QUALIFICATION HANDBOOK

# Level 3 NVQ Diploma in Aeronautical Engineering (On Aircraft Maintenance) (1789-31)

**September 2018 version 1.2**

City & Guilds


# Qualification at a glance

| | |
|---|---|
| **Subject area** | **Engineering** |
| **City & Guilds number** | 1789-31 |
| **Age group approved** | 16-18, 19+ |
| **Entry requirements** | Level 2 |
| **Assessment** | Portfolio |
| **Fast track** | Available |
| **Support materials** | Centre handbook |
| **Registration and certification** | Consult the Walled Garden/Online Catalogue for last dates |

| Title and level | City & Guilds number | Accreditation number |
|---|---|---|
| Level 3 NVQ Diploma in Aeronautical Engineering (On Aircraft Maintenance) | 1789-31 | 600/1575/5 |

| Version and date | Change detail | Section |
|---|---|---|
| 1.1 November 2012 | • Formatting (not allowing sentences to split between two pages)<br>• Amended the numbering of the assessment criteria for learning outcome 1<br>• Amended UAN<br>• Amended numbering of assessment criteria for learning outcome two<br>• The word 'using' in assessment criteria 1.10 changed to lower case<br>• The word 'either' in assessment criteria 1.5 changed to lower case | • Units 001, 403, 404<br>• Unit 562 and 736<br>• Units 708, 723 and 726<br>• Unit 710<br>• Unit 745<br>• Unit 749 |
| 1.2 September 2018 | • Changed from a seven to a nine | • Unit 001 assessment criteria 2.3 |


# Contents


# 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 (On Aircraft Manitenance)**, learners must achieve a minimum of **20** credits from the mandatory units, a minimum of **15** credits from the optional units available in Optional Group 1 and a minimum of **351** credits from Optional Group 2.

| Unit accreditation number | City & Guilds unit | Unit title | Credit value |
|---|---|---|---|
| **Mandatory** | | | |
| 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 |
| **Optional** | | **Group 1** | |
| Y/601/6136 | 701 | Lifting and trestling/shoring aircraft for maintenance/repair operations | 15 |
| K/601/6142 | 702 | Levelling and weighing aircraft | 15 |
| F/601/6146 | 703 | Towing, marshalling and parking aircraft | 15 |
| R/601/6152 | 704 | Carrying out flight servicing and routine maintenance of aircraft | 40 |

| Unit accreditation number | City & Guilds unit | Unit title | Credit value |
|---|---|---|---|
| **Optional** | | **Group 2** | |
| K/601/6156 | 705 | Maintaining air conditioning systems on aircraft (ATA 21) | 86 |
| A/601/6159 | 706 | Maintaining auto flight systems on aircraft (ATA 22) | 86 |
| F/601/6163 | 707 | Maintaining communication systems on aircraft (ATA 23) | 86 |
| L/601/6165 | 708 | Maintaining electrical power systems on aircraft (ATA 24) | 86 |
| D/601/6168 | 709 | Maintaining equipment and furnishings on aircraft (ATA 25) | 77 |
| H/601/6172 | 710 | Maintaining fire protection systems on aircraft (ATA 26) | 77 |
| F/601/6177 | 711 | Maintaining flight control systems on aircraft (ATA 27) | 86 |
| L/601/6182 | 712 | Maintaining fuel systems on aircraft (ATA 28) | 86 |
| H/601/6186 | 713 | Maintaining hydraulic systems on aircraft (ATA 29) | 86 |
| M/601/6188 | 714 | Maintaining ice and rain protection systems on aircraft (ATA 30) | 86 |
| A/601/6193 | 715 | Maintaining indicating and recording systems on aircraft (ATA 31) | 86 |
| J/601/6195 | 716 | Maintaining landing gear on aircraft (ATA 32) | 86 |
| L/601/6201 | 717 | Maintaining lighting systems on aircraft (ATA 33) | 86 |
| R/601/6202 | 718 | Maintaining navigation systems on aircraft (ATA 34 ) | 86 |
| M/601/6210 | 719 | Maintaining oxygen systems on aircraft (ATA 35) | 86 |
| L/601/6215 | 720 | Maintaining pneumatic systems on aircraft (ATA 36) | 86 |
| D/601/6221 | 721 | Maintaining vacuum systems on aircraft (ATA 37) | 86 |
| T/601/6225 | 722 | Maintaining water and waste systems on aircraft (ATA 38) | 86 |
| L/601/6232 | 723 | Maintaining cabin systems on aircraft (ATA 44) | 86 |
| M/601/6238 | 724 | Maintaining airborne auxiliary power systems on aircraft (ATA 49) | 86 |
| L/601/6246 | 725 | Maintaining cargo and accessory compartments on aircraft (ATA 50) | 55 |
| K/601/6254 | 726 | Maintaining doors on aircraft (ATA 52) | 86 |

| Unit accreditation number | City & Guilds unit | Unit title | Credit value |
|---|---|---|---|
| J/601/6259 | 727 | Maintaining fuselage, nacelles and pylons on aircraft (ATA 53 & 54) | 71 |
| R/601/6264 | 728 | Maintaining stabilisers on aircraft (ATA 55) | 77 |
| K/601/6268 | 729 | Maintaining windows on aircraft (ATA 56) | 77 |
| K/601/6271 | 730 | Maintaining wings on aircraft (ATA 57) | 86 |
| F/601/6275 | 731 | Maintaining propeller/propulsor systems on aircraft (ATA 61) | 86 |
| H/601/6284 | 732 | Maintaining rotor systems on rotorcraft (ATA 62 & 64) | 86 |
| A/601/6288 | 733 | Maintaining rotor drives systems on rotorcraft (ATA 63 & 65) | 86 |
| F/601/6292 | 734 | Maintaining rotor blade and tail pylon folding systems on rotorcraft (ATA 66) | 86 |
| L/601/6294 | 735 | Maintaining flight control systems on rotorcraft (ATA 67) | 86 |
| H/601/6298 | 736 | Maintaining power plant on aircraft (ATA 71) | 86 |
| K/601/6299 | 737 | Maintaining turbine engines on aircraft (ATA 72) | 86 |
| M/601/6336 | 738 | Maintaining reciprocating engines on aircraft (ATA 72) | 86 |
| F/601/6339 | 739 | Maintaining engine fuel and control systems on aircraft (ATA 73) | 86 |
| T/601/6340 | 740 | Maintaining ignition systems on aircraft (ATA 74) | 71 |
| F/601/6342 | 741 | Maintaining bleed air systems on aircraft (ATA 75) | 77 |
| R/601/6345 | 742 | Maintaining engine controls on aircraft (ATA 76) | 86 |
| H/601/6348 | 743 | Maintaining engine indicating systems on aircraft (ATA 77) | 86 |
| D/601/6350 | 744 | Maintaining engine exhaust systems on aircraft (ATA 78) | 77 |
| T/601/6354 | 745 | Maintaining lubricating oil systems on aircraft (ATA 79) | 77 |
| L/601/6358 | 746 | Maintaining engine starting systems on aircraft (ATA 80) | 77 |
| Y/601/6363 | 747 | Maintaining reciprocating engine turbo-supercharging systems on aircraft (ATA 81) | 77 |
| M/601/6370 | 748 | Maintaining engine water injection systems on aircraft | 77 |
| A/601/6372 | 749 | Maintaining engine water injection systems on aircraft (ATA 82) | 86 |

# 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 this these qualifications

| Description | How to access |
|---|---|
| Personal Learning and Thinking skills (required for apprenticeship) | **www.cityandguilds.com**, 1789 product documentation pages |
| Centre approval forms | **www.cityandguilds.com** |
| Semta QCF Assessment Strategy | **www.cityandguilds.com** |
| Unit assessment guidance | **www.cityandguilds.com**, 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**.

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**

## 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

| | |
|---|---|
| **UAN:** | **A/601/5013** |
| **Level:** | 2 |
| **Credit value:** | 5 |
| **GLH:** | 35 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard: Complying with statutory regulations and organisational safety requirements (Suite 2). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to deal with statutory regulations and organisational safety requirements. It does not deal with specific safety regulations or detailed requirements, it does, however, cover the more general health and safety requirements that apply to working in an industrial environment.<br>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.<br>The learner will also be required to identify the hazards and risks that are associated with their job. Typically, these will focus on their working environment, the tools and equipment that they use, the materials and substances that they use, any working practices that do not follow laid-down procedures, and manual |

lifting and carrying techniques.

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

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

| **Learning outcome** |
| --- |
| The learner will:<br>1. Be able to comply with statutory regulations and organisational safety requirements |
| **Assessment criteria** |
| The learner can:<br>1.1 comply with their duties and obligations as defined in the Health and Safety at Work Act<br>1.2 demonstrate their understanding of their duties and obligations to health and safety by:<br>• applying in principle their duties and responsibilities as an individual under the Health and Safety at Work Act<br>• identifying, within their organisation, appropriate sources of information and guidance on health and safety issues, such as:<br>o eye protection and personal protective equipment (PPE)<br>o COSHH regulations<br>o Risk assessments<br>• identifying the warning signs and labels of the main groups of hazardous or dangerous substances<br>• complying with the appropriate statutory regulations at all times<br>1.3 present themselves in the workplace suitably prepared for the activities to be undertaken<br>1.4 follow organisational accident and emergency procedures<br>1.5 comply with emergency requirements, to include:<br>• identifying the appropriate qualified first aiders and the location of first aid facilities<br>• identifying the procedures to be followed in the event of injury to themselves or others |

- following organisational procedures in the event of fire and the evacuation of premises
- identifying the procedures to be followed in the event of dangerous occurrences or hazardous malfunctions of equipment

1.6 recognise and control hazards in the workplace

1.7 Identify the hazards and risks that are associated with the following:

- their working environment
- the equipment that they use
- materials and substances (where appropriate) that they use
- working practices that do not follow laid-down procedures

1.8 use correct manual lifting and carrying techniques

1.9 demonstrate one of the following methods of manual lifting and carrying:

- lifting alone
- with assistance of others
- with mechanical assistance

1.10 apply safe working practices and procedures to include:

- maintaining a tidy workplace, with exits and gangways free from obstruction
- using equipment safely and only for the purpose intended
- observing organisational safety rules, signs and hazard warnings
- taking measures to protect others from any harm resulting from the work that they are carrying out.

