

# Level 3 NVQ Diploma in Aeronautical Engineering (Aircraft Engine Overhaul) (1789-31)

September 2018 version 1.2





## Qualification at a glance

<b>Subject area</b>	<b>Engineering</b>
<b>City &amp; Guilds number</b>	1789
<b>Age group approved</b>	16-18, 19+
<b>Entry requirements</b>	Level 3
<b>Assessment</b>	Portfolio
<b>Fast track</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 Diploma in Aeronautical Engineering (Aircraft Engine Overhaul)	1789-31	600/1575/5

<b>Version and date</b>	<b>Change detail</b>	<b>Section</b>
1.1 November 2012	<ul style="list-style-type: none"> <li>• Formatting (not allowing sentences to split between two pages)</li> <li>• Amended the numbering of the assessment criteria for learning outcome 1</li> </ul>	<ul style="list-style-type: none"> <li>• Units 001, 403, 404</li> <li>• Unit 562</li> </ul>
1.2 September 2018	<ul style="list-style-type: none"> <li>• Changed from a seven to a nine</li> </ul>	<ul style="list-style-type: none"> <li>• Unit 001 assessment criteria 2.3</li> </ul>



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# 1 Introduction

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

Area	Description
Who is the qualification for?	It is for candidates who work or want to work in the engineering sector
What does the qualification cover?	It allows candidates to learn, develop and practise the skills required for employment and/or career progression in the engineering sector.
Is the qualification part of a framework or initiative?	It serves as a technical certificate, in the engineering Apprenticeship framework.

## Structure

To achieve the **Level 3 Diploma in Aeronautical Engineering (Aircraft Engine Overhaul)**, learners must achieve **20** credits from the mandatory units and a minimum of **143** credits from the optional units available.

Unit accreditation number	City & Guilds unit	Unit title	Credit value
<b>Mandatory</b>			
A/601/5013	001	Complying with statutory regulations and organisational safety requirements	5
Y/601/5102	002	Using and interpreting engineering drawings and documents	5
K/601/5055	403	Working efficiently and effectively in engineering	5
K/601/4228	404	Reinstating the work area on completion of activities	5
<b>Optional</b>			
K/601/4505	437	Dressing aircraft engines	63
K/601/4889	561	Carrying out test bed runs on aircraft engines (uninstalled)	150
J/601/4902	562	Overhauling aircraft gas turbine engines by module replacement	150
J/601/4916	563	Overhauling aircraft gas turbine engine compressor assemblies	135
Y/601/4919	564	Overhauling aircraft gas turbine engine combustion assemblies	150

<b>Unit accreditation number</b>	<b>City &amp; Guilds unit</b>	<b>Unit title</b>	<b>Credit value</b>
Y/601/4970	565	Overhauling aircraft gas turbine engine turbine assemblies	125
H/601/4972	566	Overhauling aircraft gas turbine engine gearbox assemblies	125
J/601/4981	567	Overhauling aircraft piston engines	125
A/601/6114	612	Dismantling aircraft gas turbine engines to module/unit level	80
T/601/6127	613	Rebuilding aircraft gas turbine engines assemblies after overhaul	150



## 2 Centre requirements

### Approval

Centres currently offering the City & Guilds NVQ in Aeronautical Engineering (1689) 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

#### Physical resources and site agreements

Centres can use specially designated areas within a centre to assess, for example, the installation of specialised electrical systems, alignment and setting up of electric motors and driven devices (pumps, compressors and generators). The equipment, systems and machinery must meet industrial standards and be capable of being used under normal working conditions, for example electric motors must have a method of applying sufficient power and not be connected up to show movement.

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

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

#### Assessors and internal verifier

##### Assessor requirements to demonstrate effective assessment practice

Assessment must be carried out by competent Assessors that as a minimum must hold the 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 take the same form as in the workplace.

### **Age restrictions**

There is no age restriction for this qualification unless this is a legal requirement of the process or the environment.



## 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.

### Support materials

The following resources are available for these qualifications

Description	How to access
Personal Learning and Thinking skills (required for apprenticeship)	<a href="http://www.cityandguilds.com">www.cityandguilds.com</a> , 1789 product documentation pages
Centre approval forms	<a href="http://www.cityandguilds.com">www.cityandguilds.com</a>
Semta QCF Assessment Strategy	<a href="http://www.cityandguilds.com">www.cityandguilds.com</a>
Unit assessment guidance	<a href="http://www.cityandguilds.com">www.cityandguilds.com</a> , 1789 product documentation pages

### Recording documents

Candidates and centres may decide to use a paper-based or electronic method of recording evidence. City & Guilds endorses several ePortfolio systems, including our own, **Learning Assistant**, an easy-to-use and secure online tool to support and evidence learners' progress towards achieving qualifications. 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** (extract from Semta QCF Unit Assessment Strategy 1 January 2011)

### 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 learner's 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 together with:
- 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

Below is a list of the learning outcomes for all the units. If you want to download a complete set of units, go to **[www.cityandguilds.com](http://www.cityandguilds.com)**

### Structure of units

These units each have the following:

- City & Guilds reference number
- unit accreditation number (UAN)
- title
- level
- credit value
- unit aim
- relationship to NOS, other qualifications and frameworks
- endorsement by a sector or other appropriate body
- information on assessment
- learning outcomes which are comprised of a number of assessment criteria
- notes for guidance.

## Unit 001

# Complying with statutory regulations and organisational safety requirements

<b>UAN:</b>	<b>A/601/5013</b>
<b>Level:</b>	2
<b>Credit value:</b>	5
<b>GLH:</b>	35
<b>Relationship to NOS:</b>	This unit has been derived from national occupational standard: Complying with statutory regulations and organisational safety requirements (Suite 2).
<b>Endorsement by a sector or regulatory body:</b>	This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing
<b>Aim:</b>	<p>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.</p> <p>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.</p> <p>The learner will also be required to identify the hazards and risks that are associated with their job. Typically, these will focus on their working environment, the tools and equipment that they use, the materials and substances that they use, any working practices that do not follow laid-down procedures, and manual</p>

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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. Be able to 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>o eye protection and personal protective equipment (PPE)</li><li>o COSHH regulations</li><li>o 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></ul>



	<ul style="list-style-type: none"> <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
2.2	describe the specific regulations and safe working practices and procedures that apply to their work activities
2.3	describe the warning signs for the nine main groups of hazardous substances defined by Classification, Packaging and Labelling of Dangerous Substances Regulations
2.4	explain how to locate relevant health and safety information for their tasks, and the sources of expert assistance when help is needed
2.5	explain what constitutes a hazard in the workplace
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
2.8	describe the processes and procedures that are used to identify and rate the level of risk

- 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 001                    Complying with statutory regulations and organisational safety requirements**

## Supporting information

### **Guidance**

2.1 (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)

2.5 (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)

2.7 (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 (such as safety inspections, the use of hazard checklists, carrying out risk assessments, COSHH assessments)

## Unit 002

## Using and interpreting engineering data and documentation

<b>UAN:</b>	<b>Y/601/5102</b>
<b>Level:</b>	2
<b>Credit value:</b>	5
<b>GLH:</b>	25
<b>Relationship to NOS:</b>	This unit has been derived from national occupational standard: Using and interpreting engineering data and documentation (Suite 2).
<b>Endorsement by a sector or regulatory body:</b>	This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing
<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> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for obtaining and using the documentation applicable to the activity. They will be expected to report any problems with the use and interpretation of the documents that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to work to instructions if necessary, with an appropriate level of supervision or as a member of a team, and take personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.</p> <p>The learner's underpinning knowledge will provide a good understanding of the types of documentation used, and will provide an</p>

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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. Be able to 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><li>• location/orientation of parts</li><li>• process or treatments required</li><li>• dismantling/assembly sequence</li><li>• inspection/testing requirements</li><li>• number/volumes required</li></ul>

- 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
  - 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
  - specifications
  - reference materials
  - schedules
  - operation sheets
  - service/test information
  - planning documentation
  - quality control documents
  - company specific technical instructions

<ul style="list-style-type: none"> <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> <p>1.8 deal promptly and effectively with any problems within their control and report those which cannot be solved</p> <p>1.9 report any inaccuracies or discrepancies in documentation and specifications.</p>
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<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
2.5 explain how to use other sources of information to support the data
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
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
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 002            Using and interpreting engineering data and documentation**

### Supporting information

#### **Guidance**

1.6 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)

1.7 instructions (such as job instructions, drawing instructions, manufacturers instructions), specifications (such as material, finish, process, contractual, calibration), reference materials (such as manuals, tables, charts, guides, notes)

2.4 (such as such as drawings, job instructions product data sheets, manufacturers' manuals, financial spreadsheets, production schedules, inspection and calibration requirements, customer information)

2.5 (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)

2.14 (such as production drawings, assembly drawings, circuit and wiring diagrams, block and schematic diagrams)

2.16 (such as surface finish, electronic components, weld symbols, linear and geometric tolerances, pressure and flow characteristics)



## Unit 403

## Working efficiently and effectively in engineering

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

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opportunities for, improvements that could be made to working practices and procedures.

