to replaced components/assemblies to ensure that they function correctly (such as checking alignment, balancing of rotating components such as turbines, setting working clearance, setting travel, and pre-loading bearings)
- 2.21 describe the various mechanical fasteners that are used, and their method of removal and replacement (such as bolts, nuts, rivets, threaded fasteners, special securing devices)
- 2.22 describe the various types of electrical connectors that are used, methods of unlocking, orientation indicators, and locating and locking in of the connections
- 2.23 describe the tools and equipment used in the overhaul activities, and how to check that they are in a safe/usable 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 all tools, equipment and components are accounted for and returned to their correct location on completion of the overhauling activities
- 2.26 describe the procedure for the safe disposal of waste materials
- 2.27 explain the need to complete overhaul documentation and/or reports following the overhauling activity
- 2.28 describe the problems that can occur during the overhauling activity, and how they can be overcome
- 2.29 describe the extent of their own authority and to whom they should report if they have a problem that they cannot resolve.

## Unit 398

# Overhauling industrial power turbine combustion assemblies

<b>UAN:</b>	Y/600/5640
<b>Level:</b>	3
<b>Credit value:</b>	86
<b>GLH:</b>	210
<b>Relationship to NOS:</b>	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 109: Overhauling Industrial Power Turbine Combustion Assemblies (Level 3).
<b>Endorsement by a sector or other appropriate body:</b>	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out a complete overhaul of an industrial power turbine combustion assembly, in accordance with approved procedures. The combustion assembly to be overhauled will have been removed from the power turbine, and the overhauling activities will take place in a maintenance environment or manufacturer's workshop.</p>

In carrying out the overhauling operations, the learner will be required to follow laid-down procedures and use specific dismantling and rebuilding techniques. The overhauling activities will involve removing all ancillary components and subassemblies, removing the combustion cans/chambers, nozzle guide vanes, outer guide vanes, bearings and seals, and stripping the combustion housing of all its components. The learner will be required to inspect the components for damage and wear, and to make decisions on which components can be reused and which will need replacing.

The learner will then rebuild the combustion assembly, which will involve fitting replacement or overhauled sub-assembly units (such as combustion housing, combustion cans/chambers, nozzle guide

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vanes) and the replacement of all damaged, worn and 'lived' components. The overhauling activities will include making all necessary checks and adjustments to ensure that components are correctly replaced, positioned, aligned, adjusted, torque loaded, locked and fastened, and that the correct sealants are used.

The learner's responsibilities will require them to comply with organisational policy and procedures for the overhaul of the power turbine combustion assembly, and to report any problems with the overhauling activities, or with the tools and equipment used that they cannot personally resolve or that are outside their permitted authority, to the relevant people. The learner must ensure that all tools, equipment and materials used in the overhauling activities are removed from the work area on completion of the activities, and that all necessary job/task documentation is completed accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying appropriate overhauling techniques and procedures to power turbine combustion assemblies. The learner will understand the dismantling and reassembly methods and procedures used, and their application. The learner will know how the combustion assembly functions, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the overhauling activities to the required specification. In addition, the learner will have sufficient knowledge of these components to ensure that they are fit for purpose and meet the specifications, thus providing a sound basis for carrying out the reassembly.

The learner will understand the safety precautions required when carrying out the overhauling activities associated with power turbine combustion assemblies, especially those for lifting, handling and supporting the equipment being removed and replaced. The learner will be required to demonstrate safe working practices throughout, and will

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understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

<b>Learning outcome</b>
The learner will: 1. overhaul industrial power turbine combustion assemblies
<b>Assessment criteria</b>
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 overhaul of the power turbine combustion assembly: <ul style="list-style-type: none"><li>• obtain and use the appropriate documentation for the overhaul activities (such as job instructions, drawings, manuals)</li><li>• adhere to procedures or systems in place for risk assessment, COSHH, Personal Protective Equipment and other relevant safety regulations</li><li>• provide and maintain safe access and working arrangements for the work area</li><li>• ensure that the combustion assembly is suitably supported, and that appropriate lifting and handling equipment is available</li><li>• carry out the overhauling activities, following good practice/approved procedures</li><li>• ensure that components and surrounding structures are maintained free from damage and foreign objects</li><li>• return all tools and equipment to the correct location on completion of the activities</li><li>• leave the work area in a clean and safe condition on completion of the activities</li></ul> 1.3 follow the relevant overhauling schedules to carry out the required work 1.4 establish the components to be removed and, where appropriate, mark components to aid reassembly 1.5 ensure that any stored energy or substances are released, safely and correctly 1.6 dismantle the power turbine combustion assembly, to include removing all of the following: <ul style="list-style-type: none"><li>• combustion case</li><li>• combustion cans/chambers</li><li>• annular combustion chambers</li><li>• nozzle guide vanes</li><li>• outer guide vanes</li><li>• seals and gaskets</li><li>• shims and packing</li><li>• locking devices</li><li>• wire thread inserts</li><li>• pipes and unions</li></ul>

- 1.7 carry out the overhaul to the agreed level, using the correct tools and techniques
- 1.8 carry out all of the following activities on the equipment being overhauled:
- cleaning parts prior to dismantling
  - pre-disassembly checks and tests
  - releasing stored energy (where applicable)
  - draining/removing any remaining fluids
  - dismantling equipment to unit/sub-assembly level
  - dismantling units to component level
  - removing and replacing components having interference fits (such as by expansion, contraction, pressure)
  - proof-marking/labelling of components to aid reassembly
  - checking components for wear and serviceability (such as visual, measurement, NDT, use of probes/scopes)
  - replacing all damaged or defective sub-assemblies and components
  - replacing all 'lifer' items (such as seals, bearings, gaskets)
  - reassembling the combustion unit
  - 'blue bedding' components
  - drilling, reaming and riveting (where applicable)
  - making mechanical connections
  - setting and adjusting replaced components
  - tightening fastenings to the required torque
  - electrical bonding of components
  - applying correct lubrication during assembly
  - applying gaskets and sealant/adhesives
  - securing components using mechanical fasteners and threaded devices (such as nuts, bolts, circlips, pins)
  - applying locking and retaining devices (such as circlips, pins, wire locking, lock nuts, stiff nuts, swage nuts)
  - applying protection to openings to prevent entry of contaminating debris
- 1.9 replace/refit a range of combustion assembly components, to include ten of the following:
- combustion case
  - combustion cans/chambers
  - annular combustion chambers
  - nozzle guide vanes
  - outer guide vanes
  - locks and stops
  - static seals/gaskets
  - dynamic seals
  - shims and packing
  - locking devices
  - wire thread inserts
  - pipes and unions

<ul style="list-style-type: none"> <li>• mechanical controls (such as plungers, springs, rollers)</li> <li>• electrical controls (such as solenoids, motors, switches)</li> <li>• other specific components</li> </ul> <p>1.10 carry out checks and tests on the overhauled equipment, to include all of the following:</p> <ul style="list-style-type: none"> <li>• visual inspection for completeness of all operations</li> <li>• visual inspection for freedom from damage or foreign objects</li> <li>• applying protection to openings to prevent entry of contaminating debris</li> <li>• carrying out any 'special-to-type' test rig checks</li> </ul> <p>1.11 overhaul industrial power turbine combustion assemblies, in compliance with one of the following:</p> <ul style="list-style-type: none"> <li>• BS, ISO or BSEN standards and procedures</li> <li>• customer standards and requirements</li> <li>• company standards and procedures</li> <li>• turbine manufacturer's requirements</li> </ul> <p>1.12 ensure that all removed components are correctly identified and stored in the correct location</p> <p>1.13 report any instances where the overhauling activities cannot be fully met, or where there are identified defects outside the planned overhauling schedule</p> <p>1.14 complete the relevant documentation, in accordance with organisational requirements</p> <p>1.15 complete paperwork which includes one of the following, and pass it to the appropriate people:</p> <ul style="list-style-type: none"> <li>• job cards</li> <li>• computer records</li> <li>• turbine combustion assembly overhaul logs or documents</li> <li>• work authorisation documents</li> <li>• company-specific documentation</li> </ul> <p>1.16 dispose of unwanted components, waste materials and substances, in accordance with safe working practices and approved procedures</p> <p>1.17 deal promptly and effectively with problems within their control and report those that cannot be solved.</p>
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<b>Learning outcome</b>
The learner will: 2. know how to overhaul industrial power turbine combustion assemblies
<b>Assessment criteria</b>
The learner can: 2.1 describe the specific safety practices and procedures that they need to observe when overhauling power turbine combustion assemblies (including any specific legislation, regulations/codes of practice for the activities, equipment or materials) 2.2 describe the health and safety requirements of the area in which the overhauling activity is to take place, and the responsibility these requirements place on them 2.3 describe the hazards associated with overhauling power turbine

- combustion assemblies (such as handling oils, greases, stored pressure/force, use of power tools, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down overhauling procedures, lifting and moving large and heavy components), and how to minimise them and reduce any risks
- 2.4 describe the importance of wearing protective clothing and other appropriate safety equipment during the overhaul
  - 2.5 explain how to obtain and interpret drawings, specifications, manufacturers' manuals, history/maintenance reports, and other documents needed in the overhauling process
  - 2.6 explain how to carry out currency/issue checks on the specifications they are working with
  - 2.7 describe the quality control procedures to be followed during the overhauling operations
  - 2.8 describe the procedure for obtaining replacement parts, materials and other consumables necessary for the overhaul
  - 2.9 describe the company policy on the repair/replacement of components during the overhauling process
  - 2.10 describe the terminology used in power turbine combustion assemblies
  - 2.11 describe the basic principles of how the combustion assembly functions, its operating sequence, the working purpose of individual units/components and how they interact
  - 2.12 describe the extent to which the equipment is to be dismantled for overhaul
  - 2.13 describe the sequence to be adopted for the dismantling/reassembling of the combustion assembly
  - 2.14 describe the techniques used to dismantle the power turbine combustion assembly, without damage to the components or surrounding structure (such as release of energy/pressures/force; making mechanical disconnections; proof-marking components to aid reassembly; removing assemblies having interference fits (such as expansion, contraction, and the use of presses and extractors); removing mechanical locking and securing mechanisms/devices); and the need to protect the system integrity by ensuring that exposed components are correctly covered/protected
  - 2.15 explain how to lift and move large components and assemblies; the methods and equipment used to transport, handle and lift the components during the overhauling activities
  - 2.16 explain the need to ensure that lifting and handling equipment is within its current certification dates
  - 2.17 describe the methods of checking that components are fit for purpose, how to identify defects and wear characteristics, and the need to replace 'lifer' items (such as seals, bearings and gaskets)
  - 2.18 describe the uses of measuring equipment (such as micrometers, verniers, expansion indicators and other measuring devices)
  - 2.19 describe the methods of reassembling the power turbine combustion assembly, using new or previously overhauled components (such as replacing assemblies requiring pressure/force, ensuring correct orientation, bedding in bearings and components, fitting seals and o-rings, replacing mechanical locking and securing mechanisms/devices, torque setting components)
  - 2.20 explain how to make adjustments to replaced components/assemblies to ensure that they function correctly

(such as checking alignment, balancing of rotating components such as turbines, setting working clearance, setting travel, and pre-loading bearings)

- 2.21 describe the various mechanical fasteners that are used and their method of removal and replacement (including bolts, nuts, rivets, threaded fasteners, special securing devices)
- 2.22 describe the various types of electrical connectors that are used, methods of unlocking, orientation indicators, and locating and locking in of the connections
- 2.23 describe the tools and equipment used in the overhauling activities, and how to check that they are in a safe/usable 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 all tools, equipment and components are accounted for and returned to their correct location on completion of the overhauling activities
- 2.26 describe the procedure for the safe disposal of waste materials
- 2.27 explain the need to complete overhaul documentation and/or reports following the overhauling activity
- 2.28 describe the problems that can occur during the overhauling activity, and how they can be overcome
- 2.29 describe the extent of their own authority and to whom they should report if they have a problem that they cannot resolve.



## Unit 399

# Overhauling turbine assemblies from industrial power turbines

<b>UAN:</b>	A/600/5646
<b>Level:</b>	3
<b>Credit value:</b>	86
<b>GLH:</b>	210
<b>Relationship to NOS:</b>	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 110: Overhauling Turbine Assemblies from Industrial Power Turbines (Level 3).
<b>Endorsement by a sector or other appropriate body:</b>	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out a complete overhaul of the turbine assembly from an industrial power turbine, in accordance with approved procedures. The turbine assembly to be overhauled will have been removed from the power turbine, and the overhauling activities will take place in a maintenance environment or manufacturer's workshop.</p>

In carrying out the overhauling operations, the learner will be required to follow laid-down procedures and use specific dismantling and rebuilding techniques. The overhauling activities will involve removing all ancillary components and subassemblies, removing the low, intermediate and high pressure turbines, turbine shafts, discs, bearings and seals, and stripping the turbine housing of all its components. The learner will be required to inspect the components for damage and wear, and to make decisions on which components can be reused and which will need replacing.

The learner will then rebuild the turbine assembly, which will involve fitting replacement or overhauled sub-assembly units (such as turbine housing, low, intermediate and high pressure turbines,

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turbine shafts, bearings and seals), and the replacement of all damaged, worn and 'lifer' components. The overhauling activities will include making all necessary checks and adjustments to ensure that components are correctly replaced, positioned, aligned, adjusted, torque loaded, locked and fastened, and that the correct sealants are used.

The learner's responsibilities will require them to comply with organisational policy and procedures for the overhaul of the turbine assembly, and to report any problems with the overhauling activities, or with the tools and equipment used that they cannot personally resolve or that are outside their permitted authority, to the relevant people. The learner must ensure that all tools, equipment and materials used in the overhauling activities are removed from the work area on completion of the activities, and that all necessary job/task documentation is completed accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying appropriate overhauling techniques and procedures to the turbine assemblies. The learner will understand the dismantling and reassembly methods and procedures used, and their application. The learner will know how the turbine assembly functions, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the overhauling activities to the required specification. In addition, the learner will have sufficient knowledge of these components to ensure that they are fit for purpose and meet the specifications, thus providing a sound basis for carrying out the reassembly.