| **Learning outcome** |
| --- |
| The learner will:<br>2. Know how to comply with statutory regulations and organisational safety requirements |
| **Assessment criteria** |
| The learner can:<br>2.1 describe the roles and responsibilities of themselves and others under the Health and Safety at Work Act, and other current legislation<br>2.2 describe the specific regulations and safe working practices and procedures that apply to their work activities<br>2.3 describe the warning signs for the nine main groups of hazardous substances defined by Classification, Packaging and Labelling of Dangerous Substances Regulations<br>2.4 explain how to locate relevant health and safety information for their tasks, and the sources of expert assistance when help is needed<br>2.5 explain what constitutes a hazard in the workplace<br>2.6 describe their responsibilities for identifying and dealing with hazards and reducing risks in the workplace<br>2.7 describe the risks associated with their working environment<br>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

| | |
|---|---|
| **UAN:** | **Y/601/5102** |
| **Level:** | 2 |
| **Credit value:** | 5 |
| **GLH:** | 25 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard: Using and interpreting engineering data and documentation (Suite 2). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | 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.<br>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.<br>The learner's underpinning knowledge will provide a good understanding of the types of documentation used, and will provide an |

informed approach to applying instructions and procedures. They will be able to read and interpret the documentation used and will know about the conventions, symbols and abbreviations, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

| **Learning outcome** |
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| The learner will:<br>1. Be able to use and interpret engineering data and documentation |
| **Assessment criteria** |
| The learner can:<br>1.1 use the approved source to obtain the required data and documentation<br>1.2 use the data and documentation and carry out all of the following:<br>• check the currency and validity of the data and documentation used<br>• exercise care and control over the documents at all times<br>• correctly extract all necessary data in order to carry out the required tasks<br>• seek out additional information where there are gaps or deficiencies in the information obtained<br>• deal with or report any problems found with the data and documentation<br>• make valid decisions based on the evaluation of the engineering information extracted from the documents<br>• return all documents to the approved location on completion of the work<br>• complete all necessary work related documentation such as production documentation, installation documentation, maintenance documentation, planning documentation<br>1.3 correctly identify, interpret and extract the required information<br>1.4 extract information that includes three of the following:<br>• materials or components required<br>• dimensions<br>• tolerances<br>• build quality<br>• installation requirements<br>• customer requirements<br>• time scales<br>• financial information<br>• operating parameters<br>• surface texture requirements<br>• location/orientation of parts<br>• process or treatments required<br>• dismantling/assembly sequence<br>• inspection/testing requirements<br>• number/volumes required |

- repair/service methods
- method of manufacture
- weld type and size
- operations required
- connections to be made
- surface finish required
- shape or profiles
- fault finding procedures
- safety/risk factors
- environmental controls
- specific data (such as component data, maintenance data, electrical data, fluid data)
- resources (such as tools, equipment, personnel)
- utility supply details (such as electricity, water, gas, air)
- location of services, including standby and emergency backup systems
- circuit characteristics (such as pressure, flow, current, voltage, speed)
- protective arrangements and equipment (such as containment, environmental controls, warning and evacuation systems and equipment)
- other specific related information

1.5 use the information obtained to ensure that work output meets the specification

1.6 use information extracted from documents to include one from the following:

- drawings (such as component drawings, assembly drawings, modification drawings, repair drawings, welding/fabrication drawings, distribution and installation drawings)
- diagrams (such as schematic, fluid power diagrams, piping, wiring/circuit diagrams)
- manufacturers manuals/drawings
- approved sketches
- technical illustrations
- photographic representations
- visual display screen information
- technical sales/marketing documentation
- contractual documentation
- other specific drawings/documents

1.7 use information extracted from related documentation, to include two from the following:

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

- operation sheets
- service/test information
- planning documentation
- quality control documents
- company specific technical instructions
- national, international and organisational standards
- health and safety standards relating to the activity (such as COSHH)
- other specific related documentation

1.8 deal promptly and effectively with any problems within their control and report those which cannot be solved

1.9 report any inaccuracies or discrepancies in documentation and specifications.

| **Learning outcome** |
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| The learner will:<br>2. Know how to use and interpret engineering data and documentation |
| **Assessment criteria** |
| The learner can:<br>2.1 explain what information sources are used for the data and documentation that they use in their work activities<br>2.2 explain how documents are obtained, and how to check that they are current and valid<br>2.3 explain the basic principles of confidentiality (including what information should be available and to whom)<br>2.4 describe the different ways/formats that data and documentation can be presented<br>2.5 explain how to use other sources of information to support the data<br>2.6 describe the importance of differentiating fact from opinion when reviewing data and documentation<br>2.7 describe the importance of analysing all available data and documentation before decisions are made<br>2.8 describe the different ways of storing and organising data and documentation to ensure easy access<br>2.9 describe the procedures for reporting discrepancies in the data or documentation, and for reporting lost or damaged documents<br>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<br>2.11 explain the care and control procedures for the documents, and how damage or graffiti on documents can lead to scrapped work<br>2.12 explain the importance of returning documents to the designated location on completion of the work activities<br>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<br>2.14 explain what types of documentation are used and how they interrelate<br>2.15 explain the imperial and metric systems of measurement; tolerancing and fixed reference points |

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| 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

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

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

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.

| **Learning outcome** |
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| The learner will:<br>1. Be able to work efficiently and effectively in engineering |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 prepare the work area to carry out the engineering activity<br>1.3 prepare to carry out the engineering activity, taking into consideration all of the following, as applicable to the work to be undertaken:<br>• the work area is free from hazards and is suitably prepared for the activities to be undertaken<br>• any required safety procedures are implemented<br>• any necessary personal protection equipment is obtained and is in a usable condition |

- tools and equipment required are obtained and checked that they are in a safe and useable condition
- all necessary drawings, specifications and associated documentation is obtained
- job instructions are obtained and understood
- the correct materials or components are obtained
- storage arrangements for work are appropriate
- appropriate authorisation to carry out the work is obtained

1.4 check that there are sufficient supplies of materials and/or consumables and that they meet work requirements

1.5 ensure that completed products or resources are stored in the appropriate location on completion of the activities

1.6 complete work activities, to include all of the following:

- completing all necessary documentation accurately and legibly
- returning tools and equipment
- returning drawings and work instructions
- identifying, where appropriate, any unusable tools, equipment or components
- arranging for disposal of waste materials

1.7 tidy up the work area on completion of the engineering activity

1.8 deal promptly and effectively with problems within their control and report those that cannot be resolved

1.9 deal with problems affecting the engineering process, to include two of the following:

- materials
- tools and equipment
- drawings
- job specification
- quality
- people
- timescales
- safety
- activities or procedures

1.10 contribute to and communicate opportunities for improvement to working practices and procedures

1.11 make recommendations for improving to two of the following:

- working practices
- working methods
- quality
- safety
- tools and equipment
- supplier relationships
- internal communication
- customer service
- training and development
- teamwork
- other

1.12 maintain effective working relationships with colleagues to include two of the following:
- colleagues within own working group
- colleagues outside normal working group
- line management
- external contacts

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

1.14 review personal development objectives and targets to include one of the following:
- dual or multi-skilling
- training on new equipment / technology
- increased responsibility
- understanding of company working practices, procedures, plans and policies
- other specific requirements.

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

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| 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

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| **UAN:** | **K/601/4228** |
| **Level:** | 3 |
| **Credit value:** | 5 |
| **GLH:** | 25 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard aeronautical engineering Unit 004: Reinstating the work Area on completion of activities (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | 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.<br>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.<br>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 |

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.

| **Learning outcome** |
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| The learner will:<br>1. Be able to reinstate the work area on completion of activities |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following activities during reinstatement of the work area:<br>• work to current schedules<br>• 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<br>• report any loss or damage to equipment<br>• report any identified hazards within the work area<br>• return all consumables and materials to their correct location<br>• complete any documentation as required<br>1.3 separate equipment, components, and materials for re-use from waste items and materials<br>1.4 store reusable materials and equipment in an appropriate location<br>1.5 correctly label and store four the following resources:<br>• finished products/components<br>• components requiring overhaul/repair<br>• surplus materials/components<br>• tooling, jigs, fixtures or other equipment used<br>• drawings requiring actioning/adjusting<br>• scrap components<br>• measuring and test instruments<br>• finished drawings<br>• finished documentation<br>• documentation requiring actioning/adjusting<br>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:
- correctly segregating waste materials
- correctly dispose of waste materials
- disposing of joining compounds, sealants and adhesives
- disposing of other chemical products
- removing non-hazardous materials
- disposing of fluid waste (such as oil, hydraulic fluids, fuel)

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:
- workshops/hangers
- airside
- areas at height (such as platforms, staging, lifts)
- internal areas of aircraft (such as wings, tanks, fuselage sections)
- office environment
- computer aided design (CAD) environment
- technical/clean room environment
- other appropriate environment

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

| **Learning outcome** |
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| The learner will:<br>2. Know how to reinstate the work area on completion of activities |
| **Assessment criteria** |
| The learner can:<br>2.1 explain the specific safety practices and procedures they need to observe when reinstating the work area<br>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<br>2.3 describe the hazards associated with reinstating the work area, and explain how to minimise them and reduce any risks<br>2.4 explain the safe working practices and procedures to be followed when carrying out the various activities<br>2.5 explain what personal protective clothing and equipment needs to be worn, and where this can be obtained<br>2.6 explain why work areas need to be restored to a set standard, and what these requirements are<br>2.7 describe the types of work area that will need to be restored<br>2.8 Exp[lain the importance of tool and equipment control, and why this is critical within the aerospace industry<br>2.9 explain the meaning of 'foreign object debris', and why it is vital to ensure that this does not occur or is removed<br>2.10 describe the stores procedures for tools and equipment, documentation and surplus or waste materials<br>2.11 explain what materials will need to be stored and disposed of, and why they need to be segregated, correctly identified and labelled |

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| 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

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 701 Lifting and trestling/shoring aircraft for maintenance/repair operations

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| **UAN:** | **Y/601/6136** |
| **Level:** | 3 |
| **Credit value:** | 15 |
| **GLH:** | 56 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 301: Lifting and Trestling/Shoring Aircraft for Maintenance/Repair Operations (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to lift, and where appropriate, trestle/shore commercial, military or light aircraft, both fixed wing and rotary aircraft, for maintenance operations (such as routine maintenance, repair, refurbishment or recovery), in accordance with the aircraft maintenance manual or approved change documentation (service bulletin) requirements. The learner will be required to use correctly specified items of lifting and supporting equipment, which will include hand and/or power operated lifting and jacking equipment, and associated lifting accessories. The learner must check that the lifting equipment is within current authorisation dates, is undamaged and within the permitted safe working load (SWL). The learner will be expected to establish the weight of the aircraft to be lifted, and to attach the appropriate lifting equipment/slings to the designated lifting points on the aircraft, in order to achieve a safe and balanced lift.<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the aircraft manual or change/service bulletin documentation for the aircraft lifting and shoring activities undertaken, and to report any problems with the lifting and trestling/shoring activities or with the equipment used, that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner |

will be expected to work with a minimum of supervision and, as part of a team, they must demonstrate a significant personal contribution during the team activities, in order to satisfy the requirements of this standard, and competence in all the areas required by the standard must be demonstrated. The learner will be expected to take personal responsibility for their own actions, for their contribution to the team, and for the safety 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 correct aircraft lifting and trestling/shoring techniques and procedures. The learner will understand the lifting and trestling/shoring techniques used, and their application, and will know about the lifting equipment and accessories for lifting, in adequate depth to provide a sound basis for carrying out the activities safely and correctly.