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

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

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

<b>Learning outcome</b>
The learner will: 1. Be able to 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></ul>

- tools and equipment required are obtained and checked that they are in a safe and useable condition
  - all necessary drawings, specifications and associated documentation is obtained
  - job instructions are obtained and understood
  - the correct materials or components are obtained
  - storage arrangements for work are appropriate
  - appropriate authorisation to carry out the work is obtained
- 1.4 check that there are sufficient supplies of materials and/or consumables and that they meet work requirements
- 1.5 ensure that completed products or resources are stored in the appropriate location on completion of the activities
- 1.6 complete work activities, to include all of the following:
- completing all necessary documentation accurately and legibly
  - returning tools and equipment
  - returning drawings and work instructions
  - identifying, where appropriate, any unusable tools, equipment or components
  - arranging for disposal of waste materials
- 1.7 tidy up the work area on completion of the engineering activity
- 1.8 deal promptly and effectively with problems within their control and report those that cannot be resolved
- 1.9 deal with problems affecting the engineering process, to include two of the following:
- materials
  - tools and equipment
  - drawings
  - job specification
  - quality
  - people
  - timescales
  - safety
  - activities or procedures
- 1.10 contribute to and communicate opportunities for improvement to working practices and procedures
- 1.11 make recommendations for improving to two of the following:
- working practices
  - working methods
  - quality
  - safety
  - tools and equipment
  - supplier relationships
  - internal communication
  - customer service
  - training and development
  - teamwork
  - other

1.12	maintain effective working relationships with colleagues to include two of the following: <ul style="list-style-type: none"> <li>• colleagues within own working group</li> <li>• colleagues outside normal working group</li> <li>• line management</li> <li>• external contacts</li> </ul>
1.13	review personal training and development as appropriate to the job role
1.14	review personal development objectives and targets to include one of the following: <ul style="list-style-type: none"> <li>• dual or multi-skilling</li> <li>• training on new equipment / technology</li> <li>• increased responsibility</li> <li>• understanding of company working practices, procedures, plans and policies</li> <li>• other specific requirements.</li> </ul>

<b>Learning outcome</b>
The learner will: 2. Know how to work efficiently and effectively in engineering
<b>Assessment criteria</b>
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
- 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 403            Working efficiently and effectively in engineering**

Supporting information

## **Guidance**

2.21 (such as Equal Opportunities Act, Race and Sex Discrimination, working Time Directive)

## Unit 404

## Reinstating the work area on completion of activities

<b>UAN:</b>	<b>K/601/4228</b>
<b>Level:</b>	3
<b>Credit value:</b>	5
<b>GLH:</b>	25
<b>Relationship to NOS:</b>	This unit has been derived from national occupational standard aeronautical engineering Unit 004: Reinstating the work Area on completion of activities (Suite 3).
<b>Endorsement by a sector or regulatory body:</b>	This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to reinstate the work area, in accordance with approved procedures. The learner will be required to follow the correct procedures for the safe storage of finished products and surplus materials, and to correctly identify and separate all waste materials and ensure that they are removed to their designated locations. The learner will also need to ensure that all tools, equipment and documents used are accounted for and returned to the appropriate places. Tidying of the work area will be of prime importance and includes office and clean working area environments, workshops, staging and platforms, internal areas of aircraft such as wings, tanks and fuselage sections, and areas that are airside. The learner's responsibilities will require them to comply with organisational policy and procedures for the activities undertaken, and to report any problems with the reinstatement activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality of the work they carry out.</p> <p>The learner's knowledge will provide a good understanding of their work, and provide an informed approach to applying the required procedures. The learner will understand the need for reinstating the work areas, and will</p>

know about the storage requirements of the products, equipment, materials, documentation and consumables, in adequate depth to provide a sound basis for carrying out the activities to the required standard and ensuring that the work area is reinstated satisfactorily.

The learner will understand the safety precautions required when reinstating the work area. 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. Be able to reinstate the work area on completion of 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 activities during reinstatement of the work area: <ul style="list-style-type: none"> <li>• work to current schedules</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>• report any loss or damage to equipment</li> <li>• report any identified hazards within the work area</li> <li>• return all consumables and materials to their correct location</li> <li>• complete any documentation as required</li> </ul> 1.3 separate equipment, components, and materials for re-use from waste items and materials 1.4 store reusable materials and equipment in an appropriate location 1.5 correctly label and store four the following resources: <ul style="list-style-type: none"> <li>• finished products/components</li> <li>• components requiring overhaul/repair</li> <li>• surplus materials/components</li> <li>• tooling, jigs, fixtures or other equipment used</li> <li>• drawings requiring actioning/adjusting</li> <li>• scrap components</li> <li>• measuring and test instruments</li> <li>• finished drawings</li> <li>• finished documentation</li> <li>• documentation requiring actioning/adjusting</li> </ul> 1.6 dispose of waste materials in line with organisational and environmental safe procedures



1.7	deal with waste materials, in line with company and environmental regulations, to include two of the following: <ul style="list-style-type: none"> <li>• correctly segregating waste materials</li> <li>• correctly dispose of waste materials</li> <li>• disposing of joining compounds, sealants and adhesives</li> <li>• disposing of other chemical products</li> <li>• removing non-hazardous materials</li> <li>• disposing of fluid waste</li> </ul>
1.8	restore the work areas to a safe condition in accordance with agreed requirements and schedules
1.9	carry out reinstatement activities on two work areas from: <ul style="list-style-type: none"> <li>• workshops/hangers</li> <li>• airside</li> <li>• areas at height</li> <li>• internal areas of aircraft</li> <li>• office environment</li> <li>• computer aided design (CAD) environment</li> <li>• technical/clean room environment</li> <li>• other appropriate environment</li> </ul>
1.10	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 reinstate the work area on completion of activities
<b>Assessment criteria</b>
The learner can: 2.1 explain the specific safety practices and procedures they need to observe when reinstating the work area 2.2 explain the health and safety requirements of the work area where they are carrying out the activities, and the responsibility these requirements place on them 2.3 describe the hazards associated with reinstating the work area, and explain how to minimise them and reduce any risks 2.4 explain the safe working practices and procedures to be followed when carrying out the various activities 2.5 explain what personal protective clothing and equipment needs to be worn, and where this can be obtained 2.6 explain why work areas need to be restored to a set standard, and what these requirements are 2.7 describe the types of work area that will need to be restored 2.8 Explain the importance of tool and equipment control, and why this is critical within the aerospace industry 2.9 explain the meaning of 'foreign object debris', and why it is vital to ensure that this does not occur or is removed 2.10 describe the stores procedures for tools and equipment, documentation and surplus or waste materials 2.11 explain what materials will need to be stored and disposed of, and why they need to be segregated, correctly identified and labelled

- 2.12 explain how the various disposal bins can be identified
- 2.13 explain the procedures for disposing of hazardous materials
- 2.14 explain what documentation needs to be used on completion of the reinstatement activities
- 2.15 describe the extent of their own responsibility and explain to whom they should report if they have problems that they cannot resolve.

# **Unit 404            Reinstating the work area on completion of activities**

## Supporting information

### **Guidance**

1.7 disposing of fluid waste (such as oil, hydraulic fluids, fuel)

1.9 (such as platforms, staging, lifts), internal areas of aircraft (such as wings, tanks, fuselage sections)

2.1 (such as any specific legislation, regulations/codes of practice for the activities, equipment or materials)

2.4 (such as lifting and handling techniques)

2.7 (such as office environments, computer aided design (CAD) environment, technical/clean room environment, workshops, test areas, stages and platforms and aircraft areas such as wing, tank, fuselage, airside section areas)

2.12 (such as colour coded, labelled)

2.13 (such as chemicals, adhesives, oil, hydraulic fluids, fuel)

## Unit 437

## Dressing aircraft engines

<b>UAN:</b>	<b>K/601/4505</b>
<b>Level:</b>	3
<b>Credit value:</b>	63
<b>GLH:</b>	133
<b>Relationship to NOS:</b>	This unit has been derived from national occupational standard aeronautical engineering Unit 037: Dressing aircraft engines (Suite 3).
<b>Endorsement by a sector or regulatory body:</b>	This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out assembly operations to dress aircraft engines, in accordance with approved procedures. The learner will be required to obtain all the required tools and equipment for the assembly/dressing operations, and to check that they are in a safe and usable condition. In carrying out the assembly operations, the learner will be required to follow laid-down procedures and specific assembly techniques, in order to assemble the various components onto the engine. The assembly activities will also include making all necessary checks and adjustments to ensure that components are correctly orientated, positioned and aligned, that moving parts have the correct working clearances, that all fasteners are tightened to the correct torque, and that the assembled parts function as per the specification.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the assembly activities undertaken, and to report any problems with the assembly activities, materials or equipment that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to ensure that all tools, equipment and materials used in the installation are correctly accounted for on completion of the activities, and to complete all necessary job/task documentation accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for</p>

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

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

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

<b>Learning outcome</b>
The learner will: 1. Be able to dress aircraft 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 assembly activities: <ul style="list-style-type: none"><li>• obtain and use the appropriate 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 for the assembly area</li><li>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration date</li><li>• ensure that all the required components are available and have the correct part numbers</li><li>• follow safe practice/approved assembly/fitting techniques and procedures at all times</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 assembly activities</li><li>• ensure that all work carried out is correctly documented and recorded</li><li>• leave the work area and assembly in a safe and appropriate condition, free from foreign object debris on completion of the activities</li></ul>

- 1.3 follow the relevant instructions, assembly drawings and any other specifications
- 1.4 check that the specified components are available and that they are in a usable condition
- 1.5 use the appropriate methods and techniques to assemble the components in their correct positions
- 1.6 use five of the following assembly methods and techniques:
  - assembly of components by pressure
  - assembly of components by expansion or contraction
  - aligning components
  - setting working clearances
  - torque setting of fasteners
  - applying sealant/adhesives
  - drilling and riveting
  - electrical bonding of components
  - securing components using mechanical fasteners and threaded devices
  - making connections to electrical components and harnesses
  - applying bolt locking methods (split pins, wire locking, lock nuts, stiff nuts)
- 1.7 carry out the dressing of the aircraft engine, by fitting all of the following:
  - fuel pipes
  - manifolds
  - oil pipes
  - pumps
  - filters
  - air pipes
  - valves (solenoid, bleed, pressure)
  - coolers (air, oil, fuel)
  - heat exchangers (oil, fuel)
  - sensors (vibration, fire)
  - brackets
  - engine suspension mounts
  - thermocouples
  - electrical modules (if applicable)
  - electrical harnesses (if applicable)
- 1.8 secure the components using the specified connectors and securing devices
- 1.9 check the completed assembly to ensure that all operations have been completed and the finished assembly meets the required specification
- 1.10 carry out all of the required checks for accuracy, using the correct inspection testing equipment, to include:
  - positional accuracy
  - freedom of movement
  - operating/working clearance
  - torque loadings