The learner will understand the safety precautions required when carrying out the overhauling activities associated with turbine assemblies from industrial power turbines, especially those for lifting, handling and supporting the equipment being removed and replaced. The learner will be

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required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

<b>Learning outcome</b>
The learner will: 1. overhaul turbine assemblies from industrial power turbines
<b>Assessment criteria</b>
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 overhaul of the turbine assembly: <ul style="list-style-type: none"><li>• obtain and use the appropriate documentation for the overhaul activities (such as job instructions, drawings, manuals)</li><li>• 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</li><li>• provide and maintain safe access and working arrangements for the work area</li><li>• ensure that the turbine assembly is suitably supported, and that appropriate lifting and handling equipment is available</li><li>• carry out the overhauling activities, following good practice/approved procedures</li><li>• ensure that components and surrounding structures are maintained free from damage and foreign objects</li><li>• return all tools and equipment to the correct location on completion of the activities</li><li>• leave the work area in a clean and safe condition on completion of the activities</li></ul> 1.3 follow the relevant overhauling schedules to carry out the required work 1.4 establish the components to be removed and, where appropriate, mark components to aid re-assembly 1.5 ensure that any stored energy or substances are released safely and correctly 1.6 dismantle the turbine assembly, to include removing all of the following: <ul style="list-style-type: none"><li>• low pressure turbine</li><li>• intermediate pressure turbine</li><li>• high pressure turbine</li><li>• turbine shafts</li><li>• turbine discs</li><li>• turbine blades</li><li>• bearing races</li><li>• bearings</li></ul>

- seals and gaskets
  - shims and packing
  - wire thread inserts
  - locking devices
  - pipes and unions
- 1.7 carry out the overhaul to the agreed level, using the correct tools and techniques
- 1.8 carry out all of the following activities on the equipment being overhauled:
- cleaning parts prior to dismantling
  - pre-disassembly checks and tests
  - releasing stored energy (where applicable)
  - draining/removing any remaining fluids
  - dismantling equipment to unit/sub-assembly level
  - dismantling units to component level
  - removing and replacing components having interference fits (such as by expansion, contraction, pressure)
  - proof-marking/labelling of components to aid reassembly
  - checking components for wear and serviceability (such as visual, measurement, NDT, use of probes/scopes)
  - replacing all damaged or defective sub-assemblies and components
  - replacing all 'lived' items (such as seals, bearings, gaskets)
  - reassembling the turbine unit
  - balancing components (where applicable)
  - 'blue bedding' components (where applicable)
  - drilling, reaming and riveting (where applicable)
  - making mechanical connections
  - setting and adjusting replaced components
  - tightening fastenings to the required torque
  - electrical bonding of components
  - applying correct lubrication during assembly
  - applying gaskets and sealant/adhesives
  - securing components using mechanical fasteners and threaded devices (such as nuts, bolts, circlips, pins)
  - applying locking and retaining devices (such as circlips, pins, wire locking, lock nuts, stiff nuts, swage nuts)
  - applying protection to openings to prevent entry of contaminating debris
- 1.9 replace/refit a range of turbine assembly components, to include ten of the following:
- low pressure turbine
  - intermediate pressure turbine
  - high pressure turbine
  - turbine shafts
  - turbine discs
  - turbine blades

<ul style="list-style-type: none"> <li>• bearing races</li> <li>• bearings locks and stops</li> <li>• static seals/gaskets</li> <li>• dynamic seals</li> <li>• shims and packing</li> <li>• locking devices</li> <li>• wire thread inserts</li> <li>• pipes and unions</li> <li>• mechanical controls (such as plungers, springs, rollers)</li> <li>• electrical controls (such as solenoids, motors, switches)</li> <li>• other specific components</li> </ul> <p>1.10 carry out checks and tests on the overhauled equipment, to include all of the following:</p> <ul style="list-style-type: none"> <li>• visual inspection for completeness of all operations</li> <li>• visual inspection for freedom from damage or foreign objects</li> <li>• applying protection to openings to prevent entry of contaminating debris</li> <li>• carrying out any 'special-to-type' test rig checks</li> </ul> <p>1.11 overhaul turbine assemblies in compliance with one of the following:</p> <ul style="list-style-type: none"> <li>• BS, ISO or BSEN standards and procedures</li> <li>• customer standards and requirements</li> <li>• company standards and procedures</li> <li>• turbine manufacturer's requirements</li> </ul> <p>1.12 ensure that all removed components are correctly identified and stored in the correct location</p> <p>1.13 report any instances where the overhauling activities cannot be fully met, or where there are identified defects outside the planned overhauling schedule</p> <p>1.14 complete the relevant documentation, in accordance with organisational requirements</p> <p>1.15 complete paperwork which includes one of the following, and pass it to the appropriate people:</p> <ul style="list-style-type: none"> <li>• job cards</li> <li>• computer records</li> <li>• turbine assembly overhaul logs or documents</li> <li>• work authorisation documents</li> <li>• company-specific documentation</li> </ul> <p>1.16 dispose of unwanted components, waste materials and substances, in accordance with safe working practices and approved procedures</p> <p>1.17 deal promptly and effectively with problems within their control and report those that cannot be solved.</p>
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<p><b>Learning outcome</b></p> <p>The learner will:</p> <p>2. know how to overhaul turbine assemblies from industrial power turbines</p>
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## Assessment criteria

The learner can:

- 2.1 describe the specific safety practices and procedures that they need to observe when overhauling turbine assemblies from industrial power turbines (including any specific legislation, regulations/codes of practice for the activities, equipment or materials)
- 2.2 describe the health and safety requirements of the area in which the overhauling activity is to take place, and the responsibility these requirements place on them
- 2.3 describe the hazards associated with overhauling power turbine, turbine assemblies (such as handling oils, greases, stored energy/pressure/force; use of power tools, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down overhauling procedures, lifting and moving large and heavy components), and how to minimise them and reduce any risks
- 2.4 describe the importance of wearing protective clothing and other appropriate safety equipment during the overhaul
- 2.5 explain how to obtain and interpret drawings, specifications, manufacturers' manuals, history/maintenance reports, and other documents needed in the overhauling process
- 2.6 explain how to carry out currency/issue checks on the specifications they are working with
- 2.7 describe the quality control procedures to be followed during the overhauling operations
- 2.8 describe the procedure for obtaining replacement parts, materials and other consumables necessary for the overhaul
- 2.9 describe the company policy on the repair/replacement of components during the overhauling process
- 2.10 describe the terminology used in power turbine assemblies
- 2.11 describe the basic principles of how the turbine assembly functions, its operating sequence, the working purpose of individual units/components and how they interact
- 2.12 describe the extent to which the equipment is to be dismantled for overhaul
- 2.13 describe the sequence to be adopted for the dismantling/reassembling of the turbine assembly
- 2.14 describe the techniques used to dismantle the turbine assembly, without damage to the components or surrounding structure (such as release of energy/pressures/force; making mechanical disconnections; proof-marking components to aid reassembly; removing assemblies having interference fits (such as expansion, contraction, and the use of presses and extractors); removing mechanical locking and securing mechanisms/devices); and the need to protect the system integrity by ensuring that exposed components are correctly covered/protected
- 2.15 explain how to lift and move large components and assemblies; the methods and equipment used to transport, handle and lift the components during the overhauling activities
- 2.16 explain the need to ensure that lifting and handling equipment is within its current certification dates
- 2.17 describe the methods of checking that components are fit for purpose, how to identify defects and wear characteristics, and the

- need to replace 'lifer' items (such as seals and gaskets)
- 2.18 describe the uses of measuring equipment (such as micrometers, verniers, expansion indicators and other measuring devices)
  - 2.19 describe the methods of reassembling the turbine assembly, using new or previously overhauled components (such as replacing assemblies requiring pressure/force, ensuring correct orientation, bedding in bearings and components, replacing mechanical locking and securing mechanisms/devices, torque setting components)
  - 2.20 explain how to make adjustments to replaced components/assemblies to ensure that they function correctly (such as checking alignment, balancing of rotating components such as turbines, setting working clearance, setting travel, and pre-loading bearings)
  - 2.21 describe the various mechanical fasteners that are used, and their method of removal and replacement (including bolts, nuts, rivets, threaded fasteners, special securing devices)
  - 2.22 describe the various types of electrical connectors that are used, methods of unlocking, orientation indicators, and locating and locking in of the connections
  - 2.23 describe the tools and equipment used in the overhauling activities, and how to check that they are in a safe/usable 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 all tools, equipment and components are accounted for and returned to their correct location on completion of the overhauling activities
  - 2.26 describe the procedure for the safe disposal of waste materials
  - 2.27 explain the need to complete overhaul documentation and/or reports following the overhauling activity
  - 2.28 describe the problems that can occur during the overhauling activity, and how they can be overcome
  - 2.29 describe the extent of their own authority and to whom they should report if they have a problem that they cannot resolve.

<b>UAN:</b>	F/600/5650
<b>Level:</b>	3
<b>Credit value:</b>	86
<b>GLH:</b>	210
<b>Relationship to NOS:</b>	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 111: Overhauling Piston Engines (Level 3).
<b>Endorsement by a sector or other appropriate body:</b>	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
<b>Aim:</b>	This unit covers the skills and knowledge needed to prove the competences required to carry out a complete overhaul of piston engines, such as naturally or mechanically aspirated two-stroke and four-stroke internal combustion engines or compression ignition engines, in accordance with approved procedures. The piston engine to be overhauled will have been removed from its operating environment, and the overhauling activities will take place in a maintenance environment or manufacturer's workshop.

In carrying out the overhauling operations, the learner will be required to follow laid-down procedures and to use specific dismantling and rebuilding techniques. The activities will involve removing all ancillary equipment and components, and dismantling the engine down to the various sub-assembly units such as cylinder block, cylinder heads and pistons. The learner will then strip the various subassemblies down to their component parts and examine the various components for damage and wear, making decisions on which components can be reused and which will need replacing.

The learner will then be expected to rebuild the engine, which will involve fitting replacement or overhauled sub-assembly units (such as cylinder block, piston assemblies, cylinder heads, torque converters, oil pumps) and the replacement of all damaged, worn and 'lified' components.



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The overhaul activities will include making all necessary checks and adjustments to ensure that components are correctly replaced, positioned, aligned, adjusted, torque loaded, locked and fastened, and that the correct sealants are used.

The learner's responsibilities will require them to comply with organisational policy and procedures for the overhaul of the piston engine, and to report any problems with the overhauling activities, or with the tools and equipment used that they cannot personally resolve or that are outside their permitted authority, to the relevant people. The learner must ensure that all tools, equipment and materials used in the overhauling activities are removed from the work area on completion of the activities, and that all necessary job/task documentation is completed accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying appropriate overhauling techniques and procedures to piston engine assemblies. The learner will understand the dismantling and reassembly methods and procedures used, and their application. The learner will know how the piston engine assembly functions, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the overhauling activities to the required specification. In addition, the learner will have sufficient knowledge of these components to ensure that they are fit for purpose and meet the specifications, thus providing a sound basis for carrying out the reassembly to the required specification.

The learner will understand the safety precautions required when carrying out the overhauling activities associated with piston engine assemblies, especially those for lifting, handling and supporting the equipment being removed and replaced. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves

<b>Learning outcome</b>
The learner will: 1. overhaul piston engines
<b>Assessment criteria</b>
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 overhaul of the piston engine: <ul style="list-style-type: none"><li>• obtain and use the appropriate documentation for the overhauling activities (such as job instructions, drawings, manuals)</li><li>• 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</li><li>• provide and maintain safe access and working arrangements for the work area</li><li>• ensure all oils, fluids and fuel have been drained/removed before breaking into the system (where applicable)</li><li>• ensure that the engine assembly is suitably supported, and that appropriate lifting and handling equipment is available</li><li>• carry out the overhauling activities, following good practice/approved procedures</li><li>• ensure that components and surrounding structures are maintained free from damage and foreign objects</li><li>• return all tools and equipment to the correct location on completion of the activities</li><li>• leave the work area in a clean and safe condition on completion of the activities</li><li>• leave the engine in a condition ready for testing</li></ul> 1.3 follow the relevant overhauling schedules to carry out the required work 1.4 establish the components to be removed and, where appropriate, mark components to aid re-assembly 1.5 ensure that any stored energy or substances are released safely and correctly 1.6 carry out the overhaul to the agreed level, using the correct tools and techniques 1.7 carry out the overhaul of one of the following types of piston engine: <ul style="list-style-type: none"><li>• two-stroke internal combustion engine</li><li>• four-stroke internal combustion engine</li><li>• compression ignition engine</li></ul> 1.8 carry out all of the following activities on the engine being overhauled: <ul style="list-style-type: none"><li>• carrying out pre-disassembly checks</li><li>• disconnecting and removing wires/cables and attaching</li></ul>

suitable cable identification markers

- disconnecting and removing pipework
- removing all ancillary components
- dismantling equipment to unit/sub-assembly level
- dismantling units to component level
- proof-marking/labelling of components to aid reassembly
- replacing all 'lified' items (such as seals, bearings, locknuts)
- replacing all damaged or defective components
- re-assembling sub-assemblies to unit level
- re-assembling components to sub-assembly level
- lapping in of components (such as valves, bearings) where appropriate
- setting and adjusting replaced components (such as liner protrusion, crankshaft float)
- supporting the equipment to be removed
- applying gaskets and sealant/adhesives
- applying correct lubrication during assembly
- tightening fastenings to the required torque
- securing components using mechanical fasteners and threaded devices (such as nuts, bolts, circlips, pins)
- applying bolt locking methods (such as split pins, wire locking, lock nuts, stiff nuts, swage nuts)