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

**Notes**: 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 07 Lifting and Shoring.

| **Learning outcome** |
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| The learner will:<br>1. Be able to lift and trestle/shore aircraft for maintenance/repair operations |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the aircraft lifting and trestling/shoring activities:<br>• ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures<br>• obtain and use the appropriate documentation (such as job instructions, technical instructions, aircraft manuals and lifting/shoring maintenance documentation)<br>• check that the work area is free from hazards and suitably prepared for the activities to be undertaken<br>• adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant |

safety regulations and procedures to realise a safe system of work

- ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)
- use approved lifting and trestling/shoring techniques and procedures at all times
- return tools and equipment to the correct storage location on completion of the activities
- leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from damage and foreign object debris
- return tools and equipment to the correct storage location on completion of the activities
- ensure that the work carried out is correctly documented and recorded

1.3 check that the lifting and trestling/shoring equipment to be used is correct for the aircraft being lifted and is in a safe and usable condition, by establishing all of the following:

- the lifting equipment selected is as specified for the aircraft being lifted (such as type, lifting capacity)
- the lifting equipment is certified and is compliant, within current test dates (such as LOLER regulations and health and safety requirements)
- all lifting equipment documents/registers are up to date
- where appropriate, all slings and ancillary equipment are free from obvious defects
- all trestles and shoring equipment are in a safe and usable condition

1.4 use two of the following lifting methods and techniques:

- bellyband suspension
- nose wheel jacking
- main undercarriage jacking
- tail wheel jacking
- complete aircraft jacking
- stress jacking
- rotor head suspension
- hard point attachment slings

1.5 carry out jacking and treslling/shoring of an aircraft, to include carrying out all of the following:

- establishing the weight of the aircraft to be lifted, including fuel on board
- determining the correct lifting/jacking points on the aircraft
- removing access panels to expose the jacking/lifting points
- positioning the lifting/jacking equipment correctly on the aircraft
- attaching any required balance weights (ballast) to the aircraft (where appropriate)
- carrying out the lifting/jacking using the approved techniques and procedures for the aircraft type

- positioning the supporting equipment (such as contoured/cushioned supports, trestles, tail supports), and ensuring that it is installed at the appropriate/defined positions on the aircraft (where appropriate)
- lowering the aircraft onto the supporting equipment without causing damage to the aircraft structure (where appropriate)
- checking that the aircraft is correctly and safely balanced and held

1.6 jack and trestle/shore an aircraft for one of the following conditions:

- routine maintenance
- modifications
- repair work
- refurbishment
- recovery

1.7 position the lifting equipment so that the weight of the load is evenly distributed

1.8 attach the appropriate lifting equipment securely to the load, using approved methods to eliminate slippage

1.9 confirm that the load is secure before moving

1.10 lift the load using approved techniques and procedures

1.11 position and release the load safely in its intended location

1.12 carry out aircraft lifting and trestling/shoring operations in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/approved change documentation (service bulletin)
- aircraft manufacturer's requirements.

| **Learning outcome** |
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| The learner will:<br>2. Know how to lift and trestle/shore aircraft for maintenance/repair operations |
| **Assessment criteria** |
| The learner can:<br>2.1 explain the specific safety precautions to be taken when lifting and trestling/shoring aircraft, and the need for ensuring aircraft security<br>2.2 describe the hazards associated with lifting and trestling/shoring aircraft, and explain how to minimise them and reduce any risk<br>2.3 explain the Approved Code of Practice (ACOP) for safe use of lifting equipment, and Lifting Operation and Lifting Equipment Regulations (LOLER)<br>2.4 explain the specific requirements for the marking of lifting equipment, and the specific method used in the organisation in which they are working<br>2.5 describe the range of equipment that is to be used for the lifting operations<br>2.6 describe the lifting equipment accessories that are to be used |

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| 2.7 | explain what checks should be made on the lifting equipment prior to use, and the things that they should look for |
| 2.8 | explain how to carry out visual in-service inspections of the equipment, and what to do should any defective equipment be identified |
| 2.9 | describe the factors which affect the selection of the lifting equipment and lifting accessories |
| 2.10 | explain how to check that the lifting equipment is capable of lifting the load to be moved |
| 2.11 | explain the signalling techniques used to communicate with crane drivers |
| 2.12 | explain how to identify the lifting and trestling/shoring points on the aircraft, and why they must not use any other |
| 2.13 | explain why balance/ballast weights are sometimes required during the lifting operations |
| 2.14 | explain how to determine the type of ballast/balance weight material with regard to suspension points and floorboard loading limits |
| 2.15 | describe the various trestling/shoring methods that may be used, and the types of trestling/shoring material, contour dimensions and trestling/shoring locations on the aircraft |
| 2.16 | explain the need to carry out the lifting and trestling/shoring operations without causing damage or undue stress to the airframe and its components |
| 2.17 | explain how lifting and trestling/shoring equipment should be stored and handled |
| 2.18 | describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve. |

# Unit 701 Lifting and trestling/shoring aircraft for maintenance/repair operations

Supporting information

## Guidance

2.1 (such as general workshop and site safety, appropriate personal protective equipment, protecting other workers during the lifting operations, accident procedures, statutory regulations, risk assessment procedures and COSHH regulations)

2.5 (such as hydraulic jacks, power operated cranes, winches, pulling equipment)

2.6 (such as slings, eye bolts)

2.9 (such as weight, type of load, operating environment)

2.11 (to include both hand signals and verbal commands)

2.14 (such as water, sand, newspaper bulk)

# Unit 702 Levelling and weighing aircraft

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| **UAN:** | **K/601/6142** |
| **Level:** | 3 |
| **Credit value:** | 15 |
| **GLH:** | 56 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 302: Levelling and Weighing Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to prepare for, level and weigh commercial, military or light aircraft, both fixed wing and rotary aircraft, in accordance with the aircraft maintenance manual or approved change documentation (service bulletin) requirements. The learner will be required to prepare the aircraft ready for levelling and weighing, which will include carrying out activities such as defuelling, replenishing oil and other liquids/gaseous substances, removing foreign objects (such as tools, luggage) and cleaning the aircraft interior and exterior. The learner will be expected to obtain the correct equipment to use, as specified in the aircraft maintenance manual and weighing procedures, and to check that the equipment is within current certification requirements and is in a safe and usable condition. In carrying out the levelling and weighing activities, the learner will be expected to determine/locate the correct levelling points on the aircraft, to level the aircraft using appropriate techniques, to weigh the aircraft, to determine the weigh point arms and to determine the centre of gravity for the aircraft.<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the aircraft manual or change/service bulletin documentation for levelling and weighing the aircraft, and to complete the necessary documentation. The learner will be required to report any problems with the levelling and weighing activities that they cannot personally resolve, or which are outside their defined authority, to the relevant people. The learner will be expected to work with a minimum of supervision and as part of a team, communicating |

(where appropriate) using hand signals and other communication devices. The learner must demonstrate a significant personal contribution during the team activities in order to satisfy the requirements of this standard, and competence in all the areas required by the standard must be demonstrated. The learner will be expected to take personal responsibility for their own actions, for their contribution to the team, and for the safety and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to the levelling and weighing of aircraft. The learner will understand the levelling and weighing process, and its application, and will know about the levelling and weighing requirements and equipment to be used, in sufficient depth to provide a sound basis for carrying out the activities to the required standards.

The learner will understand the safety precautions required when carrying out the levelling and weighing operations. 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.

**Notes**: 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 08 Levelling and Weighing.

| **Learning outcome** |
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| The learner will:<br>1. Be able to level and weigh aircraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the aircraft levelling and weighing activities:<br>• ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures<br>• obtain and use the correct documentation (such as job instructions, aircraft configurations, technical instructions, aircraft manuals and levelling and weighing documentation)<br>• check that the work area is free from hazards and is suitably prepared for the activities to be undertaken<br>• adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work |

- obtain the correct tools and equipment for the levelling and weighing activity, and check that they are in a safe and usable condition and within current calibration date(s)
- use the approved levelling and weighing techniques and procedures at all times
- return tools and equipment to the correct storage location on completion of the activities
- leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from damage and foreign object debris
- ensure that work carried out is correctly documented and recorded

1.3 prepare the aircraft for the levelling and weighing operations, to include carrying out all of the following:

- de-fuel the aircraft to the unusable fuel level
- empty all waste tanks
- replenish oil, hydraulic fluid, cooling and anti-icing fluids, liquid oxygen and other gaseous substances to the appropriate level
- remove any items surplus to requirements (such as tools, cabin equipment or luggage)
- clean and dry the aircraft
- move the aircraft to a suitable environment, away from elements effecting the aircraft
- obtain or construct an inventory of equipment actually installed on the aircraft
- correct the basic weight and balance record, based upon the inventory

1.4 Obtain all the required equipment and ensure that it is in safe and usable condition

1.5 Use one of the following types of equipment for weighing the aircraft:

- stationary platform/pit weighing
- shear-beam load cells
- self levelling pressure transducer
- hydrostats
- mobile electronic weighing system
- heavy duty portable scales
- on-board weight and balance equipment

1.6 carry out the necessary preparations to the equipment, in line with work requirements

1.7 Level and weigh the aircraft, using the approved techniques and procedures

1.8 Level the aircraft, to include carrying out three of the following:

- setting and adjusting hydraulic jacks at the appropriate points (such as wing and nose)
- determining/locating the correct levelling points on the aircraft
- placing levelling bars across the levelling lugs
- creating a straight line on the floor from which measurements can be taken, or exposing the levelling plate on the aircraft

floor
- using suitable equipment to check the level of the aircraft (such as spirit level, clinometers, plumb bob, steel tape, chalk line, laser levelling equipment)
- making adjustments to level the aircraft until the plumb bob tip or clinometers are at the required attitude

1.9 Weigh the aircraft, to include carrying out five of the following:
- obtaining the appropriate type and number of scales/load cells to use
- checking that all the equipment to be used is within current calibration dates
- placing portable weighing equipment in the appropriate positions on a level surface
- setting and levelling the equipment where required
- positioning the aircraft on the scales, or jacking the aircraft at the appropriate points using load cell jacks
- allowing electronic equipment to warm up before taking readings
- taking and recording all the load readings

1.10 carry out aircraft levelling and weighing in compliance with one of the following:
- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- extended range twin engined operations procedures (ETOPS) (where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual or approved change documentation (service bulletin) requirements
- aircraft manufacturer's requirements

1.11 Use the information gained to determine four of the following:
- weigh point arms
- centre of gravity/balance point of the aircraft
- most forward centre of gravity
- most rearward centre of gravity
- empty weight of the aircraft
- basic weight of the aircraft
- gross weight of the aircraft
- weight and location of any required ballast

1.12 Record the information accurately and legibly in the appropriate documentation

1.13 complete the relevant paperwork, to include one from the following, and pass it to the appropriate people:
- job cards/work sheets
- computer records
- aircraft technical log
- aircraft log book

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

| Learning outcome |
| --- |
| The learner will:<br>2. Know how to level and weigh aircraft |
| **Assessment criteria** |
| The learner can:<br>2.1 explain the specific safety precautions to be taken when levelling and weighing aircraft, and the need for ensuring aircraft security<br>2.2 describe the hazards associated with levelling and weighing aircraft, and how to minimise them and reduce any risk<br>2.3 explain why it is necessary to check periodically the weight of the aircraft<br>2.4 explain how a change in the aircraft weight will affect its handling characteristics<br>2.5 explain what manuals and documentation they will require for the levelling and weighing activities, and how to obtain and complete them<br>2.6 explain what information they will need to extract from the manuals and documentation in order to carry out the activities correctly<br>2.7 explain the reasons for completing inventories of the actual equipment installed in the aircraft; the need to compare this with the aircraft basic weight and balance record and to update this as required<br>2.8 explain the need to carry out the levelling and weighing activities in a controlled environment, with no blowers or ventilating system blowing air onto the aircraft<br>2.9 explain what preparations and checks must be made on the aircraft and its systems prior to weighing<br>2.10 describe the range of levelling and weighing equipment that is to be used during the process<br>2.11 explain the purpose and use of the respective pieces of equipment, and the limitations<br>2.12 explain what checks need to be made on the equipment to ensure that it is safe to use, correctly calibrated and configured for the intended purpose<br>2.13 describe the various methods that may be used to level aircraft, depending on their type and size<br>2.14 describe the various methods that may be used to weigh aircraft, depending on their type and size<br>2.15 explain what information needs to be calculated from the loadings gathered<br>2.16 describe the disposal methods for waste oil, fuel and other liquids and waste<br>2.17 describe the problems with the weighing and levelling procedures, and explain the importance of informing appropriate people of defects<br>2.18 explain what recording documentation needs to be completed for the activities undertaken, and how to fully complete it<br>2.19 describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve. |