<ul style="list-style-type: none"> <li>• orientation</li> <li>• alignment</li> <li>• completeness</li> <li>• freedom from damage or foreign objects</li> </ul> <p>1.11 dress aircraft engine assemblies in compliance with one of the following standards:</p> <ul style="list-style-type: none"> <li>• Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)</li> <li>• extended twin operations procedures (ETOpS) (where appropriate)</li> <li>• Ministry of Defence (MoD)</li> <li>• Federal Aviation Authority (FAA)</li> <li>• BS, ISO or BSEN standards and procedures</li> <li>• customer standards and requirements</li> <li>• company standards and procedures</li> <li>• engine manufacturer's requirements</li> </ul> <p>1.12 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 dress aircraft engines
<b>Assessment criteria</b>
The learner can: 2.1 explain the specific safety precautions to be taken whilst carrying out the dressing of aircraft engines 2.2 explain the health and safety requirements of the work area in which they are carrying out the engine dressing activities, and the responsibility they place on them 2.3 describe the hazards associated with the dressing of aircraft engines, and explain how to minimise them and reduce any risks 2.4 explain the COSHH regulations with regard to the substances used in the engine dressing process 2.5 explain what personal protective equipment and clothing needs to be worn during the engine dressing activities 2.6 describe the various types of drawing and specification that are used during the engine dressing and assembly activities 2.7 explain how to identify the components to be used; component identification systems 2.8 explain what preparations and inspections to be undertaken on the components, prior to fitting them into the assembly 2.9 describe the assembly methods and procedures to be used, and explain the importance of adhering to the procedures 2.10 explain how the components are to be aligned and positioned prior to securing, and the tools and equipment that are used 2.11 describe the various mechanical fasteners that will be used, and explain their method of installation 2.12 explain the importance of using the specified fasteners for the assembly, and why they must not use substitutes 2.13 explain how to complete basic fitting practices, meeting regulatory

and organisational requirements

- 2.14 explain how to deal with components or fastening devices that are incorrectly assembled, damaged or have other faults
- 2.15 explain the application of sealants and adhesives within the assembly activities, and the precautions that must be taken when working with them
- 2.16 describe the quality control procedures to be followed during the assembly operations
- 2.17 explain how to conduct any necessary checks to ensure the accuracy and quality of the assemblies produced
- 2.18 explain how to detect assembly defects, and what to do to rectify them
- 2.19 explain how to move large components and assemblies, the methods and equipment used to transport, handle and lift the components into position, and how to check that the equipment is within its current certification dates
- 2.20 explain how to check that the tools and equipment to be used are correctly calibrated and are in a safe and serviceable condition
- 2.21 explain the importance of ensuring that all tools are used correctly and within their permitted operating range
- 2.22 explain the importance of ensuring that the completed assembly is free from dirt, swarf and foreign objects
- 2.23 explain the importance of ensuring that all tools, equipment and components are accounted for and returned to their correct location on completion of the assembly activities
- 2.24 describe the things that can go wrong with the engine dressing activities, and explain how they can be avoided
- 2.25 explain the importance of informing appropriate people of non-conformances
- 2.26 describe the extent of their own responsibility and explain to whom they should report if they have problems that they cannot resolve



## **Unit 437            Dressing aircraft engines**

### Supporting information

#### **Guidance**

1.2 (such as job instructions, aircraft engine/module assembly drawings, planning and quality control documentation)

2.1 (such as any specific legislation, regulations or codes of practice relating to the activities, equipment or materials)

2.7 (such as codes and component orientation indicators)

2.10 (such as jigs and fixtures)

2.11 (such as open and blind rivets, threaded fasteners, special securing devices)

2.13 (such as torque tightening, wire locking, fitting wire thread inserts, fitting O-ring seals, fitting lock nuts, blue bedding, seals, tab washers, cup washers and swage nuts)

2.18 (such as ineffective fasteners, foreign object damage)

## Unit 561

## Carrying out test bed runs on aircraft engines (uninstalled)

<b>UAN:</b>	<b>K/601/4889</b>
<b>Level:</b>	3
<b>Credit value:</b>	150
<b>GLH:</b>	357
<b>Relationship to NOS:</b>	This unit has been derived from national occupational standard aeronautical engineering Unit 161: carrying out test bed runs on aircraft engines (uninstalled) (Suite 3).
<b>Endorsement by a sector or regulatory body:</b>	This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out test bed runs on aircraft engines, as appropriate to the engine type, in accordance with approved procedures. The engines to be tested will include turbo prop, turbo jet, turbo fan, ducted fan, turbo shaft, piston engines, auxiliary power units (APU), and ground turbine start units (GTS).</p> <p>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 mounted to the test bed/pylon, that all ancillary equipment is fitted to the engine, appropriate blanking plates are fitted, test instrumentation is correctly connected and that 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> <p>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</p>

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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 engine test procedures. The learner will understand the 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 engines. 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. Be able to carry out test bed runs on aircraft engines (uninstalled)
<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 engine for testing by carrying out all of the following, as applicable to the engine type: <ul style="list-style-type: none"><li>• obtain and use the correct issue of engine 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 engine</li><li>• attach and secure the engine to the test pylon</li><li>• fit all required ancillary equipment (to include starter motors, control valves, slave oil filters, magnetic chip detectors and strainers)</li><li>• fit appropriate blanks (to include bleed off-take, anti-icing, generator and hydraulic)</li><li>• make all required connections to the engine (to include fuel connections, electrical and instrumentation)</li><li>• carry out all necessary electrical checks, and confirm that the engine is ready for testing</li><li>• ensure that all personal are clear of the test facility and that safe working distance procedures are maintained</li></ul>

- 1.3 follow the appropriate procedures for use of tools and equipment to carry out the required tests
- 1.4 set up and carry out the tests using the correct procedures and within agreed timescales
- 1.5 carry out tests to appropriate schedules, on one of the following types of engine:
  - turbo prop
  - turbo jet
  - turbo-fan
  - ducted fan
  - turbo-shaft
  - piston engines
  - auxiliary power unit (APU)
  - ground turbine start (GTS)
- 1.6 carry out tests to appropriate schedules on one of the following categories of engines:
  - production engines
  - repaired/overhauled engines
  - development engines
- 1.7 undertake engine tests, as listed in the appropriate engine test schedule, to include all of the following:
  - visually checking that the engine is free from any damage or obvious defects
  - filling the engine with oil
  - checking that engine 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 engine pressure ratios are within specification
  - checking that engine temperature is within specification
  - checking that throttle/high pressure fuel flow operates smoothly
  - checking that the bleed air system functions correctly
  - ensuring that maximum thrust/power is achieved
  - checking that fire detection and protection equipment is functioning
- 1.8 deal with two of the following complexities during the engine tests:
  - engine runs with no faults
  - engine runs with faults
  - engine with intermittent faults
- 1.9 de-rig the engine on completion of the testing procedures, to include carrying out all of the following:
  - 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 blanks and test instrumentation
  - removing the engine from the pylon, safely and correctly
  - passing the engine to dispatch (where applicable)
- 1.10 carry out tests in compliance with one of the following:
- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
  - Ministry of Defence (MoD)
  - Federal Aviation Authority (FAA)
  - Joint Airworthiness Authority (JAA)
  - extended twin operations procedures (ETOpS)
  - BS, ISO or BSEN standards and procedures
  - customer standards and requirements
  - company standards and procedures
  - power plant manufacturer's specific requirements
- 1.11 record the results of the tests in the appropriate format
- 1.12 review and analyse the results of the tests, using two of the following, and carry out further tests if necessary:
- engine test schedule
  - data sheets
  - calibration records
  - log cards/history sheet
  - fault records
  - maintenance manuals and records
  - company-specific documentation

### **Learning outcome**

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The learner will:

2. Know how to carry out test bed runs on aircraft engines (uninstalled)
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### **Assessment criteria**

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The learner can:

- 2.1 explain the specific safety practices and procedures that they need to observe when testing aircraft engines
- 2.2 explain the importance of maintenance on, and impact upon ETOpS systems, legislation and local procedures
- 2.3 explain 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
- 2.4 explain the safety procedures that must be carried out before tests are started on the engine
- 2.5 explain what protective clothing and equipment needs to be worn during the testing activities
- 2.6 describe the hazards associated with testing aircraft engines, and explain how to minimise them and reduce any risks
- 2.7 explain what preparations need to be carried out on the engine prior to starting the engine tests
- 2.8 explain how to obtain the required test schedules and specifications for the aircraft and engine type being tested, and how to check their currency and validity

- 2.9 explain how to read and interpret the specifications, and from whom they can seek assistance if they have problems or issues regarding the test schedules or specifications
- 2.10 explain the correct operating procedures for the engines being tested
- 2.11 describe the basic principle of operation of the engines under test, and explain the function of the individual units within the system
- 2.12 describe the testing methods and procedures to be used to carry out the various engine tests
- 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 for this
- 2.15 explain from whom to seek authorisation if they need to alter or change the test procedures
- 2.16 explain how to analyse the test results, and how to make valid decisions about the acceptability of the engine
- 2.17 explain the procedures to be followed if the engine or system fails to meet the test specification
- 2.18 describe the potential problems that can occur with the testing activities, and explain how they can be overcome
- 2.19 describe things that may cause errors or discrepancies in/with the test results, and explain how to avoid them
- 2.20 explain any required environmental controls relating to the testing
- 2.21 explain what documentation needs to be completed at the end of the testing activities
- 2.22 explain why equipment control is critical, and what to do if a piece of equipment is unaccounted for on completion of the activities
- 2.23 describe the extent of their own authority and explain to whom they should report if they have a problem that they cannot resolve

# **Unit 561                      Carrying out test bed runs on aircraft engines (uninstalled)**

## Supporting information

### **Guidance**

2.1 (including any specific legislation, regulations/codes of practice required for the activities, equipment or materials used)

2.4 (such as the lock guard system is functioning, test cell is empty of people, bed doors are closed, all personnel are clear of the test area)

2.7 (such as attaching to the test pylon, 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)

## Unit 562

# Overhauling aircraft gas turbine engines by module replacement

<b>UAN:</b>	<b>J/601/4902</b>
<b>Level:</b>	3
<b>Credit value:</b>	150
<b>GLH:</b>	357
<b>Relationship to NOS:</b>	This unit has been derived from national occupational standard aeronautical engineering Unit 162: Overhauling aircraft gas turbine engines by module replacement (Suite 3).
<b>Endorsement by a sector or regulatory body:</b>	This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out a complete overhaul of aircraft gas turbine engines by module replacement, in accordance with approved procedures. The engine to be overhauled will have been removed from the aircraft, and the overhauling activities may take place in a workshop or hangar.</p> <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 the engine nacelles/outer casing, removing all ancillary equipment and components and dismantling the engine down to the various sub-assembly units, such as fan case, front fan, compressor module, combustor module, turbine module and gearbox.</p> <p>The learner will then be expected to rebuild the engine, which will involve fitting replacement or overhauled sub-assembly units (such as compressor, combustor, turbine, and gearbox) and the replacement of all damaged, worn and 'lified' 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.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the overhaul of the aircraft gas</p>



turbine 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 aircraft gas turbine engines. The learner will understand the dismantling and reassembly methods and procedures used, and their application. The learner will know how the engine 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 aircraft gas turbine engines, 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. Be able to overhaul aircraft gas turbine engines 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 aircraft gas turbine engine:

- obtain and use the appropriate documentation (such as job instructions, engine overhaul manuals, engineering drawings, technical instructions, and other relevant maintenance documentation)
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - provide and maintain safe access and working arrangements for the overhauling area
  - obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current certification/calibration date
  - ensure that all oils, fluids and fuel have been drained/removed before breaking into the system
  - ensure that the engine is suitably supported, and that appropriate lifting and handling equipment is available
  - carry out the overhauling activities, using approved techniques and procedures at all times
  - 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 and engine in a safe and appropriate condition, free from foreign object debris and in a condition ready for testing
- 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 a major overhaul of one of the following types of aircraft gas turbine engine:
- turbo prop
  - ducted fan
  - turbo jet
  - turbo-shaft
  - turbo-fan
  - ground turbine start (GTS)
- 1.8 dismantle aircraft gas turbine engines, to include removing four of the following sub-assemblies:
- fan case
  - front fan
  - exhaust/reheat assembly
  - compressor module
  - combustor module
  - by-pass duct

- turbine
  - gear box
- 1.9 carry out all of the following activities on the equipment being overhauled
- pre-disassembly checks
  - removing engine nacelles/outer 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 'lifer' 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 engine components and sub-assemblies, to include:
- four of the following engine modules:
- fan case
  - front fan
  - compressor module
  - exhaust/reheat assembly
  - combustor module
  - turbine
  - gear box
  - by-pass duct
- plus eight of the following types of component:
- curvic couplings
  - bearings

- static seals/gaskets
  - dynamic seals
  - shims and packing
  - mechanical securing devices
  - locking devices
  - wire thread inserts
  - pipes and unions
  - mechanical controls (such as plungers, springs, rollers)
  - electrical units and controls (such as solenoids, motors, switches)
  - other specific components
- 1.11 carry out checks and tests on the overhauled engine, to include six of the following:
- positional accuracy
  - orientation
  - alignment
  - freedom of movement
  - bearing end float
  - operating/working clearance
  - electrical checks (such as continuity and earth bonding)
  - visual inspection for completeness and freedom from damage or foreign objects
  - 'special-to-type' test rig checks
- 1.12 overhaul aircraft gas turbine engines in compliance with one of the following:
- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
  - extended twin operations procedures (ETOpS) (where appropriate)
  - Ministry of Defence (MoD)
  - Federal Aviation Authority (FAA)
  - BS, ISO or BSEN standards and procedures
  - customer standards and requirements
  - company standards and procedures
  - engine 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 the relevant paperwork, to include one of the following, and pass it to the appropriate people:
- job cards
  - computer records
  - aircraft log books
  - engine overhaul logs or reports

<ul style="list-style-type: none"> <li>• work authorisation documents</li> <li>• permit to work/formal risk assessment and/or sign-on/off procedures</li> <li>• shift handover documentation</li> </ul> <p>1.17 dispose of unwanted components, waste materials and substances, in accordance with safe working practices and approved procedures</p> <p>1.18 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 aircraft gas turbine engines by module replacement
<b>Assessment criteria</b>
The learner can:
2.1 explain the specific safety practices and procedures that they need to observe when dismantling and replacing aircraft gas turbine engine modules
2.2 explain the importance of maintenance on, and impact upon ETOPS systems, legislation and local procedures
2.3 explain the health and safety requirements of the area in which the dismantling and module replacement activity is to take place, and the responsibility these requirements place on them
2.4 describe the hazards associated with dismantling and replacing aircraft gas turbine engine modules and explain how to minimise them and reduce any risks
2.5 explain the importance of wearing protective clothing and other appropriate safety equipment during the dismantling and module replacement activities
2.6 explain how to obtain and interpret drawings, specifications, manufacturers' manuals, history/maintenance reports, and other documents needed in the overhauling process
2.7 explain how to carry out currency/issue checks on the specifications they are working with
2.8 describe the quality control procedures to be followed during the overhauling operations
2.9 explain the procedure for obtaining replacement parts, materials and other consumables necessary for the overhaul
2.10 explain the company policy on the repair/replacement of components during the overhauling process
2.11 explain the terminology used in aircraft gas turbine engines and engine modules
2.12 describe the basic principles of how the engine functions and the working purpose of individual modules/units
2.13 explain the extent to which the equipment is to be dismantled for the overhaul
2.14 explain the sequence to be adopted for the dismantling/reassembling of various types of engine assemblies
2.15 describe the techniques used to dismantle the aircraft gas turbine engines without damage to the components or surrounding structure and explain the need to protect the system integrity by

- ensuring that exposed components are correctly covered/protected
- 2.16 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
  - 2.17 explain the need to ensure that lifting and handling equipment is within its current certification dates
  - 2.18 describe the methods of checking that components are fit for purpose, how to identify defects and wear characteristics, and explain the need to replace 'lified' items
  - 2.19 describe the uses of measuring equipment
  - 2.20 explain the methods of reassembling the aircraft gas turbine engine, using new or previously overhauled modules
  - 2.21 explain how to make adjustments to replaced components/assemblies to ensure that they function correctly
  - 2.22 describe the various mechanical fasteners that are used, and explain their method of removal and replacement
  - 2.23 describe the various types of electrical connector that are used, methods of unlocking, orientation indicators, and locating and locking in of the connections
  - 2.24 describe the tools and equipment used in the overhauling activities, and explain how to check that they are in a safe and usable condition
  - 2.25 explain the importance of ensuring that all tools are used correctly and within their permitted operating range
  - 2.26 explain 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
  - 2.27 describe the procedure for the safe disposal of waste materials
  - 2.28 explain what maintenance documentation and/or reports need to be completed following the overhauling activity
  - 2.29 describe the problems that can occur during the overhauling activity, and explain how they can be overcome
  - 2.30 describe the extent of their own authority and explain to whom they should report if they have a problem that they cannot resolve

# **Unit 562            Overhauling aircraft gas turbine engines by module replacement**

## Supporting information

### **Guidance**

2.1 (including any specific legislation, regulations/codes of practice for the activities, equipment or materials)

2.4 (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)

2.15 (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)

2.18 (such as seals and gaskets)

2.19 (such as micrometers, verniers, expansion indicators and other measuring devices)

2.20 (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)

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

2.22 (including bolts, nuts, rivets, threaded fasteners, special securing devices)

## Unit 563

## Overhauling aircraft gas turbine engine compressor assemblies

<b>UAN:</b>	<b>J/601/4916</b>
<b>Level:</b>	3
<b>Credit value:</b>	135
<b>GLH:</b>	322
<b>Relationship to NOS:</b>	This unit has been derived from national occupational standard aeronautical engineering Unit 163: Overhauling aircraft gas turbine engine compressor assemblies (Suite 3).
<b>Endorsement by a sector or regulatory body:</b>	This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out a complete overhaul of aircraft gas turbine engine compressor assemblies, in accordance with approved procedures. The compressor assembly to be overhauled will have been removed from the engine assembly, and the overhauling activities may take place in a workshop or hangar.</p> <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 sub-assemblies, removing the compressor blades, stators, bearings and seals, and stripping the compressor housing of all its components. The learner will then be expected 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 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 '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.</p>



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The learner's responsibilities will require them to comply with organisational policy and procedures for the overhauling of the aircraft gas turbine engine 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 aircraft gas turbine engine 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 aircraft gas turbine engine 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 and others in the workplace.

<b>Learning outcome</b>
The learner will: 1. Be able to overhaul aircraft gas turbine engine 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 aircraft gas turbine engine compressor assembly: <ul style="list-style-type: none"> <li>• obtain and use the appropriate documentation (such as job instructions, engine overhaul manuals, engineering drawings, technical instructions, and other relevant maintenance 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 for the overhauling area</li> <li>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current certification/calibration date</li> <li>• ensure that all oils, fluids and fuel have been drained/removed before breaking into the system</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, using approved techniques and procedures at all times</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 and compressor assembly in a safe and appropriate condition, free from foreign object debris 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 dismantle the aircraft gas turbine engine 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> </ul>

- curvic couplings
  - bearings
  - sub-assemblies
  - seals and gaskets
  - shims and packing
  - locking devices
  - wire thread inserts
  - pipes and unions
- 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 compressor
  - balancing components (where applicable)
  - 'blue bedding' components
  - making mechanical connections
  - setting and adjusting replaced components
  - tightening fastenings to the required torque
  - electrical bonding of components
  - 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 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
  - 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
- 1.10 carry out checks and tests on the overhauled equipment, to include six of the following:
- positional accuracy
  - orientation
  - alignment
  - freedom of movement
  - bearing end float
  - operating/working clearance
  - visual inspection for completeness and freedom from damage or foreign objects
  - 'special-to-type' test rig checks
- 1.11 overhaul aircraft gas turbine engine compressor assemblies in compliance with one of the following:
- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
  - Federal Aviation Authority (FAA)
  - 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 defects outside the planned overhaul schedule
- 1.14 complete the relevant documentation, in accordance with organisational requirements
- 1.15 complete the relevant paperwork, to include one of the following, and pass it to the appropriate people:
- job cards
  - computer records
  - aircraft log books
  - engine overhaul logs or reports
  - work authorisation documents
  - permit to work/formal risk assessment
- 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 aircraft gas turbine engine compressor assemblies
<b>Assessment criteria</b>
The learner can: 2.1 explain the specific safety practices and procedures that they need to observe when overhauling aircraft gas turbine engine compressor assemblies 2.2 explain 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 aircraft gas turbine engine compressor assemblies and explain how to minimise them and reduce any risks 2.4 explain 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 explain the procedure for obtaining replacement parts, materials and other consumables necessary for the overhaul 2.9 explain the company policy on the repair/replacement of components during the overhauling process 2.10 explain the terminology used in aircraft gas turbine engine 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 explain the extent to which the equipment is to be dismantled for overhaul 2.13 explain the sequence to be adopted for the dismantling/reassembling of the compressor assembly 2.14 describe the techniques used to dismantle the aircraft gas turbine engine compressor assembly, without damage to the components or surrounding structure and explain 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 explain the need to replace 'lified' items 2.18 describe the uses of measuring equipment 2.19 explain the methods of reassembling the aircraft gas turbine engine compressor assembly, using new or previously overhauled

components

- 2.20 explain how to make adjustments to replaced components/assemblies to ensure that they function correctly
- 2.21 describe the various mechanical fasteners that are used, and explain their method of removal and replacement
- 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/equipment used in the overhauling activities, and explain how to check that they are in a safe/usable condition
- 2.24 explain the importance of ensuring that all tools are used correctly and within their permitted operating range
- 2.25 explain 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 what maintenance documentation and/or reports need to be completed following the overhauling activity
- 2.28 describe the problems that can occur during the overhauling activity, and explain how they can be overcome
- 2.29 describe the extent of their own authority and explain to whom they should report if they have a problem that they cannot resolve