1.9 rebuild piston engines, to include fitting seventeen of the following:

- cylinder block
- gearbox (where applicable)
- cylinder liners
- cylinder heads
- crank shafts
- fly wheel
- torque converters
- clutch assembly
- pistons and rings
- connecting rods
- camshaft assemblies
- timing mechanisms
- injector mechanisms
- seals and gaskets
- pulleys and sprockets
- belt, chains and gears
- levers and linkages
- balancing mechanisms
- sensing devices
- shims
- inlet manifolds
- exhaust manifolds
- pipe fittings/connectors

- filters
  - spark plugs/heaters
  - bearings (such as shell, ball and race, thrust)
  - pumps (such as pressure, scavenge, fuel, oil, water)
  - charging/starting components (such as alternators, starter motors, solenoids, magnetos)
  - valve mechanisms (such as valves, guides, springs, collets)
  - mechanical fasteners and mounting studs
- 1.10 carry out checks and tests during the rebuilding of the engine, to include eight of the following:
- orientation
  - alignment
  - freedom of movement
  - end float (such as crankshaft, camshaft, bearing)
  - gear backlash
  - cylinder liner protrusion
  - checking for system blockages (such as oil and airways)
  - timing (such as valve, ignition, fuel injection)
  - operating/working clearance (such as valve)
  - belt/chain tension
  - torque loading of bolts
  - visual inspection for completeness and freedom from damage or foreign objects
- 1.11 overhaul piston engines in compliance with one of the following:
- BS, ISO or BSEN standards and procedures
  - customer standards and requirements
  - company standards and procedures
  - engine manufacturer's requirements
- 1.12 ensure that all removed components are correctly identified and stored in the correct location
- 1.13 report any instances where the overhauling activities cannot be fully met, or where there are identified
- 1.14 defects outside the planned overhauling schedule
- 1.15 complete the relevant documentation, in accordance with organisational requirements
- 1.16 complete paperwork which includes one of the following, and pass it to the appropriate people:
- job cards
  - computer records
  - piston engine assembly overhaul logs or documents
  - work authorisation documents
  - company-specific documentation
- 1.17 dispose of unwanted components, waste materials and substances, in accordance with safe working practices and approved procedures
- 1.18 deal promptly and effectively with problems within their control and report those that cannot be solved.

<b>Learning outcome</b>
The learner will: 2. know how to overhaul piston engines
<b>Assessment criteria</b>
The learner can: 2.1 describe the specific safety practices and procedures that they need to observe when overhauling piston engines (including any specific legislation, regulations/codes of practice for the activities, equipment or materials) 2.2 describe the health and safety requirements of the area in which the overhaul activity is to take place, and the responsibility these requirements place on them 2.3 describe the hazards associated with overhauling piston engines (such as handling oils, greases, fuel, stored pressure/force, use of power tools, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down overhauling procedures, lifting and moving large and heavy components), and how to minimise them and reduce any risks 2.4 describe the importance of wearing protective clothing and other appropriate safety equipment during the overhaul 2.5 explain how to obtain and interpret drawings, specifications, manufacturers' manuals, history/maintenance reports, and other documents needed in the overhaul process 2.6 explain how to carry out currency/issue checks on the specifications they are working with 2.7 describe the quality control procedures to be followed during the overhauling operations 2.8 describe the importance for obtaining the correct specification replacement parts, materials and other consumables necessary for the overhaul 2.9 describe the company policy on the repair/replacement of components during the overhauling process 2.10 describe the terminology used in piston engines and engine modules 2.11 describe the basic principles of how the engine functions, its operating sequence, the working purpose of individual units/components and how they interact 2.12 describe the extent to which the equipment is to be dismantled 2.13 describe the sequence to be adopted for the dismantling/reassembling of various types of engine assembly 2.14 describe the techniques used to dismantle the piston engines without damage to the components or surrounding structure (such as release of energy (pressure/force), draining of fluids, making electrical disconnections, proof-marking components to aid reassembly, removing assemblies requiring pressure/force, removing mechanical locking and securing mechanisms/devices); and the need to protect the system integrity by ensuring that exposed components are correctly covered/protected 2.15 explain how to lift and move large components and assemblies; the methods and equipment used to transport, handle and lift the components during the overhauling activities 2.16 explain the need to ensure that lifting and handling equipment is within its current certification dates 2.17 describe the methods of checking that components are fit for

- purpose, how to identify defects and wear characteristics, and the need to replace 'lived' items (such as seals and gaskets)
- 2.18 describe the uses of measuring equipment (such as micrometers, verniers, expansion indicators and other measuring devices)
  - 2.19 describe the methods of reassembling the piston engine using new or previously overhauled subassemblies (such as replacing assemblies requiring pressure/force, ensuring the correct orientation and location of subassemblies, replacing mechanical locking and securing mechanisms/devices, reconnecting pipes and electrical connectors)
  - 2.20 explain how to make adjustments to replaced components/assemblies to ensure that they function correctly (such as checking alignment, balancing of rotating components such as flywheels and torque converters, setting working clearance, setting travel, and pre-loading bearings)
  - 2.21 describe the various mechanical fasteners that are used, and their method of removal and replacement (including bolts, nuts, rivets, threaded fasteners, special securing devices)
  - 2.22 describe the various types of electrical connectors that are used, methods of unlocking, orientation indicators and locating and locking in of the connections
  - 2.23 describe the tools and equipment used in the overhauling activities, and how to check that they are in a safe and usable 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 all tools, equipment and components are accounted for and returned to their correct location on completion of the overhauling activities
  - 2.26 describe the procedure for the safe disposal of waste materials
  - 2.27 explain the need to complete overhauling documentation and/or reports following the overhauling activity
  - 2.28 describe the problems that can occur during the stripping and rebuilding activity, and how they can be overcome
  - 2.29 describe the extent of their own authority and to whom they should report if they have a problem that they cannot resolve.

## Unit 401

## Overhauling gearbox assemblies

<b>UAN:</b>	Y/600/5654
<b>Level:</b>	3
<b>Credit value:</b>	86
<b>GLH:</b>	210
<b>Relationship to NOS:</b>	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 112: Overhauling Gearbox Assemblies (Level 3).
<b>Endorsement by a sector or other appropriate body:</b>	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out a complete overhaul of gearbox assemblies, in accordance with approved procedures. The gearbox assembly to be overhauled will have been removed from its operating environment, and the overhauling activities will take place in a maintenance environment or manufacturer's workshop.</p> <p>In carrying out the overhauling operations, the learner will be required to follow laid-down procedures and to use specific dismantling and rebuilding techniques. The overhauling activities will involve removing all ancillary components and sub-assemblies (such as torque converters or starter units), removing the gearbox drive shafts, lay shafts and gear train assemblies, removing bearings and seals, and stripping the gearbox housing of all its components. The learner will be required to inspect the components for damage and wear, and to make decisions on which components can be reused and which will need replacing.</p> <p>The learner will then rebuild the gearbox assembly, which will involve fitting replacement or overhauled sub-assembly units (such as gearbox housing, gearbox shafts, gear train assemblies, bearings and seals) and the replacement of all damaged, worn and 'lived' components. The overhauling activities will include making all</p>

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necessary checks and adjustments to ensure that components are correctly replaced, positioned, aligned, adjusted, torque loaded, locked and fastened, the correct sealants are used and, where appropriate, the gear box is refilled with the correct grade of oil.

The learner's responsibilities will require them to comply with organisational policy and procedures for the overhaul of the gearbox assembly, and to report any problems with the overhauling activities, or with the tools and equipment used that they cannot personally resolve or that are outside their permitted authority, to the relevant people. The learner must ensure that all tools, equipment and materials used in the overhauling activities are removed from the work area on completion of the activities, and that all necessary job/task documentation is completed accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying appropriate overhauling techniques and procedures to gearbox assemblies. The learner will understand the dismantling and reassembly methods and procedures used, and their application. The learner will know how the gearbox assembly functions, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the overhauling activities to the required specification. In addition, the learner will have sufficient knowledge of these components to ensure that they are fit for purpose and meet the specifications, thus providing a sound basis for carrying out the reassembly.

The learner will understand the safety precautions required when carrying out the overhauling activities associated with gearbox assemblies, especially those for lifting, handling and supporting the equipment being removed and replaced. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves



<b>Learning outcome</b>
The learner will: 1. overhaul gearbox assemblies
<b>Assessment criteria</b>
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 overhaul of the gearbox assembly: <ul style="list-style-type: none"><li>• obtain and use the appropriate documentation for the overhauling activities (such as job instructions, drawings, manuals)</li><li>• 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</li><li>• provide and maintain safe access and working arrangements for the work area</li><li>• ensure that the gearbox unit is suitably supported, and that appropriate lifting and handling equipment is available</li><li>• carry out the overhauling activities, following good practice/approved procedures</li><li>• ensure that components and surrounding structures are maintained free from damage and foreign objects</li><li>• return all tools and equipment to the correct location on completion of the activities</li><li>• leave the work area in a clean and safe condition on completion of the activities</li></ul> 1.3 follow the relevant overhauling schedules to carry out the required work 1.4 establish the components to be removed and, where appropriate, mark components to aid re-assembly 1.5 ensure that any stored energy or substances are released safely and correctly 1.6 carry out the overhaul to the agreed level, using the correct tools and techniques 1.7 overhaul two of the following types of gearbox: <ul style="list-style-type: none"><li>• crash mesh/sliding mesh</li><li>• variable speed</li><li>• constant mesh</li><li>• speed reduction/increase</li><li>• synchromesh</li><li>• differential</li><li>• planetary</li><li>• compound</li></ul> 1.8 overhaul gearboxes operating on two of the following types of gear drive: <ul style="list-style-type: none"><li>• spur gear</li></ul>

- helical gear
  - crossed helical
  - rack and pinion
  - worm and worm wheel
  - bevel
  - spiroid (spiral bevel)
  - hypoid
  - harmonic drive
  - combined drive (such as bevel and helical)
  - other specific type
- 1.9 carry out all of the following activities on the equipment being overhauled:
- cleaning parts prior to dismantling
  - pre-disassembly checks and tests
  - releasing stored energy (where applicable)
  - draining/removing any remaining fluids
  - dismantling equipment to unit/sub-assembly level
  - dismantling units to component level
  - removing and replacing components having interference fits (such as by expansion, contraction, pressure)
  - proof-marking/labelling of components to aid reassembly
  - checking components for wear and serviceability (such as visual, measurement, use of probes/scopes)
  - replacing all damaged or defective sub-assemblies and components
  - replacing all 'lifer' items (such as seals, bearings, gaskets)
  - reassembling the gearbox unit
  - balancing components (where applicable)
  - 'blue bedding' components (where applicable)
  - making mechanical connections
  - setting and adjusting replaced components
  - tightening fastenings to the required torque
  - applying gaskets and sealant/adhesives
  - applying correct lubrication during assembly
  - securing components using mechanical fasteners and threaded devices (such as nuts, bolts, circlips, pins)
  - applying locking and retaining devices (such as circlips, pins, wire locking, lock nuts, stiff nuts, swage nuts)
  - applying protection to openings to prevent entry of contaminating debris
- 1.10 replace/refit a range of gearbox assembly components, to include eight of the following:
- gear housings
  - bearings
  - drive shafts
  - lay shafts
  - locks and stops

- gears/gear/trains/gear sub-assemblies
  - static seals/gaskets
  - dynamic seals
  - sensors (such as oil level, temperature)
  - oil filters
  - level indicators
  - oil pumps
  - shims and packing
  - levers and linkages
  - selector mechanisms
  - locking devices
  - wire thread inserts
  - pipes and unions
  - mechanical controls (such as plungers, springs, rollers)
  - electrical controls (such as solenoids, motors, switches)
  - other specific components
- 1.11 carry out checks and tests on the overhauled gear box, to include all of the following:
- visual inspection for completeness of all operations
  - visual inspection for freedom from damage or foreign objects
  - applying protection to openings to prevent entry of contaminating debris
  - carrying out any 'special-to-type' checks (such as bearing end float, gear backlash)
- 1.12 overhaul gearbox assemblies, in compliance with one of the following:
- BS, ISO or BSEN standards and procedures
  - customer standards and requirements
  - company standards and procedures
  - gearbox manufacturer's requirements
- 1.13 ensure that all removed components are correctly identified and stored in the correct location
- 1.14 report any instances where the overhauling activities cannot be fully met, or where there are identified defects outside the planned overhauling schedule
- 1.15 complete the relevant documentation, in accordance with organisational requirements
- 1.16 complete paperwork which includes one of the following, and pass it to the appropriate people:
- job cards
  - computer records
  - gearbox assembly overhaul logs or documents
  - work authorisation documents
- 1.17 dispose of unwanted components, waste materials and substances, in accordance with safe working practices and approved procedures
- 1.18 deal promptly and effectively with problems within their control and report those that cannot be solved.