# Unit 702 Levelling and weighing aircraft

Supporting information

## Guidance

2.1 (such as general airside and site safety, appropriate personal protective equipment, protecting other workers during the levelling and weighing operations, accident procedures, statutory regulations, risk assessment procedures and COSHH regulations)

2.3 (such as mandatory requirements and changes in weight due to maintenance, added or changed equipment)

2.8 (such as a closed hangar or building)

2.9 (such as cleaning, emptying all waste and fuel tanks, replenishing oil, liquid and gaseous systems to the appropriate level)

2.10 (such as portable scales, load cells, hydraulic jacks, spirit levels, clinometers and plumb bobs)

2.11 (particularly with regard to SWL)

2.13 (such as chalk lines on the floor, levelling plates in the aircraft floor)

2.14 (such as stationary platform/pit scales, mobile electronic weighing systems, load cells on hydraulic jacks)

2.15 (such as empty, basic and gross weight of the aircraft, the centre of gravity of the aircraft, weight and location of any required ballast)

# Unit 703 Towing, marshalling and parking aircraft

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|---|---|
| **UAN:** | **F/601/6146** |
| **Level:** | 3 |
| **Credit value:** | 15 |
| **GLH:** | 56 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 303: Towing, Marshalling and Parking Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out aircraft handling operations on commercial, military or light aircraft, both fixed wing and rotary, in accordance with approved procedures. The learner will be required to select the correct tools and equipment to use, based on the handling activities to be carried out, and to check that they are in a safe and serviceable condition. The learner will be required to assist in manoeuvring the aircraft to the appropriate location, and to prepare the aircraft for flight operations or post-flight recovery. The handling activities will involve assisting in aircraft towing, preparation for flight, starter crew, aircraft marshalling, recovery from flight, marshalling and parking.<br>The learner's responsibilities will require them to comply with organisational policy and procedures for the aircraft handling activities undertaken, and to report any problems with theses 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 and as part of a team, communicating (where appropriate) using hand signals and other communication devices. The learner must demonstrate a significant personal contribution during the team activities in order to satisfy the requirements of this standard, and competence in all the areas required by the standard must be demonstrated. The learner will be expected to take personal responsibility for |

their own actions, for their contribution to the team, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will be sufficient to provide a sound basis for their work, and will provide an informed approach to applying aircraft handling techniques and procedures. The learner will have an understanding of the preparations to be carried out on the aircraft prior to moving it, 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 the aircraft handling operations, especially those for jet intakes and exhaust dangers. 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.

**Notes**: 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 09 Towing and Taxiing and Chapter 10 Parking, Mooring, Storage and Return to Service.

| **Learning outcome** |
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| The learner will:<br>1. Be able to tow, marshall and park aircraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the aircraft handling activities:<br>• ensure that airport procedures applicable to movement in restricted (airside, etc) areas, including necessary security procedures, are understood and carried out<br>• ensure that appropriate authorisation to move the aircraft is obtained and that authorisations relevant to operating towing vehicles are held and valid<br>• check that the work area is free from hazards and suitably prepared for the aircraft to be moved<br>• adhere to procedures or systems in place for risk assessment, COSHH, and other relevant safety regulations and procedures to realise a safe system of work<br>• ensure that the relevant required safety procedures are implemented<br>• obtain appropriate personal protection equipment and emergency equipment, and check that it is in a usable condition<br>• obtain any required support equipment, and check that it is in a safe and useable condition |

- use approved aircraft handling and moving techniques at all times
- return tools and equipment to the correct storage location on completion of the activities
- leave the work area and the aircraft in a safe condition

1.3 prepare the aircraft and work area for the handling activities to be undertaken

1.4 prepare the aircraft for towing, by carrying out four of the following:

- ensure that the aircraft is in safe condition to move, by checking aircraft documentation
- check/set brake pressure
- make cockpit checks and apply internal power, as required
- check/fit required safety locks/pins (such as landing gear, control surface)
- check/remove electrical earthing and chocks (where appropriate)
- fit the towing arm
- obtain clearance for movement
- ensure that the aircraft is prepared in accordance with local regulations

1.5 carry out the activities within the limits of their personal authority

1.6 assist in three of the following aircraft handling activities:

- towing
- picketing
- marshalling
- parking/storing
- mooring

1.7 undertake three of the following roles when moving aircraft:

- brake man
- blade man
- safety chock man
- wing tip man
- tail safety man
- tractor/steering operator
- towing supervisor

1.8 carry out the activities in the specified sequence and in an agreed timescale

1.9 assist in carrying out all of the following during the preparation for flight operations:

- removing any fitted blanks, bungs and covers
- removing any locking/safety devices (such as undercarriage, control surface)
- carrying out cockpit checks and applying ground power
- carrying out engine starter crew activities (using headset operations and/or hand signals)
- carrying out pre-flight checks
- marshalling

1.10 carry out all of the following during recovery from flight operations:
- marshalling (where applicable)
- fitting any blanks, bungs and covers that may be required
- fitting any required locking/safety devices (such as undercarriage, control surface)
- parking of the aircraft (to include the use of wheel chocks, mooring blocks and, where appropriate, earthing)

1.11 carry out aircraft handling operations in compliance with one of the following:
- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- extended range twin engined operations procedures (ETOPS) (where appropriate)
- Federal Aviation Authority (FAA)
- Ministry of Defence (MoD)
- specific organisation standards and procedures
- aircraft manufacturer's requirements

1.12 report any instances where the activities cannot be fully met or where defects are identified

1.13 check that the aircraft and work area are left in a safe and secure condition on completion of the activities.

**Learning outcome**

The learner will:

2. Know how to tow, marshall and park aircraft

**Assessment criteria**

The learner can:

2.1 explain the specific safety precautions and procedures to be observed whilst carrying out the aircraft handling operations

2.2 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

2.3 explain the authorisation they require to commence work on the aircraft

2.4 describe the hazards associated with towing, marshalling, parking and securing the aircraft, and explain how to minimise them and reduce any risk

2.5 describe the hazards associated with engine start and running, and explain how they can be minimised

2.6 explain the importance of good aircraft husbandry and of ensuring that, throughout the activity, the aircraft and area are free from foreign objects; the implications of foreign object debris (FOD) to the safety of the aircraft

2.7 explain what protective equipment they need to use for both personal protection and protection of the aircraft

2.8 explain what specifications are used during aircraft handling, and the importance of following the procedures listed in these documents

2.9 explain the process and procedures for preparing an aircraft for flight operations

2.10 explain the process and procedures for recovering an aircraft from

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|---|---|
| | flight operations |
| 2.11 | describe the standard signals used when marshalling and handling aircraft |
| 2.12 | explain how to attach the towing devices to the aircraft, and how to identify the appropriate attachment points |
| 2.13 | explain what equipment is to be used to tow the aircraft, and how to check that they are in a safe and usable condition |
| 2.14 | explain their understanding of the minimum turning radius for the particular aircraft being handled, and the ground turning techniques to be used |
| 2.15 | explain the methods used to communicate with the handling team and/or flight crew using both headsets and hand signals |
| 2.16 | explain the importance of correctly securing the aircraft |
| 2.17 | explain the need to fit blanking plugs, covers, locking/safety devices and, where appropriate, cocooning materials |
| 2.18 | explain the importance of correct static grounding of the aircraft |
| 2.19 | explain the importance of tool control, and company tool control procedures |
| 2.20 | explain what methods and equipment is to be used to manoeuvre the aircraft, and how to check that the equipment is in a usable condition |
| 2.21 | explain how to deal with problems with aircraft handling processes or procedures, and the importance of informing appropriate people of any defects |
| 2.22 | describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve. |

# Unit 703 Towing, marshalling and parking aircraft

Supporting information

## Guidance

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

2.4 (including airfield hazards and procedures)

2.9 (including engine start and 'see off')

2.10 ('see in')

2.13 (such as towing vehicles, tow bars, towing cables)

2.16 (using such things as wheel chocks, mooring blocks and mooring cables)

# Unit 704 Carrying out flight servicing and routine maintenance of aircraft

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| **UAN:** | **R/601/6152** |
| **Level:** | 3 |
| **Credit value:** | 40 |
| **GLH:** | 105 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 304: Carrying Out Flight Servicing and Routine Maintenance of Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out flight servicing and routine maintenance activities on commercial, military or light aircraft, both fixed wing and rotary, in accordance with the aircraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. The learner will be required to select the correct tools and equipment to use for the servicing activities to be carried out in accordance with the aircraft maintenance manual, and to check that they are in a safe and serviceable condition. The learner will be required to manoeuvre the aircraft to the appropriate location and to prepare the aircraft for the work. The servicing activities will involve defuelling and refuelling, replenishing oxygen systems, replenishing oil systems, checking undercarriages, wheels and brakes, and completing the servicing records.<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the aircraft manual, change/service bulletin documentation and airworthiness requirements for the servicing/maintenance activities undertaken, and to report any problems with these requirements 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 are correctly accounted for on completion of the activities, and that all |

necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate aircraft servicing and maintenance techniques and procedures. The learner will understand the type of aircraft being serviced, the common problems that can occur, and will know about the replenishment equipment 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 working on the aircraft, especially those for ensuring system cleanliness and the avoidance of contamination. 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.

**Notes**: This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 12.

| **Learning outcome** |
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| The learner will:<br>1. Be able to carry out flight servicing and routine maintenance of aircraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the servicing and routine maintenance activities:<br>• ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures<br>• obtain and use the appropriate documentation (such as job instructions, servicing/routine maintenance documentation, technical instructions, aircraft manuals)<br>• 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<br>• ensure that relevant safety devices and mechanical/physical locks are in place (where appropriate)<br>• ensure that the aircraft is correctly earthed and follow |

approved safe procedures for connecting ground power
- use approved servicing and maintenance techniques at all times
- return tools and equipment to the correct storage location on completion of the activities
- ensure that work carried out is correctly documented and recorded
- leave the aircraft in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from damage and foreign object debris

1.3 follow the relevant maintenance schedules to carry out the required work

1.4 carry out three of the following flight inspections, in accordance with the approved servicing schedule:
- daily
- transit
- after flight
- before flight
- turnaround
- Extended Range Twin-Engine Operations Procedures (ETOPS)

1.5 to include replenishment and servicing of all of the following, as appropriate to the aircraft category:
- gas systems
- oil systems
- hydraulic systems
- water/toilet systems
- aircraft lights
- cabin/flight deck inspections
- engines
- structure examination
- landing gear examination and tyre pressure checks

1.6 carry out one of the following:
- refuelling
- defueling

1.7 carry out the maintenance activities within the limits of their personal authority

1.8 carry out the maintenance activities in the specified sequence and in an agreed timescale

1.9 carry out servicing work in compliance with one of the following:
- Civil Aviation Authority (CAA )/European Aviation Safety Agency (EASA)
- Extended Range Twin-Engine Operations Procedures (ETOPS) (where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/approved change documentation (service bulletin)

1.10 report any instances where the servicing or maintenance activities cannot be fully met or where there are identified defects outside

the planned schedule

1.11 complete the relevant maintenance records accurately and pass them on to the appropriate person

1.12 complete the relevant paperwork, to include one from the following, and pass it to the appropriate people:

- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.13 dispose of waste materials in accordance with safe working practices and approved procedures.