# **Unit 563                    Overhauling aircraft gas turbine engine compressor assemblies**

## Supporting information

### **Guidance**

2.1 (including any specific legislation, regulations/codes of practice for the activities, equipment or materials)

2.3 (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)

2.14 (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)

2.17 (such as seals and gaskets)

2.18 (such as micrometers, verniers, expansion indicators and other measuring devices)

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

2.21 (including bolts, nuts, rivets, threaded fasteners, special securing devices)

## Unit 564

## Overhauling aircraft gas turbine engine combustion assemblies

<b>UAN:</b>	<b>Y/601/4919</b>
<b>Level:</b>	3
<b>Credit value:</b>	150
<b>GLH:</b>	357
<b>Relationship to NOS:</b>	This unit has been derived from national occupational standard aeronautical engineering Unit 164: Overhauling aircraft gas turbine engine combustion assemblies (Suite 3).
<b>Endorsement by a sector or regulatory body:</b>	This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out a complete overhaul of aircraft gas turbine engine combustion assemblies, in accordance with approved procedures. The combustion assembly to be overhauled will have been removed from the engine, and the overhauling activities may take place in a workshop or hangar.</p> <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 sub-assemblies, 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 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,</p>



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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 aircraft gas turbine engine 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 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 techniques and procedures to aircraft gas turbine engine 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 aircraft gas turbine engine 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 understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

<b>Learning outcome</b>
The learner will: 1. Be able to overhaul aircraft gas turbine engine 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 aircraft gas turbine engine combustion assembly: <ul style="list-style-type: none"> <li>• obtain and use the appropriate documentation (such as job instructions, engine overhaul manuals, engineering drawings, technical instructions, and other relevant maintenance 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 for the overhaul area</li> <li>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current certification/calibration date</li> <li>• ensure that all oils, fluids and fuel have been drained/removed before breaking into the system</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, using approved techniques and procedures at all times</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 and combustion assembly in a safe and appropriate condition, free from foreign object debris 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 dismantle the aircraft gas turbine engine 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> </ul>

- nozzle guide vanes
  - outer guide vanes
  - seals and gaskets
  - shims and packing
  - locking devices
  - wire thread inserts
  - pipes and unions
- 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
  - making mechanical connections
  - setting and adjusting replaced components
  - tightening fastenings to the required torque
  - electrical bonding of components
  - 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 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
  - 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 equipment, to include six of the following:
- positional accuracy
  - orientation
  - alignment
  - freedom of movement
  - operating/working clearance
  - visual inspection for completeness and freedom from damage or foreign objects
  - 'special-to-type' test rig checks
- 1.11 overhaul aircraft gas turbine engine combustion assemblies in compliance with one of the following:
- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
  - Federal Aviation Authority (FAA)
  - 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 defects outside the planned overhauling schedule
- 1.14 complete the relevant documentation, in accordance with organisational requirements
- 1.15 complete the relevant paperwork, to include one of the following, and pass it to the appropriate people:
- job cards
  - computer records
  - aircraft log books
  - engine overhaul logs or reports
  - work authorisation documents
  - permit to work/formal risk assessment
- 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 aircraft gas turbine engine combustion assemblies
<b>Assessment criteria</b>
The learner can: 2.1 explain the specific safety practices and procedures that they need to observe when overhauling aircraft gas turbine engine combustion assemblies 2.2 explain 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 aircraft gas turbine engine combustion assemblies and explain how to minimise them and reduce any risks 2.4 explain 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 explain the procedure for obtaining replacement parts, materials and other consumables necessary for the overhaul 2.9 explain the company policy on the repair/replacement of components during the overhauling process 2.10 explain the terminology used in aircraft gas turbine engine 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 explain the extent to which the equipment is to be dismantled for overhaul 2.13 explain the sequence to be adopted for the dismantling/reassembling of the combustion assembly 2.14 describe the techniques used to dismantle the aircraft gas turbine engine combustion assembly, without damage to the components or surrounding structure and explain 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 explain the need to replace 'lived' items 2.18 describe the uses of measuring equipment 2.19 explain the methods of reassembling the aircraft gas turbine engine

- combustion assembly, using new or previously overhauled components
- 2.20 explain how to make adjustments to replaced components/assemblies to ensure that they function correctly
  - 2.21 describe the various mechanical fasteners that are used and explain their method of removal and replacement
  - 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/equipment used in the overhauling activities, and explain how to check that they are in a safe/usable condition
  - 2.24 explain the importance of ensuring that all tools are used correctly and within their permitted operating range
  - 2.25 explain 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 what maintenance documentation and/or reports need to be completed following the overhauling activity
  - 2.28 describe the problems that can occur during the overhauling activity, and explain how they can be overcome
  - 2.29 describe the extent of their own authority and explain to whom they should report if they have a problem that they cannot resolve

# Unit 564      Overhauling aircraft gas turbine engine combustion assemblies

## Supporting information

### Guidance

2.1 (including any specific legislation, regulations/codes of practice for the activities, equipment or materials)

2.3 (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)

2.14 (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)

2.17 (such as seals and gaskets)

2.18 (such as micrometers, verniers, expansion indicators and other measuring devices)

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

2.21 (including bolts, nuts, rivets, threaded fasteners, special securing devices)

## Unit 565

## Overhauling aircraft gas turbine engine turbine assemblies

<b>UAN:</b>	<b>Y/601/4970</b>
<b>Level:</b>	3
<b>Credit value:</b>	125
<b>GLH:</b>	315
<b>Relationship to NOS:</b>	This unit has been derived from national occupational standard aeronautical engineering Unit 165: Overhauling aircraft gas turbine engine turbine assemblies (Suite 3).
<b>Endorsement by a sector or regulatory body:</b>	This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out a complete overhaul of aircraft gas turbine engine turbine assemblies, in accordance with approved procedures. The turbine assembly to be overhauled will have been removed from the engine, and the overhauling activities may take place in a workshop or hangar.</p> <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; 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,</p>



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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 aircraft gas turbine engine 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 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 techniques and procedures to aircraft gas turbine engine 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 aircraft gas turbine engine turbine 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. Be able to overhaul aircraft gas turbine engine turbine 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 aircraft gas turbine engine turbine assembly: <ul style="list-style-type: none"> <li>• obtain and use the appropriate documentation (such as job instructions, engine overhaul manuals, engineering drawings, technical instructions, and other relevant maintenance 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 for the overhauling area</li> <li>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current certification/calibration date</li> <li>• ensure that all oils, fluids and fuel have been drained/removed before breaking into the system</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, using approved techniques and procedures at all times</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 and turbine assembly in a safe and appropriate condition, free from foreign object debris 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 dismantle the aircraft gas turbine engine 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> </ul>

- turbine blades
- bearing races
- bearings
- seals and gaskets
- shims and packing
- wire thread inserts
- locking devices
- pipes and unions

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 turbine unit
- balancing components (where applicable)
- 'blue bedding' components (where applicable)
- making mechanical connections
- setting and adjusting replaced components
- tightening fastenings to the required torque
- electrical bonding of components
- 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 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
- bearing races

- bearings locks and stops
  - static seals/gaskets
  - dynamic seals
  - shims and packing
  - 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
- 1.10 carry out checks and tests on the overhauled equipment, to include six of the following:
- positional accuracy
  - orientation
  - alignment
  - freedom of movement
  - bearing end float
  - operating/working clearance
  - visual inspection for completeness and freedom from damage or foreign objects
  - 'special-to-type' test rig checks
- 1.11 overhaul aircraft gas turbine engine turbine assemblies in compliance with one of the following:
- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
  - Federal Aviation Authority (FAA)
  - 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 defects outside the planned overhauling schedule
- 1.14 complete the relevant documentation, in accordance with organisational requirements
- 1.15 complete the relevant paperwork, to include one of the following, and pass it to the appropriate people:
- job cards
  - computer records
  - aircraft log books
  - engine overhaul logs or reports
  - work authorisation documents
  - permit to work/formal risk assessment
- 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

### **Learning outcome**

The learner will:

2. Know how to overhaul aircraft gas turbine engine turbine assemblies

### **Assessment criteria**

The learner can:

- 2.1 explain the specific safety practices and procedures that they need to observe when overhauling aircraft gas turbine engine turbine assemblies
- 2.2 explain 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 aircraft gas turbine engine turbine assemblies and explain how to minimise them and reduce any risks
- 2.4 explain 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 explain the procedure for obtaining replacement parts, materials and other consumables necessary for the overhaul
- 2.9 explain the company policy on the repair/replacement of components during the overhauling process
- 2.10 explain the terminology used in aircraft gas turbine engine 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 explain the extent to which the equipment is to be dismantled for overhaul
- 2.13 explain the sequence to be adopted for the dismantling/reassembling of the turbine assembly
- 2.14 describe the techniques used to dismantle the aircraft gas turbine engine turbine assembly, without damage to the components or surrounding structure and explain 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
- 2.18 describe the uses of measuring equipment

- 2.19 explain the methods of reassembling the aircraft gas turbine engine turbine assembly, using new or previously overhauled components
- 2.20 explain how to make adjustments to replaced components/assemblies to ensure that they function correctly
- 2.21 describe the various mechanical fasteners that are used, and their method of removal and replacement
- 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/equipment used in the overhauling activities, and explain how to check that they are in a safe/usable condition
- 2.24 explain the importance of ensuring that all tools are used correctly and within their permitted operating range
- 2.25 explain 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 what maintenance documentation and/or reports need to be completed following the overhauling activity
- 2.28 describe the problems that can occur during the overhauling activity, and explain how they can be overcome
- 2.29 describe the extent of their own authority and explain to whom they should report if they have a problem that they cannot resolve