<b>Learning outcome</b>
The learner will: 2. know how to overhaul gearbox assemblies
<b>Assessment criteria</b>
The learner can: 2.1 describe the specific safety practices and procedures that they need to observe when overhauling gearbox assemblies (including any specific legislation, regulations/codes of practice for the activities, equipment or materials) 2.2 describe the health and safety requirements of the area in which the overhauling activity is to take place, and the responsibility these requirements place on them 2.3 describe the hazards associated with overhauling gearbox assemblies (such as handling oils, greases, stored energy/pressure/force; use of power tools, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down overhauling procedures, lifting and moving large and heavy components), and how to minimise them and reduce any risks 2.4 describe the importance of wearing protective clothing and other appropriate safety equipment during the overhaul 2.5 explain how to obtain and interpret drawings, specifications, manufacturers' manuals, history/maintenance reports, and other documents needed in the overhauling process 2.6 explain how to carry out currency/issue checks on the specifications they are working with 2.7 describe the quality control procedures to be followed during the overhauling operations 2.8 describe the procedure for obtaining replacement parts, materials and other consumables necessary for the overhaul 2.9 describe the company policy on the repair/replacement of components during the overhauling process 2.10 describe the terminology used in gearbox assemblies 2.11 describe the basic principles of how the gearbox assembly functions, its operating sequence, the working purpose of individual units/components and how they interact 2.12 describe the extent to which the equipment is to be dismantled for overhaul 2.13 describe the sequence to be adopted for the dismantling/reassembling of the gearbox assembly 2.14 describe the techniques used to dismantle the gearbox assembly, without damage to the components or surrounding structure (such as release of energy/pressures/force; making mechanical disconnections; proof-marking components to aid reassembly; removing assemblies having interference fits (such as expansion, contraction, and the use of presses and extractors); removing mechanical locking and securing mechanisms/devices); and the need to protect the system integrity by ensuring that exposed components are correctly covered/protected 2.15 explain how to lift and move large components and assemblies; the methods and equipment used to transport, handle and lift the components during the overhauling activities 2.16 explain the need to ensure that lifting and handling equipment is within its current certification dates

- 2.17 describe the methods of checking that components are fit for purpose, how to identify defects and wear characteristics, and the need to replace 'lived' items (such as seals and gaskets)
- 2.18 describe the uses of measuring equipment (such as micrometers, verniers, expansion indicators and other measuring devices)
- 2.19 describe the methods of reassembling the gearbox, using new or previously overhauled components (such as replacing assemblies requiring pressure/force, ensuring correct orientation, bedding in bearings and components, replacing mechanical locking and securing mechanisms/devices, torque setting components)
- 2.20 explain how to make adjustments to replaced components/assemblies to ensure that they function correctly (such as checking alignment, balancing of rotating components such as torque converters, setting working clearance, setting travel, setting backlash in gears and pre-loading bearings)
- 2.21 describe the various mechanical fasteners that are used, and their method of removal and replacement (including bolts, nuts, rivets, threaded fasteners, special securing devices)
- 2.22 describe the various types of electrical connector that are used, methods of unlocking, orientation indicators, and locating and locking in of the connections
- 2.23 describe the tools and equipment used in the overhauling activities, and how to check that they are in a safe/usable 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 all tools, equipment and components are accounted for and returned to their correct location on completion of the overhauling activities
- 2.26 describe the procedure for the safe disposal of waste materials
- 2.27 explain the need to complete the overhaul documentation and/or reports following the overhauling activity
- 2.28 describe the problems that can occur during the overhauling activity, and how they can be overcome
- 2.29 describe the extent of their own authority and to whom they should report if they have a problem that they cannot resolve.

## Unit 402

## Overhauling industrial clutch and brake assemblies

<b>UAN:</b>	K/600/5657
<b>Level:</b>	3
<b>Credit value:</b>	77
<b>GLH:</b>	161
<b>Relationship to NOS:</b>	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 113: Overhauling Industrial Clutch and Brake Assemblies (Level 3).
<b>Endorsement by a sector or other appropriate body:</b>	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out a complete overhaul of clutch and brake assemblies used for industrial applications, in accordance with approved procedures. The clutch and/or brake assembly to be overhauled will have been removed from its operating environment, and the overhauling activities will take place in a maintenance environment or manufacturer's workshop.</p> <p>In carrying out the overhauling operations, the learner will be required to follow laid-down procedures and to use specific dismantling and rebuilding techniques. The overhauling activities will involve removing all ancillary components and sub-assemblies, and stripping the clutch or brake unit down to its component parts. The learner will be required to inspect the components for damage and wear, and to make decisions on which components can be re-used and which will need replacing.</p> <p>The learner will then rebuild the clutch or brake assembly, which will involve fitting replacement or overhauled sub-assembly units such as clutch drive mechanisms, release/operating mechanisms, bearings and seals, and the replacement of all damaged, worn and 'lifer' components. The overhauling activities will include making all</p>

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necessary checks and adjustments to ensure that components are correctly replaced, positioned, aligned, adjusted, torque loaded, locked and fastened, and that the correct sealants are used.

The learner's responsibilities will require them to comply with organisational policy and procedures for the overhaul of the clutch or brake assembly, and to report any problems with the overhauling activities, or with the tools and equipment used that they cannot personally resolve or that are outside their permitted authority, to the relevant people. The learner must ensure that all tools, equipment and materials used in the overhauling activities are removed from the work area on completion of the activities, and that all necessary job/task documentation is completed accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying appropriate overhauling techniques and procedures to industrial clutch and brake assemblies. The learner will understand the dismantling and reassembly methods and procedures used, and their application. The learner will know how the clutch and brake assembly functions, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the overhauling activities to the required specification. In addition, the learner will have sufficient knowledge of these components to ensure that they are fit for purpose and meet the specifications, thus providing a sound basis for carrying out the reassembly.

The learner will understand the safety precautions required when carrying out the overhauling activities associated with industrial clutch and brake assemblies, especially those for lifting, handling and supporting the equipment being removed and replaced. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others

<b>Learning outcome</b>
The learner will: 1. overhaul industrial clutch and brake assemblies
<b>Assessment criteria</b>
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 overhaul of the clutch and brake assembly: <ul style="list-style-type: none"><li>• obtain and use the appropriate documentation for the overhauling activities (such as job instructions, drawings, manuals)</li><li>• 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</li><li>• provide and maintain safe access and working arrangements for the work area</li><li>• ensure that the clutch and brake unit is suitably supported, and that appropriate lifting and handling equipment is available</li><li>• carry out the overhauling activities, following good practice/approved procedures</li><li>• ensure that components and surrounding structures are maintained free from damage and foreign objects</li><li>• return all tools and equipment to the correct location on completion of the activities</li><li>• leave the work area in a clean and safe condition on completion of the activities</li></ul> 1.3 follow the relevant overhauling schedules to carry out the required work 1.4 establish the components to be removed and, where appropriate, mark components to aid re-assembly 1.5 ensure that any stored energy or substances are released safely and correctly 1.6 carry out the overhaul to the agreed level, using the correct tools and techniques 1.7 overhaul two of the following types of clutch/braking assembly: <ul style="list-style-type: none"><li>• dry friction clutch (single or multi-plate)</li><li>• wet plate clutch</li><li>• spring and expanding ring type</li><li>• disc clutch</li><li>• tooth clutch</li><li>• oil immersed</li><li>• cone</li><li>• drum</li><li>• centrifugal</li><li>• electromagnetic</li></ul>



- hydraulic
- pneumatic
- magnetic particle
- eddy current
- tension control
- other specific type

1.8 carry out all of the following activities on the equipment being overhauled:

- cleaning parts prior to dismantling
- pre-disassembly checks and tests
- releasing stored energy (where applicable)
- draining/removing any remaining fluids
- dismantling equipment to unit/sub-assembly level
- dismantling units to component level
- removing and replacing components having interference fits (such as by expansion, contraction, pressure)
- proof-marking/labelling of components to aid reassembly
- checking components for wear and serviceability (such as visual, measurement, use of probes/scopes)
- replacing all damaged or defective sub-assemblies and components
- replacing all 'lived' items (such as seals, bearings, gaskets)
- reassembling the clutch and brake unit
- balancing components (where applicable)
- making connections (such as mechanical, electrical and fluid power)
- setting and adjusting replaced components
- tightening fastenings to the required torque
- applying gaskets and sealant/adhesives
- applying correct lubrication during assembly
- securing components using mechanical fasteners and threaded devices (such as nuts, bolts, circlips, pins)
- applying locking and retaining devices (such as circlips, pins, wire locking, lock nuts, stiff nuts, swage nuts)
- applying protection to openings to prevent entry of contaminating debris

1.9 replace/refit a range of clutch and brake assembly components, to include ten of the following:

- housings
- friction discs/pads
- drive plates
- bearings
- shafts
- couplings
- locks and stops
- static seals/gaskets
- dynamic seals

- sensors (such as temperature, speed)
  - shims and packing
  - levers and linkages
  - selector mechanisms
  - locking devices
  - fluid power fittings (such as pipes, unions and hose connectors)
  - mechanical controls (such as plungers, springs, rollers)
  - electrical controls (such as solenoids, motors, switches)
  - other specific components
- 1.10 carry out checks and tests on the overhauled clutch and brake assembly, to include all of the following:
- visual inspection for completeness of all operations
  - visual inspection for freedom from damage or foreign objects
  - applying protection to openings to prevent entry of contaminating debris
  - carrying out any 'special-to-type' checks
- 1.11 overhaul clutch and brake assemblies, in compliance with one of the following:
- BS, ISO or BSEN standards and procedures
  - customer standards and requirements
  - company standards and procedures
  - clutch and brake manufacturer's requirements
- 1.12 ensure that all removed components are correctly identified and stored in the correct location
- 1.13 report any instances where the overhauling activities cannot be fully met, or where there are identified defects outside the planned overhauling schedule
- 1.14 complete the relevant documentation, in accordance with organisational requirements
- 1.15 complete paperwork which includes one of the following, and pass it to the appropriate people:
- job cards
  - computer records
  - clutch and brake assembly overhaul logs or documents
  - work authorisation documents
  - company-specific documentation
- 1.16 dispose of unwanted components, waste materials and substances, in accordance with safe working practices and approved procedures
- 1.17 deal promptly and effectively with problems within their control and report those that cannot be solved.

<b>Learning outcome</b>
The learner will: 2. know how to overhaul industrial clutch and brake assemblies
<b>Assessment criteria</b>
The learner can: 2.1 describe the specific safety practices and procedures that they need to observe when overhauling industrial clutch and brake assemblies (including any specific legislation, regulations/codes of practice for the activities, equipment or materials) 2.2 describe the health and safety requirements of the area in which the overhauling activity is to take place, and the responsibility these requirements place on them 2.3 describe the hazards associated with overhauling clutch and brake assemblies (such as handling oils, greases, stored energy/pressure/force; use of power tools, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down overhauling procedures, lifting and moving large and heavy components), and how to minimise them and reduce any risks 2.4 describe the importance of wearing protective clothing and other appropriate safety equipment during the overhaul 2.5 explain how to obtain and interpret drawings, specifications, manufacturers' manuals, history/maintenance reports, and other documents needed in the overhauling process 2.6 explain how to carry out currency/issue checks on the specifications they are working with 2.7 describe the quality control procedures to be followed during the overhauling operations 2.8 describe the procedure for obtaining replacement parts, materials and other consumables necessary for the overhaul 2.9 describe the company policy on the repair/replacement of components during the overhauling process 2.10 describe the terminology used in clutch and brake assemblies 2.11 describe the basic principles of how the clutch and brake assembly functions, its operating sequence, the working purpose of individual units/components and how they interact 2.12 describe the extent to which the equipment is to be dismantled for overhaul 2.13 describe the sequence to be adopted for the dismantling/reassembling of the clutch and brake assembly 2.14 describe the techniques used to dismantle the clutch and brake assembly, without damage to the components or surrounding structure (such as release of energy/pressures/force; making mechanical disconnections; proof-marking components to aid reassembly; removing assemblies having interference fits (such as expansion, contraction, and the use of presses and extractors); removing mechanical locking and securing mechanisms/devices); and the need to protect the system integrity by ensuring that exposed components are correctly covered/protected 2.15 explain how to lift and move large components and assemblies; the methods and equipment used to transport, handle and lift the components during the overhauling activities 2.16 explain the need to ensure that lifting and handling equipment is

- within its current certification dates
- 2.17 describe the methods of checking that components are fit for purpose, how to identify defects and wear characteristics, and the need to replace 'lived' items (such as seals and gaskets)
  - 2.18 describe the uses of measuring equipment (such as micrometers, verniers, expansion indicators and other measuring devices)
  - 2.19 describe the methods of reassembling the clutch and brake unit, using new or previously overhauled components (such as replacing assemblies requiring pressure/force, ensuring correct orientation, bedding in bearings and components, replacing mechanical locking and securing mechanisms/devices, torque setting components)
  - 2.20 explain how to make adjustments to replaced components/assemblies to ensure that they function correctly (such as checking alignment, balancing of rotating components, setting working clearance, setting travel, setting backlash in gears and pre-loading bearings)
  - 2.21 describe the various mechanical fasteners that are used, and their method of removal and replacement (including bolts, nuts, rivets, threaded fasteners, special securing devices)
  - 2.22 describe the tools and equipment used in the overhauling activities, and how to check that they are in a safe/usable 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 all tools, equipment and components are accounted for and returned to their correct location on completion of the overhauling activities
  - 2.25 describe the procedure for the safe disposal of waste materials
  - 2.26 describe the need to complete the overhaul documentation and/or reports following the overhauling activity
  - 2.27 describe the problems that can occur during the overhauling activity, and how they can be overcome
  - 2.28 describe the extent of their own authority and to whom they should report if they have a problem that they cannot resolve.

<b>UAN:</b>	F/600/5468
<b>Level:</b>	3
<b>Credit value:</b>	77
<b>GLH:</b>	161
<b>Relationship to NOS:</b>	This unit has been derived from Semya National Occupational Standard Mechanical Manufacturing Engineering Unit 114: Overhauling Pump Assemblies (Level 3).
<b>Endorsement by a sector or other appropriate body:</b>	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
<b>Aim:</b>	This unit covers the skills and knowledge needed to prove the competences required to carry out a complete overhaul of pump assemblies, in accordance with approved procedures. The pump assembly to be overhauled will have been removed from its operating environment, and the overhauling activities will take place in a maintenance environment or manufacturer's workshop.

In carrying out the overhauling operations, the learner will be required to follow laid-down procedures and to use specific dismantling and rebuilding techniques. The overhauling activities will involve removing all ancillary components and sub-assemblies, separating the pump housing and removing the pump operating mechanism, bearings and seals, valves, wear rings, stuffing box and gland packing, and stripping the pump housing of all its components. The learner will be required to inspect the components for damage and wear, and to make decisions on which components can be re-used and which will need replacing.