**Learning outcome**

The learner will:

2. Know how to carry out flight servicing and routine maintenance of aircraft

**Assessment criteria**

The learner can:

2.1 explain the specific safety precautions and procedures to be observed whilst carrying out the aircraft servicing

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 aircraft servicing/maintenance activities, and the responsibility these requirements place on them

2.4 explain the authorisation they require to commence work on the aircraft

2.5 describe the hazards associated with carrying out flight servicing of the aircraft, and explain how to minimise them and reduce any risk

2.6 describe the hazards associated with working on and replenishing aircraft systems, and explain how they can be minimised

2.7 explain what protective equipment that they need to use for both personal protection and protection of the aircraft

2.8 explain the importance of good aircraft husbandry and of ensuring that, throughout the servicing activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft

2.9 explain the maintenance schedules and servicing specifications that are used during servicing and maintenance, and the importance of following the procedures listed in these documents

2.10 explain what replenishments need to be made and the method of replenishment to be used

2.11 explain the electrical bonding specifications, and their importance

2.12 explain how to identify the fuels, lubricants and gases to be used, and how to ensure that systems are not contaminated

2.13 explain the procedures for checking undercarriages, wheels and brakes, and what to look for

2.14 describe the quality control procedures to be followed during the servicing procedures

2.15 explain how to conduct any necessary checks to ensure the system

integrity and functionality

2.16 describe the problems that can occur with the servicing and maintenance activities, and explain how these can be overcome

2.17 explain the importance of the correct securing and locking of connections

2.18 explain the importance of personal tool control, and the organisational tool control procedures

2.19 explain how replenishment equipment is cared for, connected, operated and controlled

2.20 explain the methods and equipment used to replenish aircraft systems, and how to check that the equipment is within its current certification dates

2.21 describe the tools and equipment used in the servicing activities, and explain their calibration/care and control procedures

2.22 describe the disposal methods for waste oil, fuel and other liquids and waste

2.23 describe the problems with the servicing procedures, and explain the importance of informing appropriate people of any defects

2.24 explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation

2.25 describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve.

# Unit 704 Carrying out flight servicing and routine maintenance of aircraft

Supporting information

## Guidance

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

2.6 (such as fuel, gaseous systems and oils)

2.13 (such as tyre damage, tyre creep, tyre pressure, hydraulic leaks, shock absorber/oleo extension, security of fastenings and brake wear)

# Unit 705 Maintaining air conditioning systems on aircraft

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| **UAN:** | **K/601/6156** |
| **Level:** | 3 |
| **Credit value:** | 86 |
| **GLH:** | 168 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 305: Maintaining Air Conditioning Systems on Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft air conditioning systems, in accordance with the aircraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It covers both fixed wing and rotary winged aircraft, and covers the units and components which provide a means of pressurising, heating, cooling, moisture controlling, filtering and treating air used to ventilate the areas of the fuselage within the pressure zone, as applicable to the aircraft type. The maintenance activities will include the removal, fitting and testing of a range of air conditioning system components. The learner will be expected to use the approved procedure for correctly isolating the system before breaking into the system circuit. The learner will remove the required components and fit approved replacements, as appropriate. The learner will then need to test and adjust the completed system to meet the aircraft maintenance manual, change documentation (service bulletin) and airworthiness requirements.<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the aircraft manual, change/service bulletin documentation and airworthiness requirements for the maintenance activities undertaken, and to report any problems with these requirements 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 are correctly accounted for on completion of the activities, and that all necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to aircraft air conditioning systems. The learner will understand the removal, fitting and testing methods and procedures, and their application, along with the air conditioning system maintenance requirements. The learner will know how the equipment functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the equipment is maintained to the required standard.

The learner will understand the safety precautions required when working on aircraft air conditioning systems, especially those for isolating the system, ensuring system cleanliness and the avoidance of contamination. 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.

**Notes**: 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 21 Air Conditioning. 2. To display competence in this unit it is necessary to both remove and fit aircraft air conditioning system components. The learner must remove components; however, they may fit a replacement component where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| Learning outcome |
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| The learner will:<br>1. Be able to maintain air conditioning systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the maintenance of the aircraft air conditioning system:<br>• ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures<br>• obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)<br>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates<br>• 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<br>• ensure the safe isolation of the air conditioning equipment before breaking into the system<br>• ensure that relevant safety devices and mechanical/physical locks are in place (where appropriate)<br>• use approved removal, fitting and testing techniques and procedures at all times<br>• leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from damage and foreign object debris<br>• return tools and equipment to the correct storage location on completion of the activities<br>• ensure that the work carried out is correctly documented and recorded<br>• ensure that any outstanding tests are correctly documented<br>1.3 follow the relevant maintenance schedules to carry out the required work<br>1.4 carry out the maintenance activities within the limits of their personal authority<br>1.5 carry out maintenance activities on three of the following parts of an aircraft air conditioning system:<br>• compression<br>• distribution<br>• pressurisation control<br>• heating<br>• cooling<br>• filtration control |

- temperature control
- air contaminant control
- humidity control

1.6 carry out the maintenance activities in the specified sequence and in an agreed timescale

1.7 carry out fifteen of the following maintenance activities:

- removing access panels and covers to expose components to be removed
- carrying out fault diagnosis and system checks
- preparing the system for maintenance (such as isolating, de-pressurising, draining fluids)
- disconnecting electrical connections
- disconnecting/removing hoses and pipes
- removing securing devices and mechanical fasteners
- dismantling equipment to an appropriate level
- ensuring that any part-dismantled components are secure/supported
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing damaged/defective components
- replacing single use items (such as seals, filters, gaskets)
- refitting components in the correct position, orientation and alignment
- setting, and adjusting replaced components (such as travel, working clearance)
- making mechanical connections
- making electrical connections
- torque loading as required
- re-pressurising the system
- carrying out a system functional check
- ensuring that replacement components have the correct part numbers
- labelling (and storing in the correct location) components that require repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)
- carrying out area inspections prior to task close-up

1.8 remove and fit four different aircraft air conditioning system components, at least one must be from group A:

1.9 group a:

- reservoirs/supply tanks
- air receivers
- compresser
- regulators
- pumps
- air cycle unit
- pressure intensifiers

- diffusers
- cooling units
- heat exchanger
- cabin blowers
- vapour cycle unit
- valves (such as by-pass, shut-off, check, pressure relief, temperature control, outflow, anti-g)
- safety devices
- air-conditioning packs
- pressure/pressurisation controller

group b:

- filters
- strainers including water separator
- earthing straps/jumper braids
- rigid pipework
- actuating mechanisms
- hoses
- gaskets and seals
- unions and couplings
- ducting
- scoops
- gauges
- sensors
- electrical controls (solenoids, motors, switches)
- other specific components

1.10 service/check the aircraft air conditioning system, to include carrying out five of the following:

- checking filters
- cleaning outflow valves
- checking fluid content of reservoirs (such as deodorisers, insecticides)
- checking operation of air conditioning/heating system
- checking operation of pressurisation system
- checking indicating systems
- replenishing vapour system
- checking safety devices

1.11 carry out three of the following tests on the aircraft air conditioning system:

- cabin pressure test
- pressure balancing
- bulkhead and dome pressure tests
- air flow tests
- leak test
- air temperature tests
- safety interlock test
- air line vapour tests

- reduced system test
- equipment functional test
- visual inspection
- built in test equipment (BITE) test
- 'special-to-type' tests
- aircraft self test printout

using one of the following:

- aircraft power source/system
- ground test rig

1.12 carry out maintenance on aircraft air conditioning systems in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Extended Range Twin-Engine Operations Procedures (ETOPS) (where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/approved change documentation (service bulletin)

1.13 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.14 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:

- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.15 dispose of waste materials in accordance with safe working practices and approved procedures.

| **Learning outcome** |
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| The learner will:<br>2. Know how to maintain air conditioning systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>2.1 explain the specific safety practices and procedures that they need to observe when working on aircraft air conditioning systems<br>2.2 explain the importance of maintenance on air conditioning systems, and impact upon ETOPS systems, Electrical Wiring Interconnect Systems (EWIS), legislation and local procedures<br>2.3 describe the hazards associated with carrying out maintenance activities on aircraft air conditioning systems, and with the tools and equipment used, and explain how to minimise them and reduce any risk<br>2.4 explain what protective equipment they need to use for both personal protection and protection of the aircraft<br>2.5 explain how to extract and use information from aircraft manuals, |

log books, flight logs, charts, circuit and physical layouts, specifications, symbols used in aircraft air conditioning systems, and other documents in the maintenance activities

2.6 explain how to carry out currency/issue checks on the specifications they are working with

2.7 explain the terminology used in aircraft air conditioning systems, and the use of system diagrams and associated symbols

2.8 describe the basic principles of operation of the aircraft air conditioning system being worked on, along with corresponding safety devices

2.9 describe the various types of pipe and component that make up the aircraft air conditioning system

2.10 explain the techniques used to remove components from aircraft air conditioning systems without damage to the components or surrounding structure

2.11 describe the various mechanical fasteners that will need to be removed and replaced, and explain their methods of removal and replacement

2.12 describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections

2.13 explain the methods of lifting, handling and supporting components/equipment during the maintenance activities

2.14 explain the importance of good aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and that any exposed components or pipe ends are correctly covered/protected, and the implications of foreign object debris (FOD) to the safety of the aircraft

2.15 explain how to recognise contaminants, and the problems they can create: the effects and likely symptoms of contamination in the system

2.16 explain the need to label and store correctly components that require repair or overhaul, and to check that replacement components have the correct part/identification markings and accompanying release documentation

2.17 explain how to fit components into the circuit

2.18 explain how to make adjustments to components/assemblies to ensure that they function correctly

2.19 explain why securing devices need to be tightened to the correct torque, locked and labelled, and the different methods that are used

2.20 explain how to carry out routine servicing of the aircraft air conditioning system

2.21 explain what types of test need to be carried out on the aircraft air conditioning system

2.22 describe the methods and procedures to be used to carry out the various tests on the air conditioning system

2.23 explain the need to apply test pressures in incremental stages, and to check all readings and pressures at each stage

2.24 explain how to record the results of each individual test, and the documentation that must be used

2.25 explain how to analyse the test results, and how to make valid decisions about the acceptability of the aircraft air conditioning

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| | system |
| 2.26 | explain the procedures to be followed if the equipment or system fails to meet the test specification |
| 2.27 | explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation |
| 2.28 | describe the procedure for the safe disposal of waste materials and scrap components |
| 2.29 | describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve. |

# Unit 705 Maintaining air conditioning systems on aircraft

Supporting information

## Guidance

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

2.8 (such as system layout, compression, distribution, pressurisation control, heating, cooling, temperature control and air contaminant control; indication and warning)

2.9 (such as rigid and flexible pipes; ducting; supporting devices; valves used for pressure, flow and directional control; pumps; heaters; cooling units; air cycle units; cabin blowers; mechanical and electrical control devices)

2.10 (such as removal of components, and the need to protect the circuit integrity by fitting blanking plugs and labelling exposed circuits)

2.11 (such as threaded fasteners, special securing devices)

2.17 (such as the use of gaskets/seals and jointing/sealing compounds; ensuring the correct tightness of pipe fittings and connections; eliminating stress on pipework/connections; carrying out visual checks of all components; checking the security of joints and that the system is safe to re-charge)

2.20 (including checking for leaks, checking and changing filters, cleaning outflow valves)

2.21 (such as functional checks, pressure tests, pressure balancing, air temperature tests, safety interlock tests, leak checks)

# Unit 706 Maintaining auto flight systems on aircraft

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| **UAN:** | **A/601/6159** |
| **Level:** | 3 |
| **Credit value:** | 86 |
| **GLH:** | 168 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 306: Maintaining Auto Flight Systems on Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft auto flight systems, in accordance with the approved aircraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It covers both fixed wing and rotary winged aircraft, and includes units and components which provide a means of automatically controlling the flight of the aircraft, including direction, heading, altitude and speed, as applicable to the aircraft type. The maintenance activities will include the removal, fitting and testing of a range of auto flight components. The learner will be required to select the correct tools and equipment to use, based on the operations to be performed and the components to be removed or replaced. The aircraft components will include items such as computers, controllers, air data units, detectors, gyros (rate and vertical), trim units, actuators, stick position cancellers, and angle of attack and stall warning components. The learner will remove the required components and fit approved replacements, as appropriate. The learner will then need to test and adjust the completed system to meet the aircraft maintenance manual, change documentation (service bulletin) and airworthiness requirements.<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the aircraft manual, change/service bulletin documentation and |

airworthiness requirements for the maintenance activities undertaken, and to report any problems with these requirements 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 are correctly accounted for on completion of the activities, and that all necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to aircraft auto flight systems. The learner will understand the removal, fitting and testing methods and procedures, and their application, along with the auto flight system maintenance requirements. The learner will know how the equipment functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the equipment is maintained to the required standard.