# **Unit 565            Overhauling aircraft gas turbine engine turbine assemblies**

## Supporting information

### **Guidance**

2.1 (including any specific legislation, regulations/codes of practice for the activities, equipment or materials)

2.3 (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)

2.14 (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)

2.17 (such as seals and gaskets)

2.18 (such as micrometers, verniers, expansion indicators and other measuring devices)

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

2.21 (including bolts, nuts, rivets, threaded fasteners, special securing devices)

## Unit 566

# Overhauling aircraft gas turbine engine gearbox assemblies

<b>UAN:</b>	<b>H/601/4972</b>
<b>Level:</b>	3
<b>Credit value:</b>	125
<b>GLH:</b>	315
<b>Relationship to NOS:</b>	This unit has been derived from national occupational standard aeronautical engineering Unit 166: Overhauling aircraft gas turbine engine gearbox assemblies (Suite 3).
<b>Endorsement by a sector or regulatory body:</b>	This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out a complete overhaul of aircraft gas turbine engine gearbox assemblies, in accordance with approved procedures. The gearbox assembly to be overhauled will have been removed from the engine, and the overhauling activities may take place in a workshop or hangar.</p> <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 sub-assemblies (such as torque converters and 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. 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 'lifer' components. The overhauling activities will include making all necessary checks and adjustments to ensure that components are correctly replaced, positioned, aligned,</p>



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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 aircraft gas turbine engine 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 aircraft gas turbine engine 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 aircraft gas turbine engine 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 and others in the workplace

<b>Learning outcome</b>
The learner will: 1. Be able to overhaul aircraft gas turbine engine 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 aircraft gas turbine engine gearbox assembly: <ul style="list-style-type: none"> <li>• obtain and use the appropriate documentation (such as job instructions, engine overhauling manuals, engineering drawings, technical instructions, and other relevant maintenance 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 for the overhauling area</li> <li>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current certification/calibration date</li> <li>• ensure that all oils, fluids and fuel have been drained/removed before breaking into the system</li> <li>• ensure that the gearbox assembly is suitably supported, and that appropriate lifting and handling equipment is available</li> <li>• carry out the overhauling activities, using approved techniques and procedures at all times</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 and gearbox assembly in a safe and appropriate condition, free from foreign object debris 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 dismantle the aircraft gas turbine engine gearbox assembly, to include removing all of the following: <ul style="list-style-type: none"> <li>• gear housings</li> <li>• bearings</li> <li>• seals and gaskets</li> <li>• drive shafts</li> <li>• lay shafts</li> </ul>

- gear trains/sub-assemblies
  - torque converters
  - starter units
  - temperature sensors
  - levers and linkages
  - shims and packing
  - wire thread inserts
  - locking devices
  - pipes and unions
- 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 'lified' items (such as seals, bearings, gaskets)
  - reassembling the gearbox unit
  - balancing components (where applicable)
  - 'blue bedding' components
  - making mechanical connections
  - setting and adjusting replaced components
  - tightening fastenings to the required torque
  - electrical bonding of components
  - 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 a range of gearbox assembly components, to include ten of the following:
- gear housings
  - bearings
  - seals and gaskets
  - drive shafts
  - lay shafts locks and stops
  - gear trains/sub-assemblies

- static seals/gaskets
  - torque converter
  - starter units
  - temperature sensors
  - dynamic seals
  - 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 components
- 1.10 carry out checks and tests on the overhauled equipment, to include six of the following:
- positional accuracy
  - orientation
  - alignment
  - freedom of movement
  - gear backlash
  - bearing end float
  - operating/working clearance
  - visual inspection for completeness and freedom from damage or foreign objects
  - 'special-to-type' test rig checks
- 1.11 overhaul aircraft gas turbine engine gearbox assemblies in compliance with one of the following:
- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
  - Federal Aviation Authority (FAA)
  - 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 defects outside the planned overhauling schedule
- 1.14 complete the relevant documentation, in accordance with organisational requirements
- 1.15 complete the relevant paperwork, to include one of the following, and pass it to the appropriate people:
- job cards
  - computer records
  - aircraft log books
  - engine overhaul logs or reports
  - work authorisation documents

<ul style="list-style-type: none"> <li>• permit to work/formal risk assessment</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 aircraft gas turbine engine gearbox assemblies</p>
<p><b>Assessment criteria</b></p> <p>The learner can:</p> <p>2.1 explain the specific safety practices and procedures that they need to observe when overhauling aircraft gas turbine engine gearbox assemblies</p> <p>2.2 explain 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</p> <p>2.3 describe the hazards associated with overhauling aircraft gas turbine engine gearbox assemblies and explain how to minimise them and reduce any risks</p> <p>2.4 explain the importance of wearing protective clothing and other appropriate safety equipment during the overhaul</p> <p>2.5 explain how to obtain and interpret drawings, specifications, manufacturers' manuals, history/maintenance reports, and other documents needed in the overhauling process</p> <p>2.6 explain how to carry out currency/issue checks on the specifications they are working with</p> <p>2.7 describe the quality control procedures to be followed during the overhauling operations</p> <p>2.8 explain the procedure for obtaining replacement parts, materials and other consumables necessary for the overhaul</p> <p>2.9 explain the company policy on the repair/replacement of components during the overhauling process</p> <p>2.10 explain the terminology used in aircraft gas turbine engine gearbox assemblies</p> <p>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</p> <p>2.12 explain the extent to which the equipment is to be dismantled for overhaul</p> <p>2.13 explain the sequence to be adopted for the dismantling/reassembling of the gearbox assembly</p> <p>2.14 describe the techniques used to dismantle the aircraft gas turbine engine gearbox assembly, without damage to the components or surrounding structure removing mechanical locking and securing mechanisms/devices; and explain the need to protect the system integrity by ensuring that exposed components are correctly covered/protected</p> <p>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</p>

- 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 explain the need to replace 'lified' items
- 2.18 describe the uses of measuring equipment
- 2.19 explain the methods of reassembling the aircraft engine gearbox, using new or previously overhauled components
- 2.20 explain how to make adjustments to replaced components/assemblies to ensure that they function correctly
- 2.21 describe the various mechanical fasteners that are used, and their method of removal and replacement
- 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/equipment used in the overhauling activities, and explain how to check that they are in a safe/usable condition
- 2.24 explain the importance of ensuring that all tools are used correctly and within their permitted operating range
- 2.25 explain 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 what maintenance documentation and/or reports need to be completed following the overhauling activity
- 2.28 describe the problems that can occur during the overhauling activity, and explain how they can be overcome
- 2.29 describe the extent of their own authority and explain to whom they should report if they have a problem that they cannot resolve

# **Unit 566            Overhauling aircraft gas turbine engine gearbox assemblies**

## Supporting information

### **Guidance**

2.1 (including any specific legislation, regulations/codes of practice for the activities, equipment or materials)

2.3 (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)

2.14 (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)

2.17 (such as seals and gaskets)

2.18 (such as micrometers, verniers, expansion indicators and other measuring devices)

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

2.21 (including bolts, nuts, rivets, threaded fasteners, special securing devices)

## Unit 567

## Overhauling aircraft piston engines

<b>UAN:</b>	<b>J/601/4981</b>
<b>Level:</b>	3
<b>Credit value:</b>	125
<b>GLH:</b>	315
<b>Relationship to NOS:</b>	This unit has been derived from national occupational standard aeronautical engineering Unit 167: Overhauling aircraft piston engines (Suite 3).
<b>Endorsement by a sector or regulatory body:</b>	This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out a complete overhaul of aircraft piston engines, in accordance with approved procedures. The engine to be overhauled will have been removed from the aircraft, and the overhauling activities may take place in a workshop or hangar.</p> <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 the engine nacelles/outer casing, removing all ancillary equipment and components and dismantling the engine down to the various sub-assembly units, such as cylinder block and cylinder heads. The learner will be expected to strip the various sub-assemblies down to their component parts. The learner will then rebuild the engine, which will involve fitting replacement or overhauled sub-assembly units (such as cylinder block, cylinder heads, torque converters, oil pumps) 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.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the overhauling of the aircraft</p>



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 aircraft piston engines. The learner will understand the dismantling and reassembly methods and procedures used, and their application. The learner will know how the engine 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 aircraft piston engines, 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. Be able to overhaul aircraft 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 aircraft piston engine: <ul style="list-style-type: none"> <li>• obtain and use the appropriate documentation (such as job</li> </ul>

instructions, engine overhauling manuals, engineering drawings, technical instructions, and other relevant maintenance documentation)

- adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
- provide and maintain safe access and working arrangements for the overhauling area
- obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current certification/calibration date
- ensure that all oils, fluids and fuel have been drained/removed before breaking into the system
- ensure that the piston engine assembly is suitably supported, and that appropriate lifting and handling equipment is available
- carry out the overhauling activities, using approved techniques and procedures at all times
- 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 and piston engine assembly in a safe and appropriate condition, free from foreign object debris and in a condition ready for testing

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 a major overhaul of one of the following types of aircraft piston engine:

- in line engine
- 'vee' engine
- rotary engine

1.8 dismantle aircraft piston engines, to include removing ten of the following:

- cylinder head
- crank shaft
- flywheel
- gearbox
- torque converter
- piston assemblies
- cylinder liners
- camshaft assemblies
- timing mechanisms
- valve mechanisms

- oil pumps
  - fuel/injector pumps and mechanisms
  - carburettor systems
  - manifolds and exhaust systems
  - turbo/supercharger
- 1.9 carry out all of the following activities on the equipment being overhauled:
- pre-disassembly checks
  - removing engine nacelles/outer casing
  - disconnecting and removing wires/cables and attaching suitable cable identification markers
  - removing all ancillary components
  - dismantling equipment to unit/sub-assembly level
  - dismantling units to component level
  - proof-marking/labelling of components to aid reassembly
  - checking components for wear and serviceability
  - replacing all 'lived' items (such as seals, bearings, gaskets)
  - replacing all damaged or defective components
  - re-assembling components to sub-assembly level
  - re-assembling sub-assemblies to unit level
  - setting and adjusting replaced components
  - using specialist tooling
  - making use of ground support equipment
  - supporting the equipment to be removed
  - electrical bonding of components
  - applying gaskets and sealant/adhesives
  - tightening fastenings to the required torque
  - disconnecting and removing pipework
  - 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 a range of piston engine components, to include twelve of the following:
- cylinder head
  - crank shaft
  - flywheel
  - torque converters
  - cylinder liners
  - piston assemblies
  - camshaft assemblies
  - timing mechanisms
  - valve mechanisms
  - oil pumps
  - bearings
  - injector mechanisms