The learner will then rebuild the pump assembly, which will involve fitting replacement or overhauled sub-assembly units, such as pump shaft, diaphragms, impeller, pistons, gears, wear rings, bearings and seals, and the replacement of all damaged, worn and 'lified' components. The overhauling activities will include making all necessary checks and adjustments to ensure

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that components are correctly replaced, positioned, aligned, adjusted, torque loaded, locked and fastened, and that the correct sealants are used.

The learner's responsibilities will require them to comply with organisational policy and procedures for the overhaul of the pump assembly, and to report any problems with the overhauling activities, or with the tools and equipment used that they cannot personally resolve or that are outside their permitted authority, to the relevant people. The learner must ensure that all tools, equipment and materials used in the overhauling activities are removed from the work area on completion of the activities, and that all necessary job/task documentation is completed accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying appropriate overhauling techniques and procedures to pump assemblies. The learner will understand the dismantling and reassembly methods and procedures used, and their application. The learner will know how the pump assembly functions, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the overhauling activities to the required specification. In addition, the learner will have sufficient knowledge of these components to ensure that they are fit for purpose and meet the specifications, thus providing a sound basis for carrying out the reassembly.

The learner will understand the safety precautions required when carrying out the overhauling activities associated with pump assemblies, especially those for lifting, handling and supporting the equipment being removed and replaced. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

<b>Learning outcome</b>
The learner will: 1. overhaul pump assemblies
<b>Assessment criteria</b>
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 overhaul of the pump assembly: <ul style="list-style-type: none"> <li>• obtain and use the appropriate documentation for the overhauling activities (such as job instructions, drawings, manuals)</li> <li>• 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</li> <li>• provide and maintain safe access and working arrangements for the work area</li> <li>• ensure that the pump assembly is suitably supported, and that appropriate lifting and handling equipment is available</li> <li>• carry out the overhauling activities, following good practice/approved procedures</li> <li>• ensure that components and surrounding structures are maintained free from damage and foreign objects</li> <li>• return all tools and equipment to the correct location on completion of the activities</li> <li>• leave the work area in a clean and safe condition on completion of the activities</li> </ul> 1.3 follow the relevant overhauling schedules to carry out the required work 1.4 establish the components to be removed and, where appropriate, mark components to aid re-assembly 1.5 ensure that any stored energy or substances are released safely and correctly 1.6 carry out the overhaul to the agreed level, using the correct tools and techniques 1.7 overhaul both of the following types of pump: <ul style="list-style-type: none"> <li>• kinetic/centrifugal</li> <li>• positive displacement</li> </ul> 1.8 overhaul pump assemblies operating on two of the following methods: <ul style="list-style-type: none"> <li>• piston/plunger</li> <li>• diaphragm</li> <li>• bellows</li> <li>• flexible impeller</li> <li>• rotary vane</li> <li>• internal gear</li> <li>• lobe type</li> <li>• flexible liner</li> <li>• hydrostatic</li> </ul>

- progressive cavity/screw type
  - other specific type
- 1.9 carry out all of the following activities on the pump equipment being overhauled:
- cleaning/decontaminating parts prior to dismantling
  - pre-disassembly checks and tests
  - releasing stored energy (where applicable)
  - draining/removing any remaining fluids
  - dismantling equipment to unit/sub-assembly level
  - dismantling units to component level
  - removing and replacing components having interference fits (such as by expansion, contraction, pressure)
  - proof-marking/labelling of components to aid reassembly
  - checking components for wear and serviceability (such as visual, measurement, use of probes/scopes)
  - replacing all damaged or defective sub-assemblies and components
  - replacing all 'lifer' items (such as seals, bearings, gaskets)
  - reassembling the pump unit
  - balancing components (where applicable)
  - 'blue bedding' components (where applicable)
  - making mechanical connections
  - setting and adjusting replaced components
  - tightening fastenings to the required torque
  - applying gaskets and sealant/adhesives
  - applying correct lubrication during assembly
  - securing components using mechanical fasteners and threaded devices (such as nuts, bolts, circlips, pins)
  - applying locking and retaining devices (such as circlips, pins, wire locking, lock nuts, stiff nuts, swage nuts)
  - applying protection to openings to prevent entry of contaminating debris
- 1.10 replace/refit a range of pump assembly components, to include ten of the following:
- pump housings
  - bearings
  - shafts
  - diaphragms
  - impellers
  - bellows
  - pistons
  - valves
  - gear assemblies
  - static seals/gaskets
  - dynamic seals (lipped or mechanical)
  - gland packing
  - connecting rods



- locks and stops
  - wear rings
  - shims and packing
  - levers and linkages
  - operating mechanisms
  - locking devices
  - wire thread inserts
  - pipes and unions
  - mechanical controls (such as plungers, springs, rollers)
  - electrical controls (such as solenoids, motors, switches)
  - other specific components
- 1.11 carry out checks and tests on the overhauled pump assembly, to include all of the following:
- visual inspection for completeness of all operations
  - visual inspection for freedom from damage or foreign objects
  - applying protection to openings to prevent entry of contaminating debris
  - carrying out any 'special-to-type' checks (such as bearing end float, impeller clearance, pump gear timing)
- 1.12 overhaul pump assemblies, in compliance with one of the following:
- BS, ISO or BSEN standards and procedures
  - customer standards and requirements
  - company standards and procedures
  - pump manufacturer's requirements
- 1.13 ensure that all removed components are correctly identified and stored in the correct location
- 1.14 report any instances where the overhauling activities cannot be fully met, or where there are identified defects outside the planned overhauling schedule
- 1.15 complete the relevant documentation, in accordance with organisational requirements
- 1.16 complete paperwork which includes one of the following, and pass it to the appropriate people:
- job cards
  - computer records
  - pump assembly overhaul logs or documents
  - work authorisation documents
  - company-specific documentation
- 1.17 dispose of unwanted components, waste materials and substances, in accordance with safe working practices and approved procedures
- 1.18 deal promptly and effectively with problems within their control and report those that cannot be solved.

<b>Learning outcome</b>
The learner will: 2. know how to overhaul pump assemblies
<b>Assessment criteria</b>
The learner can: 2.1 describe the specific safety practices and procedures that they need to observe when overhauling pump assemblies (including any specific legislation, regulations/codes of practice for the activities, equipment or materials) 2.2 describe the health and safety requirements of the area in which the overhauling activity is to take place, and the responsibility these requirements place on them 2.3 describe the hazards associated with overhauling pump assemblies (such as ensuring that the pump is correctly drained and decontaminated; handling lubricating oils and greases; stored energy/pressure/force; use of power tools, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down overhauling procedures, lifting and moving large and heavy components), and how to minimise them and reduce any risks 2.4 describe the importance of wearing protective clothing and other appropriate safety equipment during the overhaul 2.5 explain how to obtain and interpret drawings, specifications, manufacturers' manuals, history/maintenance reports, and other documents needed in the overhauling process 2.6 explain how to carry out currency/issue checks on the specifications they are working with 2.7 describe the quality control procedures to be followed during the overhauling operations 2.8 describe the procedure for obtaining replacement parts, materials and other consumables necessary for the overhaul 2.9 describe the company policy on the repair/replacement of components during the overhauling process 2.10 describe the terminology used in pump assemblies 2.11 describe the basic principles of how the pump assembly functions, its operating sequence, the working purpose of individual units/components and how they interact 2.12 describe the extent to which the equipment is to be dismantled for overhaul 2.13 describe the sequence to be adopted for the dismantling/reassembling of the pump assembly 2.14 describe the techniques used to dismantle the pump assembly, without damage to the components or surrounding structure (such as release of energy/pressures/force; making mechanical disconnections; proof-marking components to aid reassembly; removing assemblies having interference fits (such as expansion, contraction, and the use of presses and extractors); removing mechanical locking and securing mechanisms/devices); and the need to protect the system integrity by ensuring that exposed components are correctly covered/protected 2.15 explain how to lift and move large components and assemblies; the methods and equipment used to transport, handle and lift the components during the overhauling activities

- 2.16 explain the need to ensure that lifting and handling equipment is within its current certification dates
- 2.17 describe the methods of checking that components are fit for purpose, how to identify defects and wear characteristics, and the need to replace 'lived' items (such as seals and gaskets)
- 2.18 describe the uses of measuring equipment (such as micrometers, verniers, expansion indicators and other measuring devices)
- 2.19 describe the methods of reassembling the pump, using new or previously overhauled components (such as replacing assemblies requiring pressure/force, ensuring correct orientation, bedding in bearings and components, replacing mechanical locking and securing mechanisms/devices, torque setting components)
- 2.20 explain how to make adjustments to replaced components/assemblies to ensure that they function correctly (such as checking alignment, balancing of rotating components such as impellers, setting working clearance, setting travel, setting timing in pump gears and pre-loading bearings)
- 2.21 describe the various mechanical fasteners that are used, and their method of removal and replacement (including bolts, nuts, rivets, threaded fasteners, special securing devices)
- 2.22 describe the various types of electrical connectors that are used, methods of unlocking, orientation indicators, and locating and locking in of the connections
- 2.23 describe the tools and equipment used in the overhauling activities, and how to check that they are in a safe/usable 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 all tools, equipment and components are accounted for and returned to their correct location on completion of the overhauling activities
- 2.26 describe the procedure for the safe disposal of waste materials
- 2.27 explain the need to complete the overhaul documentation and/or reports following the overhauling activity
- 2.28 describe the problems that can occur during the overhauling activity, and how they can be overcome
- 2.29 describe the extent of their own authority and to whom they should report if they have a problem that they cannot resolve.

<b>UAN:</b>	K/600/5478
<b>Level:</b>	3
<b>Credit value:</b>	77
<b>GLH:</b>	161
<b>Relationship to NOS:</b>	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 115: Overhauling Valve Assemblies (Level 3).
<b>Endorsement by a sector or other appropriate body:</b>	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
<b>Aim:</b>	This unit covers the skills and knowledge needed to prove the competences required to carry out a complete overhaul of valve assemblies, in accordance with approved procedures. The valve assembly to be overhauled will have been removed from its operating environment, and the overhauling activities will take place in a maintenance environment or manufacturer's workshop.

In carrying out the overhauling operations, the learner will be required to follow laid-down procedures and to use specific dismantling and rebuilding techniques. The overhauling activities will involve removing all ancillary components and sub-assemblies, separating the valve housing and removing the valve operating mechanism, bearings, valve seats and seals, and stripping the valve body of all its components. The learner will be required to inspect the components for damage and wear, and to make decisions on which components can be re-used and which will need replacing.

The learner will then rebuild the valve assembly, which will involve fitting replacement or overhauled sub-assembly units, such as valve spindle, valve seat, spindle bearings, operating mechanisms and seals and gaskets, and the replacement of all damaged, worn and 'lifer' components. The overhauling activities will include making all necessary checks and adjustments to ensure that components are correctly replaced,

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positioned, aligned, adjusted, torque loaded, locked and fastened, and that the correct sealants are used.

The learner's responsibilities will require them to comply with organisational policy and procedures for the overhaul of the valve assembly, and to report any problems with the overhauling activities, or with the tools and equipment used that they cannot personally resolve or that are outside their permitted authority, to the relevant people. The learner must ensure that all tools, equipment and materials used in the overhauling activities are removed from the work area on completion of the activities, and that all necessary job/task documentation is completed accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying appropriate overhauling techniques and procedures to valve assemblies. The learner will understand the dismantling and reassembly methods and procedures used, and their application. The learner will know how the valve assembly functions, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the overhauling activities to the required specification. In addition, the learner will have sufficient knowledge of these components to ensure that they are fit for purpose and meet the specifications, thus providing a sound basis for carrying out the reassembly.

The learner will understand the safety precautions required when carrying out the overhauling activities associated with valve assemblies, especially those for lifting, handling and supporting the equipment being removed and replaced. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

<b>Learning outcome</b>
The learner will: 1. overhaul valve assemblies
<b>Assessment criteria</b>
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 overhaul of the valve assembly: <ul style="list-style-type: none"> <li>• obtain and use the appropriate documentation for the overhauling activities (such as job instructions, drawings, manuals)</li> <li>• 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</li> <li>• provide and maintain safe access and working arrangements for the work area</li> <li>• ensure that the valve assembly is suitably supported, and that appropriate lifting and handling equipment is available</li> <li>• carry out the overhauling activities, following good practice/approved procedures</li> <li>• ensure that components and surrounding structures are maintained free from damage and foreign objects</li> <li>• return all tools and equipment to the correct location on completion of the activities</li> <li>• leave the work area in a clean and safe condition on completion of the activities</li> </ul> 1.3 follow the relevant overhauling schedules to carry out the required work 1.4 establish the components to be removed and, where appropriate, mark components to aid re-assembly 1.5 ensure that any stored energy or substances are released safely and correctly 1.6 carry out the overhaul to the agreed level, using the correct tools and techniques 1.7 overhaul both of the following types of valve: <ul style="list-style-type: none"> <li>• rotary action valves</li> <li>• linear action valves</li> </ul> 1.8 overhaul valve assemblies operating on two of the following methods: <ul style="list-style-type: none"> <li>• globe (single or double seat )</li> <li>• wedge gate</li> <li>• parallel slide</li> <li>• piston</li> <li>• diaphragm</li> <li>• gate</li> <li>• pinch</li> <li>• ball</li> <li>• butterfly</li> </ul>