The learner will understand the safety precautions required when working on the aircraft auto flight system, and when using the associated tools and equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

**Notes**: 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 22 Auto Flight. 2. To display competence in this unit it is necessary to both remove and fit aircraft auto flight system components. The learner must remove components; however, they may fit a replacement component where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| Learning outcome |
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| The learner will:<br>1. Be able to maintain auto flight systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the maintenance of the aircraft auto flight system:<br>• ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures<br>• obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)<br>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates<br>• 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<br>• ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)<br>• where appropriate, apply electrostatic discharge (ESD) avoidance procedures<br>• use approved removal, fitting and testing techniques and procedures at all times<br>• leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from damage and foreign object debris<br>• return tools and equipment to the correct storage location on completion of the activities<br>• ensure that work carried out is correctly documented and recorded<br>• ensure that any outstanding tests are correctly documented<br>1.3 follow the relevant maintenance schedules to carry out the required work<br>1.4 carry out the maintenance activities within the limits of their personal authority<br>1.5 carry out maintenance on two of the following parts of the aircraft auto flight system:<br>• autopilot<br>• mach trim<br>• auto throttle<br>• auto land systems<br>• auto pilot system monitoring<br>• integrated flight director system |

- aerodynamic load alleviating
- command stability and augmentation system

1.6 carry out the maintenance activities in the specified sequence and in an agreed timescale

1.7 carry out fifteen of the following maintenance activities:

- removing access panels and covers to expose components to be removed
- carrying out fault diagnosis and system checks
- preparing the system for maintenance (such as isolating)
- disconnecting electrical connections
- removal of bonding
- removing cable securing devices
- removing securing devices and mechanical fasteners
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing damaged/defective components
- refitting components in the correct position, orientation and alignment
- setting and adjusting/tuning replaced components (such as power output, voltage)
- making mechanical connections
- making electrical connections
- carrying out bonding
- installing cable securing devices
- torque loading as required
- carrying out functional checks of systems
- ensuring that replacement components have the correct part numbers
- labelling (and storing in the correct location) components that require repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)
- carrying out area inspections prior to task close down

1.8 remove and fit three different aircraft auto flight system components (at least one must be from group A):

group a:

- computers
- controllers
- amplifier
- detectors/position sensors
- receiver units
- gyros (rate and vertical)
- trim units
- actuators

- transformers
- stick position cancellers
- embedded GPS and INS (EGI)

group b:

- batteries
- switches
- relays
- servos
- aerials
- instruments/gauges/indicators
- wires/cables
- plugs/sockets
- other specific components

1.9 service/check aircraft auto flight systems, to include carrying out four of the following:

- check operation of autopilot
- check operation of auto throttle
- check operation of yaw damper
- check and adjust servo clutch
- other specific aircraft checks
- perform autopilot gain adjustments
- perform mach trim functional check
- check autoland system
- check stability augmentation system

1.10 carry out five of the following types of test/check on aircraft auto flight systems:

- functional check
- bonding tests
- BITE test
- continuity checks
- signal injection tests
- rate/range/sense of movement
- audio warning
- visual warning
- 'special-to-type' tests
- voltage checks

using four of the following:

- simulators
- clinometers
- air data test sets
- tilt tables
- multimeter
- external power source (electrical/hydraulic)
- aircraft power source (electrical/hydraulic)
- bonding tester
- 'special to type' test equipment

- internal aircraft equipment
- oscilloscope
- reference gyros

1.11 carry out maintenance on aircraft auto flight systems in compliance with one of the following:
- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Extended Range Twin-Engine Operations Procedures (ETOPS) (where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/approved change documentation (service bulletin)

1.12 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.13 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:
- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.14 dispose of waste materials in accordance with safe working practices and approved procedures .

| **Learning outcome** |
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| The learner will:<br>2. Know how to maintain auto flight systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>2.1 explain the specific safety practices and procedures that they need to observe when working with aircraft auto flight systems<br>2.2 explain the importance of maintenance on auto flight systems, and impact upon ETOPS systems, RVSM operations, Electrical Wiring Interconnect Systems (EWIS), Autoland system status and legislation and local procedures<br>2.3 describe the hazards associated with removing, fitting and testing aircraft flight control system components, and with the tools and equipment used, and explain how to minimise them and reduce any risk<br>2.4 explain what protective equipment that they need to use for both personal protection and protection of the aircraft<br>2.5 explain the importance of good aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft<br>2.6 explain how to extract and use information from aircraft manuals, log books, flight logs, charts, circuit and physical layouts, specifications, symbols used in aircraft flight control systems, other documents needed in the maintenance process |

2.7 explain how to carry out currency/issue checks on the specifications they are working with

2.8 explain the terminology used in aircraft flight control systems, and the use of system diagrams and associated symbols

2.9 describe the basic principles of operation of the auto flight system being worked on, and the function of the various units within the system

2.10 describe the various mechanical fasteners that are used, and explain their methods of removal and replacement

2.11 explain the importance of using the specified fasteners for the installation, and why they must not substitute others

2.12 explain why securing devices need to be locked and labelled, and the different methods that are used to remove and install them

2.13 explain the torque loading requirements on the fasteners, and what to do if these loadings are exceeded or not achieved

2.14 describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections

2.15 explain the techniques used to remove components from aircraft auto flight systems without damage to the components or surrounding structure

2.16 explain the importance of applying electrostatic discharge (ESD) avoidance procedures when working on sensitive equipment or devices

2.17 explain the need to label and store correctly components that require repair or overhaul, and to check that replaced components have the correct part/identification markings and accompanying release documentation

2.18 explain the techniques used to position, align, adjust and secure the replaced components to the aircraft without damage to the components or surrounding structure

2.19 explain the methods of lifting, handling and supporting the components/equipment during the removal and fitting activities

2.20 explain why electrical bonding is critical, and why it must be both mechanically and electrically secure

2.21 describe the tools and equipment used in the maintenance activities, and explain their calibration/care and control procedures

2.22 explain why tool/equipment control is critical, and what to do if a tool or piece of equipment is unaccounted for on completion of the activities

2.23 explain how to recognise defects

2.24 explain how to carry out routine servicing of the aircraft auto flight system

2.25 explain the need to check that cabin/cockpit switches, selectors and circuit breakers are in the correct position before applying any form of external power

2.26 explain what types of test to need be carried out on the aircraft auto flight system, and the test equipment to be used

2.27 explain the methods and procedures to be used to carry out the various tests on the auto flight system

2.28 explain the importance of carrying out the tests in the specified sequence, checking readings/movements at each stage

2.29 explain how to record the results of each individual test, and the documentation that must be used

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| 2.30 | explain how to analyse the test results and make valid decisions about the acceptability of the aircraft auto flight systems |
| 2.31 | explain the procedures to be followed if the equipment or system fails to meet the test specification |
| 2.32 | describe the problems that can occur with the auto flight system maintenance operations, and explain how these can be overcome |
| 2.33 | explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation |
| 2.34 | describe the procedure for the safe disposal of waste materials and scrap components |
| 2.35 | describe the extent of their own authority, and to whom they should report if they have problems that they cannot resolve. |

# Unit 706 Maintaining auto flight systems on aircraft

Supporting information

## Guidance

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

2.10 (such as threaded fasteners, special securing devices)

2.15 (such as proof marking, the need to protect the circuit integrity by covering and labelling exposed circuits)

2.23 (such as incorrectly seated plugs and sockets, ineffective fasteners, foreign object damage or contamination)

2.25 (such as electrical, hydraulic, air or vacuum)

# Unit 707 Maintaining communication systems on aircraft

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| **UAN:** | **F/601/6163** |
| **Level:** | 3 |
| **Credit value:** | 86 |
| **GLH:** | 168 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 307: Maintaining Communication Systems on Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft communication systems, in accordance with the approved aircraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It covers both fixed wing and rotary winged aircraft, and includes units and components which provide a means of communicating from one part of the aircraft to another, between aircraft and aircraft to ground stations. The maintenance activities will include the removal, fitting and testing of a range of communication system components. The learner will be required to select the correct tools and equipment to use, based on the operations to be performed and the components to be removed or replaced. The communication system will include units and components associated with speech and satellite communication, data transmission, automatic calling, passenger address, interphone, audio integrating, static discharging, integrated automatic tuning, audio and video monitoring, as applicable to the aircraft type. The learner will remove the required components and to fit approved replacements, as appropriate. The learner will then need to test and adjust the completed system to meet the aircraft maintenance manual or change documentation (service bulletin) and airworthiness requirements.<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the aircraft manual, change/service bulletin documentation and airworthiness |

requirements for the maintenance activities undertaken, and to report any problems with these requirements 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 are correctly accounted for on completion of the activities, and that all necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to aircraft communication systems. The learner will understand the removal, fitting and testing methods and procedures, and their application, along with the system maintenance requirements. The learner will know how the equipment functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the equipment is maintained to the required standard.