- fuel pumps
  - seals and gaskets
  - pulleys and sprockets
  - belts and chains
  - levers and linkages
  - sensing devices
  - manifolds
  - sump pans
  - exhaust systems
  - pipes and unions
  - turbo/supercharger
- 1.11 carry out checks and tests on the overhauled equipment, to include seven of the following:
- positional accuracy
  - orientation
  - alignment
  - freedom of movement
  - bearing end float
  - gear backlash
  - compression
  - timing (such as valve, ignition fuel injection)
  - operating/working clearance
  - visual inspection for completeness and freedom from damage or foreign objects
  - boost pressure
  - 'special-to-type' test rig checks
- 1.12 overhaul aircraft piston engines in compliance with one of the following:
- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
  - Federal Aviation Authority (FAA)
  - BS, ISO or BSEN standards and procedures
  - customer standards and requirements
  - company standards and procedures
  - engine 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 the relevant paperwork, to include one of the following, and pass it to the appropriate people:
- job cards
  - computer records
  - aircraft log books
  - engine overhaul logs or reports

<ul style="list-style-type: none"> <li>• work authorisation documents</li> <li>• permit to work/formal risk assessment</li> </ul> <p>1.17 dispose of unwanted components, waste materials and substances, in accordance with safe working practices and approved procedures</p> <p>1.18 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 aircraft piston engines
<b>Assessment criteria</b>
The learner can:
2.1 explain the specific safety practices and procedures that they need to observe when overhauling aircraft piston engines
2.2 explain 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 aircraft piston engines and explain how to minimise them and reduce any risks
2.4 explain 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 explain the procedure for obtaining replacement parts, materials and other consumables necessary for the overhaul
2.9 explain the company policy on the repair/replacement of components during the overhauling process
2.10 explain the terminology used in aircraft 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 explain the extent to which the equipment is to be dismantled for overhaul
2.13 explain the sequence to be adopted for the dismantling/reassembling of various types of engine assemblies
2.14 describe the techniques used to dismantle the aircraft piston engines, without damage to the components or surrounding structure and explain 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
- 2.18 describe the uses of measuring equipment
- 2.19 explain the methods of reassembling the aircraft piston engine, using new or previously overhauled subassemblies
- 2.20 explain how to make adjustments to replaced components/assemblies to ensure that they function correctly
- 2.21 describe the various mechanical fasteners that are used, and explain their method of removal and replacement
- 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 explain how to check that they are in a safe and usable condition
- 2.24 explain the importance of ensuring that all tools are used correctly and within their permitted operating range
- 2.25 explain 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 what maintenance documentation and/or reports need to be completed following the overhauling activity
- 2.28 describe the problems that can occur during the overhauling activity, and explain how they can be overcome
- 2.29 describe the extent of their own authority and explain to whom they should report if they have a problem that they cannot resolve

# Unit 567      Overhauling aircraft piston engines

## Supporting information

### Guidance

2.1 (including any specific legislation, regulations/codes of practice for the activities, equipment or materials)

2.3 (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)

2.14 (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)

2.17 (such as seals and gaskets)

2.18 (such as micrometers, verniers, expansion indicators and other measuring devices)

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

2.21 (including bolts, nuts, rivets, threaded fasteners, special securing devices)

## Unit 612

## Dismantling aircraft gas turbine engines to module/unit level

<b>UAN:</b>	<b>A/601/6114</b>
<b>Level:</b>	3
<b>Credit value:</b>	80
<b>GLH:</b>	168
<b>Relationship to NOS:</b>	This unit has been derived from national occupational standard aeronautical engineering Unit 212: Dismantling aircraft gas turbine engines to module/unit level (Suite 3).
<b>Endorsement by a sector or regulatory body:</b>	This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to dismantle aircraft gas turbine engines to module/unit level, in readiness for overhaul of the individual modules/units, in accordance with approved procedures. The engine to be dismantled will have been removed from the aircraft. In carrying out the dismantling operations, the learner will be required to follow laid-down procedures and to use specific engine dismantling techniques. The dismantling activities will involve removing the engine nacelle/outer casing, removing all ancillary equipment and components, and dismantling the engine down to the various sub-assembly units such as fan case, front fan, compressor module, combustor module, turbine module and gear box.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the dismantling of the aircraft gas turbine engine, and to report any problems with the dismantling 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 dismantling 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</p>



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 and procedures to aircraft gas turbine engines. The learner will understand the dismantling methods and procedures used, and their application. The learner will know how the engine functions, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the dismantling activities to the required level.

The learner will understand the safety precautions required when carrying out the dismantling activities associated with aircraft gas turbine engines, especially those for lifting, handling and supporting the equipment being removed. 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. Be able to dismantle aircraft gas turbine engines to module/unit level
<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 dismantling of the aircraft gas turbine engine: <ul style="list-style-type: none"><li>• obtain and use the correct issue of aircraft manuals and maintenance 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 for the dismantling area</li><li>• visually inspect the engine for signs of any damage prior to dismantling it</li><li>• ensure that all oils, fluids and fuel have been drained/removed before breaking into the system</li><li>• ensure that the engine is suitably supported, and that appropriate lifting and handling equipment is available</li><li>• carry out the dismantling activities to the appropriate level, using appropriate techniques and procedures</li><li>• ensure that components and surrounding structures are</li></ul>

- maintained free from damage and foreign objects
  - return all tools and equipment to the correct location on completion of the activities
  - ensure that all work carried out is correctly documented and recorded
  - leave the work area and engine in a safe and appropriate condition on completion of the activities
- 1.3 establish and, where appropriate, mark components for re-assembly
- 1.4 ensure that any stored energy or substances are released safely and correctly
- 1.5 make all isolations and disconnections to the equipment in line with approved procedures
- 1.6 carry out the dismantling to the agreed level using correct tools and techniques
- 1.7 carry out the dismantling of one of the following types of aircraft gas turbine engine:
- turbo prop
  - ducted fan
  - turbo jet
  - turbo shaft
  - turbo fan
  - ground turbine start (GTS)
- 1.8 dismantle aircraft gas turbine engines, to include removing five of the following sub-assemblies:
- fan case
  - front fan
  - exhaust/reheat assembly
  - compressor module
  - combustor module
  - bypass duct
  - turbine
  - gearbox
- 1.9 carry out all of the following dismantling activities:
- removing engine nacelle/outer casing
  - cleaning parts prior to dismantling
  - disconnecting and removing wires/cables, and attaching suitable cable identification markers
  - disconnect/removing hoses and pipework
  - ensuring that any remaining fluids are drained into suitable containers
  - supporting components to be removed
  - removing bolt locking devices (such as split pins, wire locking, lock nuts)
  - removing mechanical fastening devices
  - removing all accessories/line replacement units (LRUs)
  - dismantling the engine to module/sub-assembly level
  - removing components having interference fits (such as by expansion, contraction, pressure)

<ul style="list-style-type: none"> <li>• carrying out visual inspection of removed parts for any significant defects or damage caused by removal</li> <li>• applying appropriate part protection techniques and procedures to the removed modules and components</li> <li>• labelling and storing the modules and components in the correct location ready for inspection and overhaul</li> <li>• disposing of all items that will be renewed on reassembly (such as seals, locking devices, mechanical fasteners)</li> </ul> <p>1.10 dismantle aircraft gas turbine engines in compliance with one of the following:</p> <ul style="list-style-type: none"> <li>• Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)</li> <li>• extended twin operations procedures (ETOpS) (where appropriate)</li> <li>• Ministry of Defence (MoD)</li> <li>• Federal Aviation Authority (FAA)</li> <li>• BS, ISO or BSEN standards and procedures</li> <li>• customer standards and requirements</li> <li>• company standards and procedures</li> <li>• engine manufacturer's requirements</li> </ul> <p>1.11 store components for re-use in approved locations</p> <p>1.12 dispose of unwanted components and substances in accordance with approved procedures</p> <p>1.13 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>• computer records</li> <li>• aircraft log books</li> <li>• engine overhaul logs or reports</li> <li>• work authorisation documents</li> <li>• significant defect reports</li> <li>• shift handover documentation</li> </ul> <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 aircraft gas turbine engines to module/unit level
<b>Assessment criteria</b>
The learner can:
2.1 explain the specific safety practices and procedures that they need to observe when dismantling aircraft gas turbine engines
2.2 explain the importance of maintenance on, and impact upon ETOpS systems, legislation and local procedures
2.3 explain the health and safety requirements of the area in which the dismantling activity is to take place, and the responsibility these requirements place on them
2.4 describe the hazards associated with dismantling aircraft gas

- turbine engines and explain how to minimise them and reduce any risks
- 2.5 explain the importance of wearing protective clothing and other appropriate safety equipment during the dismantling activities
  - 2.6 explain how to obtain and interpret drawings, specifications, manufacturers' manuals, history/maintenance reports, and other documents needed in the dismantling process
  - 2.7 explain how to carry out currency/issue checks on the specifications they are working with
  - 2.8 describe the quality control procedures to be followed during the dismantling operations
  - 2.9 explain the company policy on the repair/replacement of components during the dismantling process
  - 2.10 explain the terminology used in aircraft gas turbine engines and engine modules
  - 2.11 describe the basic principles of how the engine functions and the purpose of the individual modules/units
  - 2.12 explain the extent to which the equipment is to be dismantled for overhaul
  - 2.13 describe the sequence to be adopted for the dismantling of various types of engine assemblies
  - 2.14 describe the various mechanical fasteners that are used, and explain their method of removal
  - 2.15 describe the various types of electrical connector that are used, and their methods of unlocking
  - 2.16 explain the techniques used to dismantle the aircraft gas turbine engines without damage to the components or surrounding structure
  - 2.17 explain how to lift and move large components and assemblies; the methods and equipment used to transport, handle and lift the components during the dismantling activities
  - 2.18 explain the need to ensure that lifting and handling equipment is within its current certification dates
  - 2.19 explain the need to carry out visual inspections of the removed components, checking for any significant defects or damage caused by the dismantling activities
  - 2.20 explain the need to carry out part protection techniques and procedures on the removed modules and components, and the protection methods that are used
  - 2.21 explain the need to correctly identify, label and store the modules and components ready for overhaul
  - 2.22 describe the tools and equipment used in the dismantling activities, and explain how to check that they are in a safe and usable condition
  - 2.23 explain the importance of ensuring that all tools are used correctly and within their permitted operating range
  - 2.24 explain the importance of ensuring that all tools and equipment are returned to the correct location on completion of the dismantling activities
  - 2.25 describe the procedure for the safe disposal of waste materials
  - 2.26 explain what recording documentation needs to be completed for the dismantling undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation

- 2.27 describe the problems that can occur during the dismantling activity, and explain how they can be overcome
- 2.28 describe the extent of their own authority and explain to whom they should report if they have a problem that they cannot resolve

# **Unit 612            Dismantling aircraft gas turbine engines to module/unit level**

## Supporting information

### **Guidance**

2.1 (including any specific legislation, regulations/codes of practice for the activities, equipment or materials)

2.4 (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, lifting and moving large and heavy components)

2.14 (including bolts, nuts, rivets, threaded fasteners, special securing devices)

2.16 (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)

## Unit 613

## Rebuilding aircraft gas turbine engines assemblies after overhaul

<b>UAN:</b>	<b>T/601/6127</b>
<b>Level:</b>	3
<b>Credit value:</b>	150
<b>GLH:</b>	357
<b>Relationship to NOS:</b>	This unit has been derived from national occupational standard aeronautical engineering Unit 213: Rebuilding aircraft gas turbine engine assemblies after overhaul (Suite 3).
<b>Endorsement by a sector or regulatory body:</b>	This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing
<b>Aim:</b>	<p>This unit covers the skills and knowledge needed to prove the competences required to carry out the reassembly of aircraft gas turbine engine overhauled modules, into part and final engine assemblies, in accordance with approved procedures. In carrying out the reassembly operations, the learner will be required to follow laid-down procedures and specific engine assembly techniques in order to assemble the various sub-assembly units and components.</p> <p>The learner will be required to obtain all the required tools and equipment for the assembly operations, and to check that they are in a safe and usable condition. The learner will then rebuild the gas turbine engine assembly, which will involve fitting new replacement or overhauled sub-assembly units such as fan case, front fan, compressor module, combustor module, turbine module and gearbox. The rebuilding 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.</p> <p>The learner's responsibilities will require them to comply with organisational policy and procedures for the reassembly of the aircraft gas turbine engine, and to report any problems with the reassembly activities or with the tools and equipment used that they cannot personally resolve, or that are outside their</p>

permitted authority, to the relevant people. The learner must ensure that all tools, equipment and materials used in the assembly activities are correctly accounted for and 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 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 reassembly techniques and procedures to aircraft gas turbine engines. The learner will understand the assembly methods and procedures used, and their application. The learner will know how the engine functions, the purpose of the individual modules, relevant components and fastening devices, in adequate depth to provide a sound basis for carrying out the reassembly activities to the required specification.

The learner will understand the safety precautions required when carrying out the reassembly activities associated with aircraft gas turbine engines, especially those for lifting, handling and supporting the equipment being assembled. 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. Be able to rebuild aircraft gas turbine engine assemblies after 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 carry out all of the following during the reassembly of the aircraft gas turbine engine: <ul style="list-style-type: none"> <li>• obtain and use the correct issue of engine assembly drawings, overhaul manual and planning 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 for the assembly area</li> </ul>



- ensure that all the required modules and components are available and have the correct part numbers
  - ensure that all tools and measuring instruments to be used are within current calibration dates
  - ensure that the engine/modules are suitably supported
  - use lifting and slinging equipment in accordance with health and safety guidelines and procedures
  - carry out the reassembly activities, using approved techniques and 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
  - ensure that all work carried out is correctly documented and recorded
  - leave the work area and engine in a safe and appropriate condition on completion of the activities
- 1.3 follow the relevant instructions, assembly drawings and any other specifications
- 1.4 carry out the reassembly of one of the following types of aircraft gas turbine engine:
- turbo prop
  - ducted fan
  - turbo jet
  - turbo-shaft
  - turbo-fan
  - ground turbine start (GTS)
- 1.5 check that the specified components are available and that they are in a usable condition
- 1.6 use the appropriate methods and techniques to assemble the components in their correct positions
- 1.7 carry out ten of the following reassembly methods and techniques on the engine being rebuilt:
- cleaning parts/mating faces prior to assembly
  - correctly positioning and orienting the modules to be assembled
  - fitting gaskets and applying sealant/adhesives
  - aligning components
  - assembly of components by pressure
  - assembly of components by expansion or contraction
  - 'blue bedding' components (where applicable)
  - setting and adjusting replaced components (such as shimming and packing)
  - torque setting of bolts, fasteners, clips, sub-assemblies
  - electrical bonding of components
  - 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
- 1.8 reassemble aircraft gas turbine engines, to include refitting five of the following:
- fan case
  - front fan
  - exhaust/reheat assembly
  - compressor module
  - combustor module
  - bypass duct
  - turbine
  - gearbox
- 1.9 secure the components using the specified connectors and securing devices
- 1.10 check the completed assembly to ensure that all operations have been completed and the finished assembly meets the required specification
- 1.11 carry out checks for accuracy, using the correct inspection and testing equipment, to include all of the following:
- dimensions
  - positional accuracy
  - freedom of movement
  - operating/working clearance
  - bearing end float
  - orientation
  - alignment
  - completeness
  - visual inspection for completeness and freedom from damage or foreign objects
  - 'special-to-type' test rig checks
- 1.12 rebuild aircraft gas turbine engine assemblies in compliance with one of the following:
- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
  - extended twin operations procedures (ETOPs) (where appropriate)
  - Ministry of Defence (MoD)
  - Federal Aviation Authority (FAA)
  - BS, ISO or BSEN standards and procedures
  - customer standards and requirements
  - company standards and procedures
  - engine manufacturer's requirements
- 1.13 deal promptly and effectively with problems within their control and report those that cannot be solved
- 1.14 complete the relevant paperwork, to include one of the following, and pass it to the appropriate people:
- job cards
  - computer records

- aircraft log books
- engine overhaul logs or reports
- work authorisation documents
- shift handover documentation

### **Learning outcome**

The learner will:

2. Know how to rebuild aircraft gas turbine engine assemblies after overhaul

### **Assessment criteria**

The learner can:

- 2.1 explain the specific safety precautions to be taken whilst carrying out the aircraft gas turbine engine reassembly
- 2.2 explain the health and safety requirements of the work area in which they are carrying out the reassembly activities, and the responsibility these requirements place on them
- 2.3 explain the COSHH regulations with regard to the substances used in the assembly process
- 2.4 describe the hazards associated with producing aircraft gas turbine engine assemblies, and with the tools and equipment used, and explain how to minimise them and reduce any risks
- 2.5 explain what personal protective equipment and clothing to be worn during the reassembly activities
- 2.6 describe the various types of drawing/overhaul manual and specification that are used during the reassembly activities
- 2.7 explain how to identify the modules and components to be used; component identification systems
- 2.8 explain what preparations need to be undertaken on the modules and components, prior to fitting them into the assembly
- 2.9 explain the reassembly methods and procedures to be used, and the importance of adhering to these procedures
- 2.10 explain the methods of reassembling the aircraft gas turbine engine, using new or previously overhauled components
- 2.11 explain how the components are to be positioned and aligned prior to securing them, and the tools and equipment to be used
- 2.12 explain how to make adjustments to the replaced modules/assemblies to ensure that they function correctly
- 2.13 describe the various mechanical fasteners that will be used, and explain their method of installation
- 2.14 explain the importance of using the specified mechanical fastening devices for the reassembly, and why they must not use substitutes
- 2.15 explain how to complete basic fitting practices, meeting regulatory and organisational requirements
- 2.16 explain how to deal with components or fastening devices incorrectly assembled, damaged or having other faults
- 2.17 describe the application of sealants and adhesives within the reassembly activities, and the precautions that must be taken when working with them
- 2.18 describe the quality control procedures to be followed during the reassembly operations
- 2.19 explain how to conduct any necessary checks to ensure the accuracy and quality of the gas turbine engine assemblies

- 2.20 explain how to detect assembly defects, and what to do to rectify them
- 2.21 explain how to lift and move large engine modules and sub-assemblies; the methods and equipment used to transport, handle and lift the assemblies during the rebuilding activities
- 2.22 explain the need to ensure that lifting and handling equipment is within its current certification dates
- 2.23 explain how to check that the tools and equipment to be used are correctly calibrated and are in a safe and serviceable condition
- 2.24 explain the importance of ensuring that all tools are used correctly and within their permitted operating range
- 2.25 explain the importance of ensuring that the completed assembly is free from dirt, swarf and foreign objects
- 2.26 explain the importance of ensuring that all tools, equipment and components are accounted for and returned to their correct location on completion of the assembly activities
- 2.27 describe the problems with the reassembly operations, and the importance of informing appropriate people of non-conformances
- 2.28 describe the procedure for the safe disposal of waste materials
- 2.29 explain what recording documentation needs to be completed for the aircraft gas turbine engine rebuilding activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation
- 2.30 describe the extent of their own responsibility and explain to whom they should report if they have problems that they cannot resolve

# **Unit 613            Rebuilding aircraft gas turbine engines assemblies after overhaul**

## Supporting information

### **Guidance**

2.1 (including any specific legislation, regulations or codes of practice relating to the activities, equipment or materials)

2.7 (such as codes and component orientation indicators)

2.10 (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)

2.11 (such as use of jigs and fixtures, micrometers, Verniers, laser alignment techniques)

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

2.13 (such as bolts, nuts, rivets, threaded fasteners, special securing devices)

2.15 (such as torque tightening, wire locking, fitting wire thread inserts, fitting O-ring seals, fitting lock nuts, blue bedding, tab washers, cup washers and swage nuts)

2.20 (such as ineffective fasteners, foreign object damage)



## Appendix 1 Relationships to other qualifications

### 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.

**Centre Guide – Delivering International Qualifications** 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. Specifically, the document includes sections on:

- The centre and qualification approval process and forms
- Assessment, verification and examination roles at the centre
- Registration and certification of candidates
- Non-compliance
- Complaints and appeals
- Equal opportunities
- Data protection
- Frequently asked questions.



## Useful contacts

<b>UK learners</b> <b>General qualification information</b>	<b>T: +44 (0)844 543 0033</b> <b>E: 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**

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