- plug
  - rotating shoe
  - needle
  - other specific method
- 1.9 carry out all of the following activities on the valve equipment being overhauled:
- cleaning/decontaminating valves prior to dismantling
  - pre-disassembly checks and tests
  - releasing stored energy (where applicable)
  - dismantling equipment to unit/sub-assembly level
  - dismantling units to component level
  - removing and replacing components having interference fits (such as by expansion, contraction, pressure)
  - proof-marking/labelling of components to aid reassembly
  - checking components for wear and serviceability (such as visual, measurement, use of probes/scopes)
  - replacing all damaged or defective sub-assemblies and components
  - replacing all 'lived' items (such as seals, bearings, gaskets)
  - reassembling the valve unit
  - lapping in components (where applicable)
  - making mechanical connections
  - setting and adjusting replaced components
  - tightening fastenings to the required torque
  - applying gaskets and sealant/adhesives
  - applying correct lubrication during assembly
  - securing components using mechanical fasteners and threaded devices (such as nuts, bolts, circlips, pins)
  - applying locking and retaining devices (such as circlips, pins, wire locking, lock nuts, stiff nuts, swage nuts)
  - applying protection to openings to prevent entry of contaminating debris
- 1.10 replace/refit a range of valve assembly components, to include ten of the following:
- valve body
  - bonnet
  - valve spindle/shaft
  - diaphragms
  - valve plug
  - piston
  - valve seat
  - valve disc or slide
  - static seals/gaskets
  - stem seals/gland packing
  - bearings
  - locks and stops
  - valve springs

- shims and packing
  - levers and linkages
  - locking devices
  - wire thread inserts
  - pipes and unions
  - mechanical controls (such as plungers, springs, rollers)
  - electrical controls (such as solenoids, motors, switches)
  - other specific valve components
- 1.11 carry out checks and tests on the overhauled valve assembly, to include all of the following:
- visual inspection for completeness of all operations
  - visual inspection for freedom from damage or foreign objects
  - applying protection to openings to prevent entry of contaminating debris
  - carrying out any 'special-to-type' checks
- 1.12 overhaul valve assemblies, in compliance with one of the following:
- BS, ISO or BSEN standards and procedures
  - customer standards and requirements
  - company standards and procedures
  - valve manufacturer's requirements
- 1.13 ensure that all removed components are correctly identified and stored in the correct location
- 1.14 report any instances where the overhauling activities cannot be fully met, or where there are identified
- 1.15 defects outside the planned overhauling schedule
- 1.16 complete the relevant documentation, in accordance with organisational requirements
- 1.17 complete paperwork which includes one of the following, and pass it to the appropriate people:
- job cards
  - computer records
  - valve assembly overhaul logs or documents
  - work authorisation documents
  - company-specific documentation
- 1.18 dispose of unwanted components, waste materials and substances, in accordance with safe working practices and approved procedures
- 1.19 deal promptly and effectively with problems within their control and report those that cannot be solved.

<b>Learning outcome</b>
The learner will: 2. know how to overhaul valve assemblies
<b>Assessment criteria</b>
The learner can: 2.1 describe the specific safety practices and procedures that they need to observe when overhauling valve assemblies (including any specific legislation, regulations/codes of practice for the activities,



- equipment or materials)
- 2.2 describe the health and safety requirements of the area in which the overhauling activity is to take place, and the responsibility these requirements place on them
  - 2.3 describe the hazards associated with overhauling valve assemblies (such as ensuring that the valve is correctly drained and decontaminated; handling lubricating oils and greases; stored energy/pressure/force; use of power tools, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down overhauling procedures, lifting and moving large and heavy components), and how to minimise them and reduce any risks
  - 2.4 describe the importance of wearing protective clothing and other appropriate safety equipment during the overhaul
  - 2.5 explain how to obtain and interpret drawings, specifications, manufacturers' manuals, history/maintenance reports, and other documents needed in the overhauling process
  - 2.6 explain how to carry out currency/issue checks on the specifications they are working with
  - 2.7 describe the quality control procedures to be followed during the overhauling operations
  - 2.8 describe the procedure for obtaining replacement parts, materials and other consumables necessary for the overhaul
  - 2.9 describe the company policy on the repair/replacement of components during the overhauling process
  - 2.10 describe the terminology used in valve assemblies
  - 2.11 describe the basic principles of how the valve assembly functions, its operating sequence, the working purpose of individual units/components and how they interact
  - 2.12 describe the extent to which the equipment is to be dismantled for overhaul
  - 2.13 describe the sequence to be adopted for the dismantling/reassembling of the valve assembly
  - 2.14 describe the techniques used to dismantle the valve assembly, without damage to the components or surrounding structure (such as release of energy/pressures/force; making mechanical disconnections; proof marking components to aid reassembly; removing assemblies having interference fits (such as expansion, contraction, and the use of presses and extractors); removing mechanical locking and securing mechanisms/devices); and the need to protect the system integrity by ensuring that exposed components are correctly covered/protected
  - 2.15 explain how to lift and move large components and assemblies; the methods and equipment used to transport, handle and lift the components during the overhauling activities
  - 2.16 explain the need to ensure that lifting and handling equipment is within its current certification dates
  - 2.17 describe the methods of checking that components are fit for purpose, how to identify defects and wear characteristics, and the need to replace 'lifer' items (such as seals and gaskets)
  - 2.18 describe the uses of measuring equipment (such as micrometers, verniers, expansion indicators and other measuring devices)
  - 2.19 describe the methods of reassembling the valve, using new or previously overhauled components (such as replacing assemblies requiring pressure/force, ensuring correct orientation, bedding in

- bearings and components, replacing mechanical locking and securing mechanisms/devices, torque setting components)
- 2.20 explain how to make adjustments to replaced components/assemblies to ensure that they function correctly (such as checking alignment, setting working clearance, setting travel)
  - 2.21 describe the various mechanical fasteners that are used, and their method of removal and replacement (including bolts, nuts, rivets, threaded fasteners, special securing devices)
  - 2.22 describe the tools and equipment used in the overhauling activities, and how to check that they are in a safe/usable 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 all tools, equipment and components are accounted for and returned to their correct location on completion of the overhauling activities
  - 2.25 describe the procedure for the safe disposal of waste materials
  - 2.26 explain the need to complete the overhaul documentation and/or reports following the overhauling activity
  - 2.27 describe the problems that can occur during the overhauling activity, and how they can be overcome
  - 2.28 describe the extent of their own authority and to whom they should report if they have a problem that they cannot resolve.

## Unit 405

## Overhauling components of hydraulic equipment

<b>UAN:</b>	J/600/5486
<b>Level:</b>	3
<b>Credit value:</b>	77
<b>GLH:</b>	161
<b>Relationship to NOS:</b>	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 116: Overhauling Components of Hydraulic Equipment (Level 3).
<b>Endorsement by a sector or other appropriate body:</b>	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out overhauling activities on hydraulic equipment and components, in accordance with approved procedures. The components to be overhauled will have been removed from hydraulic equipment, and the overhauling activities will take place in a maintenance environment or manufacturer's workshop.</p> <p>It includes components such as cylinders/rams/actuators, pumps, hydraulic motors, control valves, pressure intensifiers, accumulators, oil coolers, reservoirs and tanks and other specific hydraulic equipment. The overhauling activities will include carrying out all necessary safety checks, dismantling the equipment to unit or component level, inspecting and checking all components for damage and wear, replacing all 'lifer' items and worn/faulty components or units, reassembling the equipment and carrying out all necessary tests/checks.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the overhauling activities undertaken, and to report any problems with these activities, or with the tools and equipment used that they cannot personally resolve or that are outside their permitted authority, to the relevant people. The learner</p>

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must ensure that all tools, equipment, and materials used in the overhauling activities are removed from the work area, and that all necessary job/task documentation is completed 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 appropriate overhauling procedures to hydraulic components and equipment. The learner will understand the dismantling and reassembly methods and procedures used, and their application. The learner will know how the equipment functions, the common faults encountered, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the overhauling activities, correcting faults and ensuring that the overhauled equipment meets the required specification.

The learner will understand the safety precautions required when carrying out the overhauling activities, especially those for handling hydraulic fluids. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

<b>Learning outcome</b>
The learner will: 1. overhaul components of hydraulic equipment
<b>Assessment criteria</b>
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 overhaul of the hydraulic equipment: <ul style="list-style-type: none"><li>• obtain and use the appropriate documentation for the overhauling activities (such as job instructions, drawings, manuals)</li><li>• adhere to procedures or systems in place for risk assessment, COSHH, Personal Protective Equipment, decontamination and other relevant safety regulations and procedures to realise a safe system of work</li></ul>

- provide and maintain safe access and working arrangements for the work area
  - ensure the safe depressurisation of the hydraulic equipment (where appropriate)
  - carry out the overhauling activities, following good practice/approved procedures
  - ensure that components and surrounding structures are maintained free from damage and foreign objects
  - return all tools and equipment to the correct location on completion of the activities
- 1.3 follow the relevant overhauling schedules to carry out the required work
- 1.4 establish the components to be removed and, where appropriate, mark components to aid re-assembly
- 1.5 ensure that any stored energy or substances are released safely and correctly
- 1.6 carry out the overhaul to the agreed level, using the correct tools and techniques
- 1.7 carry out the overhauling activities to component level on four of the following types of hydraulic unit:
- pumps
  - hydraulic motors
  - hydraulic power units
  - oil coolers
  - pressure control valves
  - flow control valves
  - directional control valves
  - proportional control valves
  - pressure intensifiers
  - pressure regulators
  - hydraulic accumulators
  - single acting cylinders
  - double acting cylinders
  - rotary cylinders/actuators
  - reservoirs/tanks
  - actuators/rams
  - other specific components
- 1.8 carry out all of the following activities, as applicable to the hydraulic equipment being overhauled:
- cleaning parts prior to dismantling
  - pre-disassembly checks and tests
  - releasing stored pressure (where applicable)
  - draining/removing any remaining fluids
  - dismantling equipment to unit/sub-assembly level
  - dismantling units to component level
  - proof-marking/labelling of components
  - checking components for serviceability (such as visual, measurement, NDT, use of probes/scopes)

- replacing all damaged or defective components
- reassembling equipment
- making mechanical connections
- setting and adjusting replaced components
- tightening fastenings to the required torque
- replacing all 'lived' items (such as piston seals, dust caps, filters, gaskets)
- securing components using mechanical fasteners and threaded devices
- applying locking and retaining devices (such as circlips, pins, wire locking, lock nuts, stiff nuts, swage nuts)
- fitting blanks to openings to prevent entry of contaminating debris

1.9 replace/refit a range of hydraulic equipment components, to include eight of the following:

- pipework and hoses
- pistons
- spools
- valves and seats
- diaphragms
- static and dynamic seals
- housings
- actuating mechanisms
- plungers
- bearings
- rollers
- regulators
- filters
- hydraulic fuses
- spring mechanisms
- gauges
- gaskets
- sensors
- other specific components

1.10 carry out checks and tests on the overhauled equipment, to include three of the following:

- visual inspection for completeness of all operations
- visual inspection for freedom from damage or foreign objects
- check that there is appropriate protection to openings to prevent entry of contaminating debris
- carrying out any 'special-to-type' test rig checks (such as leak, pressure, range of movement)

1.11 overhaul hydraulic equipment, in compliance with one of the following:

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

<ul style="list-style-type: none"> <li>• equipment manufacturer's requirements</li> </ul> <p>1.12 ensure that all removed components are correctly identified and stored in the correct location</p> <p>1.13 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule</p> <p>1.14 complete the relevant documentation, in accordance with organisational requirements</p> <p>1.15 complete the relevant paperwork which includes one of the following, and pass it to the appropriate people:</p> <ul style="list-style-type: none"> <li>• job cards</li> <li>• computer records</li> <li>• equipment overhaul logs or reports</li> <li>• work authorisation documents</li> <li>• company-specific documentation</li> </ul> <p>1.16 dispose of unwanted components, waste materials and substances, in accordance with safe working practices and approved procedures</p> <p>1.17 deal promptly and effectively with problems within their control and report those that cannot be solved.</p>
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<b>Learning outcome</b>
The learner will:
2. know how to overhaul components of hydraulic equipment
<b>Assessment criteria</b>
The learner can:
2.1 describe the safe working practices and procedures and the specific safety precautions to be taken when overhauling hydraulic components and equipment (to include wearing protective clothing and equipment; lifting and handling techniques; safe working practices and procedures with regard to working on hydraulic equipment and when using synthetic oils; procedures and guidelines which satisfy current regulations such as HASAWA, COSHH and other work related legislation and guidelines)
2.2 describe the hazards associated with carrying out overhauling activities on hydraulic equipment (such as using lifting and handling equipment, handling hydraulic oils, releasing stored pressure/fluids, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down overhauling procedures), and how to minimise them and reduce any risks
2.3 describe the importance of following the correct decontamination procedures
2.4 describe the importance of wearing protective clothing and other appropriate safety equipment during the overhaul
2.5 explain how to use and extract information from equipment manuals, history/maintenance reports, charts, circuit and physical layouts, specifications, symbols used in hydraulic systems, and other documents needed in the overhauling process
2.6 explain how to carry out currency/issue checks on the specifications they are working with
2.7 describe the procedure for obtaining replacement parts, materials and other consumables necessary for the overhaul

- 2.8 describe the terminology used in hydraulic systems, and the use of fluid power diagrams and associated symbols
- 2.9 describe the various types of component that make up the hydraulic equipment (such as pipes, flexible hoses, valves used for pressure, flow and directional control, double and single action cylinders/actuators, pumps, pressure intensifiers, mechanical and electrical control devices)
- 2.10 describe the basic principles of operation of the hydraulic equipment being worked on, and the function of the valves, cylinders/actuators within the circuit
- 2.11 describe the sequence to be adopted for the dismantling/reassembling of various types of hydraulic assemblies
- 2.12 describe the techniques used to dismantle the equipment to unit or component level, without damage to the components (such as release of pressures/force, draining of fluids, proof-marking/labelling removed components, extraction of components), and the need to protect the circuit integrity by fitting blanking plugs/covers
- 2.13 explain how to identify and use different types of valves, sensors and actuators (such as rotary, linear, mechanical, electrical), cylinders (such as single acting, double acting), pumps (such as positive and non-positive displacement), static and dynamic seals
- 2.14 describe the various mechanical fasteners that will need to be removed and replaced, and their method of removal and replacement (such as threaded fasteners, special securing devices)
- 2.15 describe the methods of lifting, handling and supporting the components/equipment during the removal and replacement activities
- 2.16 describe the methods of checking that components are fit for purpose, and the uses of inspection/measuring equipment (such as gauges, micrometers, verniers, dial test indicators, mirrors, endoprobes, boroscopes, video probes, scales)
- 2.17 explain how to identify defects and wear characteristics, and the need to replace 'lified' items (such as filters, seals and gaskets)
- 2.18 explain how to check that replacement components have the correct part/identification markings
- 2.19 explain how to reassemble the components (such as the use of gaskets and seals, jointing/sealing compounds, ensuring correct tightness of fittings and connections, eliminating stress on pipework/connections, carrying out visual checks of all components, checking security of joints and that the system is safe to re-pressurise)
- 2.20 describe the tools and equipment used in the overhauling activities, and their calibration/care and control procedures
- 2.21 explain how to make adjustments to components/assemblies to ensure that they function correctly (such as setting working clearance, setting travel)
- 2.22 explain the need to complete the overhaul documentation and/or reports following the overhauling activity
- 2.23 describe the procedure for the safe disposal of waste materials, scrap components and hydraulic fluids
- 2.24 describe the extent of their own authority and to whom they should report if they have a problem that they cannot resolve.