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

**Notes**: 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 23 Communications. 2. To display competence in this unit, it is necessary to both remove and fit aircraft communication system components. The learner must remove components; however, they may fit a replacement component where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| **Learning outcome** |
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| The learner will:<br>1. Be able to maintain communication systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the maintenance of the aircraft communication system equipment:<br>• ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures<br>• obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)<br>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates<br>• 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<br>• ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)<br>• where appropriate, apply electrostatic discharge (ESD) avoidance procedures<br>• use approved removal, fitting and testing techniques and procedures at all times<br>• leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from damage and foreign object debris<br>• return tools and equipment to the correct storage location on completion of the activities<br>• ensure that work carried out is correctly documented and recorded<br>• ensure that any outstanding tests are correctly documented<br>1.3 follow the relevant maintenance schedules to carry out the required work<br>1.4 carry out the maintenance activities within the limits of their personal authority<br>1.5 carry out maintenance on three of the following aircraft communication systems:<br>• speech communication (such as HF radio, VHF radio, UHF radio, intercom (clear), intercom (secure speech))<br>• satellite communications (such as SATCOM, GPS systems, crash position indicators)<br>• data transmission and automatic calling (such as telecommunications/teleprinter, Selcal, Calsel, ACARS)<br>• passenger address |

- interphone
- audio integrating (such as microphones, headphones, cockpit loudspeakers)
- static discharging
- integrated automatic tuning (such as digital data links)
- audio and video monitoring (such as voice recorders, passenger conversation/movement, external cameras)

1.6 carry out the maintenance activities in the specified sequence and in an agreed timescale

1.7 carry out fifteen of the following maintenance activities:

- removing access panels and covers to expose components to be removed
- carrying out fault diagnosis and system checks
- preparing the system for maintenance (such as isolating)
- disconnecting electrical connections
- removal of bonding
- removing cable securing devices
- removing securing devices and mechanical fasteners
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing damaged/defective components
- refitting components in the correct position, orientation and alignment
- making mechanical connections
- making electrical connections
- carrying out bonding
- installing cable securing devices
- torque loading as required
- carrying out functional checks of the system
- ensuring that replacement components have the correct part numbers
- labelling (and storing in the correct location) components that require repair or overhaul
- setting, and adjusting/tuning replaced components (such as power output, voltage, frequency presets)
- applying bolt locking methods (such as split pins, wire locking, lock nuts)
- carrying out area inspections prior to task closedown

1.8 remove and fit four different communication system components (at least two must be from group A):

group a:

- aerials/antennas
- receiver units
- satellite beacons
- transponders

- voice recorder
- antenna switching units
- tuning units
- transmitter units
- amplifiers
- cameras
- transformers
- control units
- intercom station boxes
- monitors
- display panels

group b:

- switches
- relays
- unit trays
- static discharge wicks
- headsets
- handsets
- speakers
- wires/cables
- plugs/sockets
- instruments/gauges/indicators
- microphone units
- other specific components

1.9 service/check aircraft communication systems, to include carrying out five of the following:

- checking operation of speech communication system
- checking operation of satellite communications
- checking operation of data transmission and automatic calling system
- checking operation of passenger address, entertainment and comfort system
- replacing static discharge wicks
- checking operation of interphone system
- checking operation of audio integrating system
- checking operation of integrated automatic tuning system
- checking operation of audio and video monitoring system

1.10 carry out three of the following types of test/check on aircraft communication systems:

- continuity check
- bonding tests
- power output
- BITE test
- distortion checks
- VSWR checks
- 'special-to-type' tests

using five of the following:

- 'special to type' test equipment
- multimeter
- time domain reflectometer (TDR) equipment
- bonding tester
- headset
- wattmeter
- insulation resistance (Megger) tester
- oscilloscope
- modulation analyser
- RF signal generator
- voltage standing wave ratio (VSWR) equipment
- aircraft power source
- external power source

1.11 carry out maintenance on aircraft communication systems in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Extended Range Twin-Engine Operations Procedures (ETOPS) (where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/approved change documentation (service bulletin)

1.12 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.13 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:

- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.14 dispose of waste materials in accordance with safe working practices and approved procedures.

| **Learning outcome** |
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| The learner will:<br>2. Know how to maintain communication systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>2.1 explain the specific safety practices and procedures that they need to observe when working with aircraft communication systems<br>2.2 explain the importance of maintenance on aircraft communication systems, and impact upon ETOPS systems, Electrical Wiring Interconnect Systems (EWIS), legislation and local procedures<br>2.3 describe the hazards associated with removing, fitting and testing |

aircraft communication system components, and with the tools and equipment used, and explain how to minimise them and reduce any risk

2.4 explain what protective equipment they need to use for both personal protection and protection of the aircraft

2.5 explain the importance of good aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft

2.6 explain how to extract and use information from aircraft manuals, log books, flight logs, charts, circuit and physical layouts, specifications, symbols used in aircraft communication systems, and other documents in the maintenance process

2.7 explain how to carry out currency/issue checks on the specifications they are working with

2.8 explain the terminology used in aircraft communication systems, and the use of system diagrams and associated symbols

2.9 describe the basic principles of operation of the communication system being worked on, and the function of the various units that make up the system

2.10 describe the various mechanical fasteners that are used, and explain their method of removal and replacement

2.11 explain the importance of using the specified fasteners for the installation, and why they must not substitute others

2.12 explain why securing devices need to be locked and labelled, and the different methods that are used to remove and install them

2.13 explain the torque loading requirements on the fasteners, and what to do if these loadings are exceeded or not achieved

2.14 describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections

2.15 explain the techniques used to remove components from aircraft communication systems without damage to the components or surrounding structure

2.16 explain the importance of applying electrostatic discharge (ESD) avoidance procedures when working on sensitive equipment or devices

2.17 explain the need to label and store correctly components that require repair or overhaul, and to check that replaced components have the correct part/identification markings and accompanying release documentation

2.18 explain the techniques used to position, align, adjust and secure the replaced components to the aircraft without damage to the components or surrounding structure

2.19 explain the methods of lifting, handling and supporting the components/equipment during the maintenance activities

2.20 explain why electrical bonding is critical, and why it must be both mechanically and electrically secure

2.21 describe the tools and equipment used in the maintenance activities, and explain their calibration/care and control procedures

2.22 explain why tool/equipment control is critical, and what to do if a tool or piece of equipment is unaccounted for on completion of the activities

2.23 explain how to recognise defects

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| 2.24 | explain how to carry out routine checks and servicing of the aircraft communication system (including performing antenna VSWR checks, checking function of radios and passenger address system) |
| 2.25 | explain the need to check that cabin/cockpit switches, selectors and circuit breakers are in the correct position before applying any form of external power |
| 2.26 | explain what types of test need to be carried out on the aircraft communication system, and the test equipment to be used |
| 2.27 | explain the methods and procedures to be used to carry out the various tests on the communication system |
| 2.28 | explain the importance of carrying out the tests in the specified sequence, checking readings/movements at each stage |
| 2.29 | explain how to record the results of each individual test, and the documentation that must be used |
| 2.30 | explain how to analyse the test results, and make valid decisions about the acceptability of the communication system |
| 2.31 | explain the procedures to be followed if the equipment or system fails to meet the test specification |
| 2.32 | explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation |
| 2.33 | describe the procedure for the safe disposal of waste materials and scrap components |
| 2.34 | describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve . |

# Unit 707 Maintaining communication systems on aircraft

Supporting information

## Guidance

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

2.10 (such as threaded fasteners, special securing devices)

2.15 (such as proof marking, the need to protect the circuit integrity by covering and labelling exposed circuits)

2.23 (such as incorrectly seated plugs and sockets, ineffective fasteners, foreign object damage or contamination)

2.25 (such as electrical, hydraulic, air or vacuum)

# Unit 708 Maintaining electrical power systems on aircraft

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|---|---|
| **UAN:** | **L/601/6165** |
| **Level:** | 3 |
| **Credit value:** | 86 |
| **GLH:** | 168 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 308: Maintaining Electrical Power Systems on Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft electrical power systems, in accordance with the approved aircraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It covers both fixed wing and rotary winged aircraft, and includes units and components which generate, control and supply AC and/or DC electrical power for other systems, as applicable to the aircraft type. The maintenance activities will include the removal, fitting and testing of a range of electrical power system components. The learner will be required to select the correct tools and equipment to use, based on the operations to be performed and the components to be removed or replaced. The aircraft components will include items such as batteries, generators, alternators, regulators, invertors, transformers, rectifier units, contactors and relays, under-voltage phase sequence units, switches and circuit breakers. The learner will remove the required components and fit approved replacements, as appropriate. The learner will then need to test and adjust the completed system to meet the aircraft maintenance manual, change documentation (service bulletin) and airworthiness requirements.<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the aircraft manual, change/service bulletin documentation and |

airworthiness requirements for the maintenance activities undertaken, and to report any problems with these requirements 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 are correctly accounted for on completion of the activities, and that all necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to aircraft electrical power systems. The learner will understand the removal, fitting and testing methods and procedures, and their application, along with the system maintenance requirements. The learner will know how the equipment functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the equipment is maintained to the required standard.

The learner will understand the safety precautions required when working on the aircraft electrical power systems, and when using the associated tools and equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

**Notes**: 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 24 Electrical Power. 2. To display competence in this unit, it is necessary to both remove and fit aircraft electrical power system components. The learner must remove components; however, they may fit a replacement component where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| Learning outcome |
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| The learner will:<br>1. Be able to maintain electrical power systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the maintenance of the aircraft electrical power system:<br>• ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures<br>• obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)<br>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates<br>• 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<br>• ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)<br>• where appropriate, apply electrostatic discharge (ESD) avoidance procedures<br>• use approved removal, fitting and testing techniques and procedures at all times<br>• leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from damage and foreign object debris<br>• return tools and equipment to the correct storage location on completion of the activities<br>• ensure that work carried out is correctly documented and recorded<br>• ensure that any outstanding tests are correctly documented<br>1.3 follow the relevant maintenance schedules to carry out the required work<br>1.4 carry out the maintenance activities within the limits of their personal authority<br>1.5 carry out maintenance on three of the following aircraft electrical power systems:<br>• generator drive system<br>• AC power generation equipment<br>• external power equipment<br>• emergency power backup equipment<br>• DC power generation equipment<br>• AC electrical load distribution |

- DC electrical load distribution
- secondary/standby power generation equipment

1.6 carry out the maintenance activities in the specified sequence and in an agreed timescale

1.7 carry out fifteen of the following maintenance activities:

- removing access panels and covers to expose components to be removed
- carrying out fault diagnosis and system checks
- preparing the system for maintenance (such as isolating)
- disconnecting electrical connections
- removal of bonding
- removing cable securing devices
- removing securing devices and mechanical fasteners
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing damaged/defective components
- refitting components in the correct position, orientation and alignment
- making mechanical connections
- making electrical connections
- carrying out bonding
- installing cable securing devices
- torque loading as required
- setting and adjusting replaced components (such as voltage regulation, power output)
- carrying out functional checks of the system
- ensuring that replacement components have the correct part numbers
- labelling (and storing in the correct location) components that require repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)
- carrying out area inspections prior to task close down

1.8 remove and fit six different electrical power system components (at least three must be from group A):

group a:

- starter/generators
- alternators
- integrated drive generator
- main batteries
- under-voltage phase sequence units
- regulators
- invertors
- circuit breakers

- voltage regulators
- transformer/rectifier units
- main contactors
- generator control panels/units
- ram air turbine

group b:

- switches
- relays
- transducers/sensors
- transformer
- batteries (such as emergency lighting)
- connectors
- warning lights
- indicators (such as volts/frequency)
- wires/cables
- plugs/sockets
- other specific components

1.9 carry out four of the following types of test/check on aircraft electrical power systems:

- functional check
- continuity check
- voltage check
- insulation test
- BITE test
- standby power failure checks
- comparison check
- 'special-to-type' tests

using two of the following:

- external power source
- aircraft power source/system
- 'special-to-type' test sets
- measuring equipment (such as multimeters, insulation testers)

1.10 carry out maintenance on aircraft electrical power systems in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Extended Range Twin-Engine Operations Procedures (ETOPS) (where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/approved change documentation (service bulletin)

1.11 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.12 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:

- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.13 dispose of waste materials in accordance with safe working practices and approved.