## Unit 406

# Overhauling components of pneumatic, vacuum or compressed air equipment

<b>UAN:</b>	D/600/5493
<b>Level:</b>	3
<b>Credit value:</b>	77
<b>GLH:</b>	161
<b>Relationship to NOS:</b>	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 117: Overhauling Components of Pneumatic, Vacuum or Compressed Air Equipment (Level 3).
<b>Endorsement by a sector or other appropriate body:</b>	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out overhauling activities on pneumatic, vacuum or compressed air equipment and components, in accordance with approved procedures. The equipment to be overhauled will have been removed from its operating environment, and the overhauling activities will take place in a maintenance environment or equipment manufacturer's workshop.</p> <p>It covers a range of pneumatic, vacuum and compressed air equipment such as air and vacuum pumps, pressure and flow control valves, cylinders and actuators, compressors, intensifiers, accumulators, regulators and other specific equipment. The overhauling activities will include carrying out all necessary safety activities, dismantling the equipment to component level, inspecting and checking all components for damage and wear, replacing all 'lifer' items and worn/faulty components or units, reassembling the equipment and carrying out all necessary tests/checks.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the overhauling activities</p>

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undertaken, and to report any problems with these activities, or with the tools and equipment used that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner must ensure that all tools, equipment and materials used in the overhauling activities are removed from the work area, and that all necessary job/task documentation is completed 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 appropriate overhauling procedures to pneumatic, vacuum or compressed air equipment. The learner will understand the dismantling and reassembly methods and procedures used, and their application. The learner will know how the equipment functions, the common faults encountered, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the overhauling activities, correcting faults and ensuring that the overhauled equipment meets the required specification.

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

<b>Learning outcome</b>
The learner will: 1. overhaul components of pneumatic, vacuum or compressed air equipment
<b>Assessment criteria</b>
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 overhaul of the pneumatic, vacuum or compressed air equipment: <ul style="list-style-type: none"><li>• obtain and use the appropriate documentation for the overhauling activities (such as job instructions, drawings,</li></ul>

- manuals)
- 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
  - provide and maintain safe access and working arrangements for the work area
  - ensure the safe depressurisation of the pneumatic, vacuum or compressed air equipment (where appropriate)
  - carry out the overhauling activities, following good practice/approved procedures
  - ensure that components and surrounding structures are maintained free from damage and foreign objects
  - return all tools and equipment to the correct location on completion of the activities
  - leave the work area in a clean and safe condition on completion of the activities
- 1.3 follow the relevant overhauling schedules to carry out the required work
- 1.4 establish the components to be removed and, where appropriate, mark components to aid re-assembly
- 1.5 ensure that any stored energy or substances are released safely and correctly
- 1.6 carry out the overhaul to the agreed level, using the correct tools and techniques
- 1.7 carry out the overhauling activities, to component level, on three of the following types of pneumatic, vacuum or compressed air equipment:
- air pumps
  - vacuum pumps
  - air coolers
  - water extractors
  - heat exchangers
  - humidifier
  - pressure intensifiers
  - accumulators
  - compressors
  - pressure control valves
  - flow/directional control valves
  - pressure regulators
  - pressure controllers
  - air reservoirs/tanks
  - linear actuating mechanisms
  - rotary cylinders/motors
  - safety devices
  - other specific components
- 1.8 carry out all of the following activities, as applicable to the equipment being overhauled:
- cleaning parts prior to dismantling

- pre-disassembly checks and tests
- releasing stored energy (where applicable)
- dismantling equipment to unit/sub-assembly level
- dismantling units to component level
- proof-marking/labelling of components
- replacing all damaged or defective components
- reassembling equipment
- making mechanical connections
- setting and adjusting replaced components
- tightening fastenings to the required torque
- checking components for serviceability (such as visual, measurement, NDT, use of probes/scopes)
- replacing all 'lifer' items (such as piston seals, dust caps, filters, gaskets)
- securing components using mechanical fasteners and threaded devices
- applying locking and retaining devices (such as circlips, pins, wire locking, lock nuts, stiff nuts, swage nuts)
- fitting blanks to openings to prevent entry of contaminating debris

1.9 replace/refit a range of pneumatic, vacuum or compressed air equipment components, to include eight of the following:

- pipes and hoses
- unions and couplings
- pistons
- strainers (including water separator)
- non-return valves
- actuating mechanisms
- pressure reducing valves
- diaphragms
- housings
- plungers
- bearings
- rollers
- regulators
- filters
- sensors
- spring mechanisms
- gauges
- gaskets
- sealing devices
- electrical controls (solenoids, motors, switches)
- other specific components

1.10 carry out checks and tests on the overhauled equipment, to include three of the following:

- visual inspection for completeness of all operations
- visual inspection for freedom from damage or foreign objects

<ul style="list-style-type: none"> <li>• check that there is appropriate protection to openings to prevent entry of contaminating debris</li> <li>• carrying out any 'special-to-type' test rig checks (such as leak, pressure, range of movement, timings/sequencing)</li> </ul> <p>1.11 overhaul pneumatic, vacuum or compressed air equipment, in compliance with one of the following:</p> <ul style="list-style-type: none"> <li>• BS, ISO or BSEN standards and procedures</li> <li>• customer standards and requirements</li> <li>• company standards and procedures</li> <li>• equipment manufacturer's requirements</li> </ul> <p>1.12 ensure that all removed components are correctly identified and stored in the correct location</p> <p>1.13 report any instances where the overhauling activities cannot be fully met, or where there are identified defects outside the planned overhauling schedule</p> <p>1.14 complete the relevant documentation, in accordance with organisational requirements</p> <p>1.15 complete paperwork which includes one of the following, and pass it to the appropriate people:</p> <ul style="list-style-type: none"> <li>• job cards</li> <li>• computer records</li> <li>• equipment overhaul logs or reports</li> <li>• work authorisation documents</li> <li>• company-specific documentation</li> </ul> <p>1.16 dispose of unwanted components, waste materials and substances, in accordance with safe working practices and approved procedures</p> <p>1.17 deal promptly and effectively with problems within their control and report those that cannot be solved.</p>
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<p><b>Learning outcome</b></p> <p>The learner will:</p> <p>2. know how to overhaul components of pneumatic, vacuum or compressed air equipment</p>
<p><b>Assessment criteria</b></p> <p>The learner can:</p> <p>2.1 describe the safe working practices and procedures and the specific safety precautions to be taken when overhauling pneumatic, vacuum or compressed air equipment (to include wearing protective clothing and equipment; lifting and handling techniques; safe working practices and procedures with regard to working on pneumatic, vacuum and compressed air equipment; procedures and guidelines which satisfy current regulations such as HASAWA, COSHH and other work related legislation and guidelines)</p> <p>2.2 describe the hazards associated with carrying out overhauling activities on pneumatic, vacuum and compressed air equipment (such as releasing stored pressure, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down overhauling procedures), and how to minimise them and reduce any risks</p> <p>2.3 describe the importance of wearing protective clothing and other</p>

- appropriate safety equipment during the overhaul
- 2.4 explain how to use and extract information from equipment manuals, history/maintenance reports, charts, circuit and physical layouts, specifications, symbols used in pneumatic, vacuum and compressed air systems, and other documents needed in the overhauling process
  - 2.5 explain how to carry out currency/issue checks on the specifications they are working with
  - 2.6 describe the procedure for obtaining replacement parts, materials and other consumables necessary for the overhaul
  - 2.7 describe the terminology used in pneumatic, vacuum and compressed air systems, and the use of fluid power diagrams and associated symbols
  - 2.8 describe the various types of component that make up the pneumatic, vacuum or compressed air equipment (such as pipes, flexible hoses, valves used for pressure, flow and directional control, double and single action cylinders/actuators, pumps, pressure intensifiers, mechanical and electrical control devices)
  - 2.9 describe the basic principles of operation of the pneumatic, vacuum or compressed air equipment being worked on, and the performance characteristics and function of the valves, cylinders/actuators within the circuit
  - 2.10 describe the sequence to be adopted for the dismantling/reassembling of various types of pneumatic, vacuum or compressed air assemblies
  - 2.11 describe the techniques used to dismantle the equipment to unit or component level without damage to the components (such as release of pressures/force, proof-marking/labelling removed components, extraction of components and the need to protect the circuit integrity by fitting blanking plugs/covers)
  - 2.12 explain how to identify and use different types of valves, sensors and actuators (such as rotary, linear, mechanical, electrical); cylinders (such as single acting, double acting); pumps (such as positive and non-positive displacement); static and dynamic seals
  - 2.13 describe the various mechanical fasteners that will need to be removed and replaced, and their method of removal and replacement (such as threaded fasteners, special securing devices)
  - 2.14 explain how to recognise contaminants, and the problems they can create; the effects and likely symptoms of contamination in the pneumatic, vacuum or compressed air equipment
  - 2.15 explain how to identify defects and wear characteristics, and the need to replace 'lified' items (such as filters, seals and gaskets)
  - 2.16 explain how to check that replacement components have the correct part/identification markings
  - 2.17 explain how to reassemble the components (such as the use of gaskets and seals, jointing/sealing compounds; ensuring correct tightness of fittings and connections; eliminating stress on pipework/connections; carrying out visual checks of all components; checking the security of joints and that the system is safe to re-pressurise)
  - 2.18 explain why securing devices need to be tightened to the correct torque, locked and labelled, and the different methods that are used for this
  - 2.19 describe the tools and equipment used in the overhauling activities, and their calibration/care and control procedures

- 2.20 explain how to make adjustments to components/assemblies to ensure that they function correctly (such as setting working clearance, setting travel)
- 2.21 explain the need to complete the overhaul documentation and/or reports following the overhauling activity
- 2.22 describe the procedure for the safe disposal of waste materials and scrap components
- 2.23 describe the extent of their own authority and to whom they should report if they have a problem that they cannot resolve.

## Unit 407

# Carrying out tests on overhauled industrial power turbines

<b>UAN:</b>	K/600/5500
<b>Level:</b>	3
<b>Credit value:</b>	70
<b>GLH:</b>	210
<b>Relationship to NOS:</b>	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 118: Carrying Out Tests on Overhauled Industrial Power Turbines (Level 3).
<b>Endorsement by a sector or other appropriate body:</b>	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out tests on overhauled industrial power turbines, as appropriate to the power turbine type, in accordance with approved procedures. The learner will be required to carry out all necessary preparations to the power turbine, in readiness for the tests to be carried out, and these will include ensuring that the power turbine is correctly mounted to the test facility, that all ancillary equipment is fitted to the power turbine, appropriate blanking plates are fitted, test instrumentation is correctly connected and that all necessary electrical checks are carried out.</p>

In carrying out the tests, the learner will be required to follow laid-down procedures, to ensure that the working area is clear, appropriate guards and notices are displayed, power turbine runs/tests are carried out in accordance with the appropriate schedule, monitoring procedures are complied with, analysis of results is made, and that test documentation is completed, accurately and legibly.

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



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and to report any problems with the testing activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their 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 undertaking the power turbine test procedures. The learner will understand the power turbine being tested, the specific test schedule to be followed, and will know what the various instruments and readings mean, in adequate depth to provide a sound basis for carrying out the tests to the required specification.

The learner will understand the safety precautions required when carrying out the testing activities, in particular those involved with fuelling and running the power turbines. 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.

<b>Learning outcome</b>
The learner will: 1. carry out tests on overhauled industrial power turbines
<b>Assessment criteria</b>
The learner can: 1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines 1.2 follow the appropriate procedures for use of tools and equipment to carry out the required tests 1.3 prepare the power turbine for testing by carrying out all of the following, as applicable to the turbine type: <ul style="list-style-type: none"><li>• obtain and use the appropriate documentation for the testing activities (such as job instructions, test schedule, test procedures and quality documentation)</li><li>• 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</li><li>• fit all the required test instrumentation to the power turbine</li><li>• attach and secure the engine to the test facility</li><li>• fit all required ancillary equipment (to include starter motors, control valves, slave oil filters, magnetic chip detectors and strainers)</li><li>• where appropriate, fit appropriate blanks/plugs to any unused</li></ul>

- electrical/mechanical or fluid power off-takes
- make all required connections to the engine (to include fuel connections, electrical and instrumentation)
- carry out all necessary electrical checks, and confirm that the engine is ready for testing
- load and prepare computer software for operation (where applicable)
- ensure that all personal are clear of the test facility and that safe working distance procedures are maintained
- 1.4 set up and carry out the tests using the correct procedures and within agreed timescales
- 1.5 undertake power turbine tests, as listed in the appropriate test schedule, to include all of the following:
  - filling the turbine with oil
  - checking that turbine igniter mechanisms operate correctly
  - carrying out ground idle checks
  - checking that fuel flow is operating correctly
  - carrying out running and handling checks
  - carrying out performance curves
  - carrying out vibration surveys
  - checking that turbine pressure ratios are within specification
  - checking that the operating temperature is within specification
  - checking that fire detection and protection equipment is functioning
- 1.6 deal with two of the following complexities during the power turbine tests:
  - turbine runs with no faults
  - turbine runs with faults
  - turbine with intermittent faults
- 1.7 de-rig the power turbine on completion of the testing procedures, to include carrying out all of the following:
  - shutting down the computer driver (where appropriate)
  - removing and checking magnetic chip detectors for contamination
  - removing and checking slave filters for contamination
  - installing the power turbine's own magnetic chip detectors and filters
  - draining all oil and fuel from the power turbine
  - removing all blanks and test instrumentation
  - removing the power turbine from the test facility, safely and correctly
  - passing the power turbine to dispatch (where applicable)
- 1.8 carry out tests on overhauled power turbines in compliance with one of the following:
  - BS, ISO or BSEN standards and procedures
  - customer standards and requirements
  - company standards and procedures
  - power turbine manufacturer's specific requirements
- 1.9 record the results of the tests in the appropriate format

<p>1.10 use one of the following to record the results of the test:</p> <ul style="list-style-type: none"> <li>• test report</li> <li>• job card</li> <li>• computer record</li> <li>• company-specific documentation</li> </ul> <p>1.11 review the results and carry out further tests if necessary</p> <p>1.12 review and analyse the results of the test run, using two of the following:</p> <ul style="list-style-type: none"> <li>• power turbine test schedule</li> <li>• data sheets</li> <li>• calibration records</li> <li>• log cards/history sheet</li> <li>• fault records</li> <li>• maintenance manuals and records</li> <li>• other specific documents.</li> </ul>
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<p><b>Learning outcome</b></p> <p>The learner will:</p> <p>2. know how to carry out tests on overhauled industrial power turbines</p>
<p><b>Assessment criteria</b></p> <p>The learner can:</p> <p>2.1 describe the specific safety practices and procedures that they need to observe when carrying out tests on overhauled industrial power turbines (including any specific legislation, regulations/codes of practice required for the activities, equipment or materials used)</p> <p>2.2 describe the health and safety requirements of the work area in which they are carrying out the activities, and the responsibility these requirements place on them</p> <p>2.3 describe the safety procedures that must be carried out before tests are started on the power turbine (such as checking that the lock guard system is functioning, the test cell is empty of people, bed doors are closed, all personnel are clear of the test area)</p> <p>2.4 describe the personal protective clothing and equipment to be worn during the testing activities</p> <p>2.5 describe the hazards associated with testing industrial power turbines, and how to minimise them and reduce any risks</p> <p>2.6 describe the preparations to be carried out on the power turbine prior to starting the tests (such as attaching to the test facility, fitting test instrumentation, fitting ancillary equipment, fitting blanking plates, filling the engine with oil, making fuel connections, attaching electrical power and making final electrical checks of all systems)</p> <p>2.7 explain how to obtain the required test schedules and specifications for the particular power turbine being tested, and how to check their currency and validity</p> <p>2.8 explain how to read and interpret the specifications, and whom they can seek assistance from if they have problems or issues regarding the test schedules or specifications</p> <p>2.9 explain how to access and set up the computer software required to run the turbine tests</p> <p>2.10 describe the correct operating procedures for the power turbine</p>

- being tested
- 2.11 describe the basic principle of operation of the power turbine under test, and the function of the individual components within the system
  - 2.12 describe the methods and procedures to be used to carry out the various tests
  - 2.13 explain how to carry out initial start-up procedures and checks (to include checking that the turbine starting and shutdown systems operate correctly, idle speed is satisfactory, fuel flow is operating correctly, oil pressure is to specification, and oil filters, connections, gaskets and seals are free from leaks)
  - 2.14 explain the need to apply turbine power in incremental stages, and to check all readings, temperatures and pressures at each stage
  - 2.15 explain how to record the results of each individual test, and the documentation that must be used for this
  - 2.16 explain whom to seek authorisation from if they need to alter or change the test procedures
  - 2.17 describe the procedures to be followed if the power turbine or system fails to meet the test specification
  - 2.18 explain how to analyse the test results and make valid decisions about the acceptability of the power turbine
  - 2.19 describe the potential problems that can occur with the testing activities, and how they can be overcome
  - 2.20 describe the things that may cause errors or discrepancies in/with the test results, and how to avoid them
  - 2.21 describe any environmental controls required relating to the testing
  - 2.22 describe the documentation to be completed at the end of the testing activities
  - 2.23 describe the extent of their own authority and to whom they should report if they have a problem that they cannot resolve.

## Unit 408

## Carrying out tests on overhauled piston engines (fixed dynamometer)

<b>UAN:</b>	D/600/5512
<b>Level:</b>	3
<b>Credit value:</b>	70
<b>GLH:</b>	210
<b>Relationship to NOS:</b>	This unit has been derived from Semta National Occupational Standard Mechanical Manufacturing Engineering Unit 119: Carrying Out Tests on Overhauled Piston Engines (Fixed Dynamometer) (Level 3).
<b>Endorsement by a sector or other appropriate body:</b>	This unit is endorsed by Semta, the Sector Skills Council for Science, Engineering and Manufacturing Technologies.
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out dynamometer tests on overhauled piston engines, such as naturally or mechanically aspirated two-stroke and four-stroke internal combustion engines or compression ignition engines, as appropriate to the engine type, in accordance with approved procedures. The learner will be required to carry out all necessary preparations to the engine in readiness for the tests to be carried out, and these will include ensuring that the engine is correctly connected to the dynamometer, that all ancillary equipment is fitted to the engine, appropriate blanking plates are fitted, test instrumentation is correctly connected and all necessary electrical checks are carried out.</p> <p>In carrying out the tests, the learner will be required to follow laid-down procedures, to ensure that the working area is clear, appropriate guards and notices are displayed, engine runs/tests are carried out in accordance with the appropriate schedule, monitoring procedures are complied with, analysis of results is made, and that test documentation is completed accurately and legibly.</p>

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The learner's responsibilities will require them to comply with organisational policy and procedures for the tests undertaken, and to report any problems with the testing activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their 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 undertaking the appropriate piston engine test procedures. The learner will understand the piston engine being tested, the specific test schedule to be followed, and will know what the various instruments and readings mean, in adequate depth to provide a sound basis for carrying out the tests to the required specification.

The learner will understand the safety precautions required when carrying out the testing activities, in particular those involved with fuelling and running the engine. 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.

<b>Learning outcome</b>
The learner will: 1. carry out tests on overhauled piston engines (fixed dynamometer)
<b>Assessment criteria</b>
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 testing activities: <ul style="list-style-type: none"><li>• obtain and use the appropriate documentation for the testing activities (such as job instructions, test schedule, test procedures and quality documentation)</li><li>• 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</li><li>• use safe and approved testing techniques and procedures</li><li>• return all tools and equipment to the correct location on completion of the activities</li><li>• leave the engine and work area in a clean and safe condition on completion of the activities</li></ul>

- 1.3 follow the appropriate procedures for use of tools and equipment to carry out the required tests
- 1.4 prepare the engine for testing and carry out initial start-up checks, to include all of the following, as applicable to the engine type:
  - connect the engine correctly to the dynamometer
  - fit all required engine ancillary equipment (such as starter motors, slave oil filters, magnetic chip detectors and strainers)
  - fit all required environmental equipment (such as forced air fans, exhaust extraction)
  - fit blanking plates (where appropriate)
  - filling the engine with oil
  - make all required connections to the engine (to include fuel connections, electrical and instrumentation)
  - carry out all necessary electrical checks, and confirm that the engine is ready for testing
  - ensure that all personal are clear of the test facility and that safe working distance procedures are maintained
  - load and prepare computer software for operation (where applicable)
  - check the engine starting system
  - run the engine and check that the engine shutdown system operates correctly
  - carry out idle checks
  - check that engine oil pressure is satisfactory
  - check that fuel flow is operating correctly
  - check all oil filters, connections, gaskets and seals for signs of leakage
- 1.5 set up and carry out the tests using the correct procedures and within agreed timescales
- 1.6 test one of the following types of piston engine:
  - two-stroke internal combustion engine
  - four-stroke internal combustion engine
  - compression ignition engine
- 1.7 undertake engine tests as, listed in the appropriate engine test schedule, to include all of the following:
  - initiating the engine test sequence
  - carrying out running and handling checks
  - carrying out performance curves
  - carrying out vibration surveys
  - checking that engine pressures are within specification
  - checking that engine temperature is within specification
  - checking that the throttle/high pressure fuel flow operates smoothly
  - ensuring that maximum power is achieved
  - checking exhaust gases (analysis)
- 1.8 deal with two of the following complexities during the engine tests:
  - engine runs with no faults
  - engine runs with faults
  - engines with intermittent faults

- 1.9 disconnect the engine on completion of the testing procedures, to include carrying out all of the following:
- shutting down the computer driver (where appropriate)
  - checking all oil filters, connections, gaskets and seals for signs of leakage
  - removing and checking magnetic chip detectors for contamination
  - removing and checking slave filters for contamination
  - installing the engine's own magnetic chip detectors and filters
  - draining all oil and fuel from the engine
  - removing all fitted blanks and instrumentation
  - removing the engine from the dynamometer, safely and correctly
  - preparing the engine for passing to the race team/customer
- 1.10 carry out tests on overhauled piston engines in compliance with one of the following:
- BS, ISO or BSEN standards and procedures
  - engine manufacturer's specification
  - customer standards and requirements
  - company standards and procedures
- 1.11 record the results of the tests in the appropriate format
- 1.12 record the results of the test, using one of the following:
- test report
  - job card
  - computer record
  - company-specific documentation
- 1.13 review and analyse the results and carry out further tests if necessary
- 1.14 use two of the following to review and analyse the results of the test run:
- engine test schedule
  - data sheets
  - calibration records
  - log cards/history sheet
  - fault records
  - other specific records.

<b>Learning outcome</b>
The learner will:
2. know how to carry out tests on overhauled piston engines (fixed dynamometer)
<b>Assessment criteria</b>
The learner can:
2.1 describe the specific safety practices and procedures that they need to observe when carrying out tests on overhauled piston engines (including any specific legislation, regulations/codes of practice required for the activities, equipment or materials used)
2.2 describe the health and safety requirements of the work area in



- which they are carrying out the activities, and the responsibility these requirements place on them
- 2.3 describe the safety procedures that must be carried out before tests are started on the engine (such as checking that the dynamometer safety system is functioning, and that all personnel are clear of the test area)
  - 2.4 describe the personal protective clothing and equipment to be worn during the testing activities
  - 2.5 describe the hazards associated with dynamometer testing of piston engines, and how to minimise them and reduce any risks
  - 2.6 describe the preparations to be carried out on the engine, prior to starting the engine tests (such as attaching to the dynamometer, fitting test instrumentation, fitting ancillary equipment, fitting blanking plates, filling the engine with oil, making fuel connections, attaching electrical power and making final electrical checks of all systems)
  - 2.7 explain how to obtain the required test schedules and specifications for the piston engine being tested, and how to check their currency and validity
  - 2.8 explain how to read and interpret the specifications, and whom they can seek assistance from if they have problems or issues regarding the test schedules or specifications
  - 2.9 explain how to access and set up the computer software required to run the engine tests
  - 2.10 describe the methods and procedures to be used to carry out the various engine tests
  - 2.11 describe the basic principle of operation of the piston engine under test, and the function of the individual components within the system
  - 2.12 explain how to carry out initial start-up procedures and checks (to include checking that the engine starting and shutdown systems operate correctly, idle speed is satisfactory, fuel flow is operating correct, oil pressure is to specification, and oil filters, connections, gaskets and seals are free from leaks)
  - 2.13 explain the need to apply engine power in incremental stages, and to check all readings, temperatures and pressures at each stage
  - 2.14 explain how to record the results of each individual test, and the documentation that must be used
  - 2.15 explain whom to seek authorisation from if they need to alter or change the test procedures
  - 2.16 describe the procedures to be followed if the engine or system fails to meet the test specification
  - 2.17 explain how to analyse the test results and make valid decisions about the acceptability of the engine
  - 2.18 describe the potential problems that can occur with the testing activities, and how they can be overcome
  - 2.19 describe the things that may cause errors or discrepancies in/with the test results, and how to avoid them
  - 2.20 describe any environmental controls required relating to the testing
  - 2.21 describe the documentation to be completed at the end of the testing 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 3 NVQ in Mechanical Manufacturing Engineering (1682).

### Literacy, language, numeracy and ICT skills development

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

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

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

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

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

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

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

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

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

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

## Useful contacts

<b>UK learners</b> General qualification information	T: +44 (0)844 543 0033 E: <b>learnersupport@cityandguilds.com</b>
<b>International learners</b> General qualification information	T: +44 (0)844 543 0033 F: +44 (0)20 7294 2413 E: <b>intcg@cityandguilds.com</b>
<b>Centres</b> 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: <b>centresupport@cityandguilds.com</b>
<b>Single subject qualifications</b> 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: <b>singlesubjects@cityandguilds.com</b>
<b>International awards</b> 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: <b>intops@cityandguilds.com</b>
<b>Walled Garden</b> 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: <b>walledgarden@cityandguilds.com</b>
<b>Employer</b> Employer solutions, Mapping, Accreditation, Development Skills, Consultancy	T: +44 (0)121 503 8993 E: <b>business@cityandguilds.com</b>
<b>Publications</b> Logbooks, Centre documents, Forms, Free literature	T: +44 (0)844 543 0000 F: +44 (0)20 7294 2413

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

## **City & Guilds Group**

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

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