| **Learning outcome** |
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| The learner will:<br>2. Know how to Maintain electrical power systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>2.1 explain the specific safety practices and procedures that they need to observe when working with aircraft electrical power systems<br>2.2 explain the importance of maintenance on aircraft electrical power systems, and impact upon ETOPS systems, Electrical Wiring Interconnect Systems (EWIS), legislation and local procedures<br>2.3 describe the hazards associated with removing, fitting and testing aircraft electrical power system components, and with the tools and equipment used, and explain how to minimise them and reduce any risk<br>2.4 explain what protective equipment they need to use for both personal protection and protection of the aircraft<br>2.5 explain the importance of good aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft<br>2.6 explain how to extract and use information from aircraft manuals, log books, flight logs, charts, circuit and physical layouts, specifications and other documents needed in the maintenance process<br>2.7 explain how to carry out currency/issue checks on the specifications they are working with<br>2.8 explain the terminology used in aircraft electrical power systems, and the use of system diagrams and associated symbols<br>2.9 describe the basic principles of operation of the electrical power system being worked on; AC and DC power supplies and the function of the various units within the system<br>2.10 describe the various mechanical fasteners that are used, and explain their method of removal and replacement<br>2.11 explain the importance of using the specified fasteners for the installation, and why they must not substitute others<br>2.12 explain why securing devices need to be locked and labelled, and the methods that are used to remove and install them<br>2.13 explain the torque loading requirements on the fasteners, and what to do if these loadings are exceeded or not achieved<br>2.14 describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections<br>2.15 explain the techniques used to remove components from aircraft electrical power systems without damage to the components or |

surrounding structure

2.16 explain the importance of applying electrostatic discharge (ESD) avoidance procedures when working on sensitive equipment or devices

2.17 explain the need to label and store correctly components that require repair or overhaul, and to check that replaced components have the correct part/identification markings and accompanying release documentation

2.18 explain the techniques used to position, align, adjust and secure the replaced components to the aircraft without damage to the components or surrounding structure

2.19 explain the procedures for ensuring that they have the correct tools, equipment, components and fasteners for the activities

2.20 explain the methods of lifting, handling and supporting the components/equipment during the maintenance activities

2.21 explain why electrical bonding is critical, and why it must be both mechanically and electrically secure

2.22 describe the tools and equipment used in the maintenance activities, and explain their calibration/care and control procedures

2.23 explain why tool/equipment control is critical, and what to do if a tool or piece of equipment is unaccounted for on completion of the activities

2.24 describe the problems that can occur with the maintenance operations, and explain how these can be overcome

2.25 explain how to recognise defects

2.26 explain how to carry out routine checks and servicing of the aircraft electrical power system (including adjusting voltage regulators, checking battery capacity and charging batteries)

2.27 explain the need to check that cabin/cockpit switches, selectors and circuit breakers are in the correct position before applying any form of external power

2.28 explain what types of test need to be carried out on the aircraft electrical power system, and the test equipment used

2.29 explain what methods and procedures are to be used to carry out the various tests on the electrical power system

2.30 explain how to record the results of each individual test, and the documentation that must be used

2.31 explain how to analyse the test results, and make valid decisions about the acceptability of the electrical power system

2.32 explain the procedures to be followed if the equipment or system fails to meet the test specification

2.33 describe the recording documentation that needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation

2.34 describe the procedure for the safe disposal of waste materials and scrap components

2.35 describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve.

# Unit 708 Maintaining electrical power systems on aircraft

Supporting information

## Guidance

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

2.10 (such as threaded fasteners, special securing devices)

2.15 (such as proof marking, the need to protect the circuit integrity by covering and labelling exposed circuits)

2.25 (such as incorrectly seated plugs and sockets, ineffective fasteners, foreign object damage or contamination)

2.27 (such as electrical, hydraulic, air or vacuum)

# Unit 709 Maintaining equipment and furnishings on aircraft

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| **UAN:** | **D/601/6168** |
| **Level:** | 3 |
| **Credit value:** | 77 |
| **GLH:** | 154 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 309: Maintaining Equipment and Furnishings on Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft equipment and furnishings, in accordance with the approved aircraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It covers both fixed wing and rotary winged aircraft, and includes those removable items of equipment and furnishings externally mounted on the aircraft or contained in the flight, passenger, cargo and accessory compartments. The maintenance activities will include the removal, fitting and, where appropriate, testing of a range of equipment and furnishings. The learner will be required to select the correct tools and equipment to use, based on the operations to be performed and the equipment to be removed or fitted. The aircraft equipment and furnishings will include galley and toilet equipment, flight crew seats, tables, food containers, wardrobes, curtains, wall coverings, carpets, overhead storage compartments, movable partitions, mirrors and other similar equipment. The learner will remove the required components and fit approved replacements, as appropriate. The learner will then need to test and adjust the completed system to meet the aircraft maintenance manual, change documentation (service bulletin) and airworthiness requirements.<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the aircraft manual, |

change/service bulletin documentation and airworthiness requirements for the maintenance activities undertaken, and to report any problems with these requirements 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 are correctly accounted for on completion of the activities, and that all necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to aircraft equipment and furnishings. The learner will understand the removal, fitting and testing/checking methods and procedures, and their application, along with the equipments maintenance requirements. The learner will know how the equipment functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the equipment is maintained to the required standard.

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

**Notes**: 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 25 Equipment and Furnishings. 2. To display competence in this unit, it is necessary to both remove and fit aircraft equipment and furnishings. The learner must remove equipment and furnishings; however, they may fit replacement equipment and furnishings where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| Learning outcome |
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| The learner will:<br>1. Be able to maintain equipment and furnishings on aircraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the maintenance of the aircraft equipment and furnishings:<br>• ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures<br>• obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)<br>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates<br>• 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<br>• ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)<br>• use approved removal, fitting and testing techniques and procedures at all times<br>• leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from damage and foreign object debris<br>• return tools and equipment to the correct storage location on completion of the activities<br>• ensure that work carried out is correctly documented and recorded<br>• ensure that any outstanding tests are correctly documented<br>1.3 follow the relevant maintenance schedules to carry out the required work<br>1.4 carry out the maintenance activities within the limits of their personal authority<br>1.5 carry out maintenance on equipment and furnishings from two of the following areas of the aircraft:<br>• flight compartment<br>• passenger compartment<br>• cargo compartments<br>• buffet/galley<br>• toilet/dressing rooms<br>• accessory compartments<br>• emergency kit<br>• insulation |

1.6 carry out the maintenance activities in the specified sequence and in an agreed timescale

1.7 carry out fifteen of the following maintenance activities:

- removing access panels and covers to expose components/fastenings to be removed
- carrying out fault diagnosis and system checks
- preparing the equipment for maintenance (such as isolating)
- disconnecting electrical connections
- removing securing devices and mechanical fasteners
- supporting components to be removed
- removal of bonding
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing damaged/defective components
- refitting components in the correct position, orientation and alignment
- positioning and aligning replaced equipment
- making mechanical connections
- making electrical connections
- carrying out bonding
- torque loading as required
- carrying out equipment functional checks
- ensuring that replacement equipment is of the correct type (have the correct part numbers)
- labelling (and storing in the correct location) equipment that requires repair or overhaul
- setting, and adjusting replaced components (such as seats)
- applying bolt locking methods (such as split pins, wire locking, lock nuts)
- carrying out area inspections prior to task close down

1.8 remove and fit six different aircraft equipment and furnishing components (at least two must be from group A):

group a:

- flight crew seats
- passenger seats
- berths
- wardrobes
- overhead storage compartments
- inertia reels
- movable partitions
- removable and fixed cabinets
- ovens
- refrigerators
- garbage containers/compactor

- coffee maker and dispenser
- cargo rollers/drive equipment
- cargo restraint equipment
- evacuation equipment
- drag parachutes
- Kevlar/armour plating

group b:

- carpets
- curtains
- wall coverings
- insulation blankets
- mirrors
- cargo restraint nets
- emergency locator transmitters
- seat belts
- life rafts
- life jackets
- first aid kit
- batteries
- sound proofing
- signal flares
- spare bulbs/fuses
- other specific components

1.9 service/check aircraft equipment and furnishings, to include carrying out four of the following:

- checking inertia reels for correct operation
- checking seat belts for damage and security
- checking that emergency equipment is all present and in a serviceable condition
- checking ELT for compliance with regulations
- changing cabin configuration
- repairing upholstery
- checking seat structure, recline and table mechanisms
- checking contents of first aid kit
- checking operation of emergency megaphone
- checking operation of galley compartment door primary and secondary latches

1.10 carry out maintenance on aircraft equipment and furnishings in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Extended Range Twin-Engine Operations Procedures (ETOPS) (where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/approved change documentation (service bulletin)

1.11 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.12 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:

- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.13 dispose of waste materials in accordance with safe working practices and approved procedures.

| **Learning outcome** |
| --- |
| The learner will:<br>2. Know how to maintain equipment and furnishings on aircraft |
| **Assessment criteria** |
| The learner can:<br>2.1 explain the specific safety practices and procedures that they need to observe when carrying out maintenance activities on aircraft equipment and furnishings<br>2.2 explain the importance of maintenance on aircraft equipment and furnishings, and impact upon ETOPS systems, legislation and local procedures<br>2.3 describe the hazards associated with removing and fitting aircraft equipment and furnishings, and with the tools and equipment used, and explain how to minimise them and reduce any risk<br>2.4 explain what protective equipment they need to use for both personal protection and protection of the aircraft<br>2.5 explain the importance of good aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft<br>2.6 explain how to extract and use information from aircraft manuals, log books, flight logs, and other documents needed in the maintenance process<br>2.7 explain how to carry out currency/issue checks on the specifications they are working with<br>2.8 describe the range of equipment and furnishings that may need to be maintained/replaced<br>2.9 describe the various mechanical fasteners that are used to hold the equipment in place, and explain their method of removal and replacement<br>2.10 explain the importance of using the specified fasteners for the installation, and why they must not substitute others<br>2.11 explain why securing devices need to be locked and labelled, and the different methods that are used to remove and install them<br>2.12 explain the torque loading requirements on the fasteners, and what to do if these loadings are exceeded or not achieved<br>2.13 describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections |

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| 2.14 | explain the need to take care when removing equipment and furnishings so as not to cause damage to the equipment or surrounding structure |
| 2.15 | explain the need to label and store correctly components that require repair or overhaul, and to check that replaced components have the correct part/identification markings and accompanying release documentation |
| 2.16 | explain the need to correctly position, align, adjust and secure the replaced equipment in the aircraft without damage to the components or surrounding structure |
| 2.17 | explain the methods of lifting, handling and supporting the components/equipment during the removal and fitting activities |
| 2.18 | explain why electrical bonding is critical, and why it must be both mechanically and electrically secure |
| 2.19 | explain how to carry out routine checks of the aircraft equipment and furnishings |
| 2.20 | explain why tool/equipment control is critical, and what to do if a tool or piece of equipment is unaccounted for on completion of the activities |
| 2.21 | describe the problems that can occur with the maintenance operations, and explain how these can be overcome |
| 2.22 | explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation |
| 2.23 | describe the procedure for the safe disposal of waste materials and scrap components |
| 2.24 | describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve. |

# Unit 709 Maintaining equipment and furnishings on aircraft

Supporting information

## Guidance

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

2.9 (such as threaded fasteners, special securing devices)

2.19 (such as checking contents of emergency and first aid equipment, checking condition and security of seat belts)

# Unit 710 Maintaining fire protection systems on aircraft

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| **UAN:** | **H/601/6172** |
| **Level:** | 3 |
| **Credit value:** | 77 |
| **GLH:** | 154 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 310: Maintaining Fire Protection Systems on Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft fire protection systems, in accordance with the approved aircraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It covers both fixed wing and rotary winged aircraft, and covers both fixed and portable units and components which detect and indicate fire or smoke, and which store and distribute fire extinguishing agents to all protected areas of the aircraft. The maintenance activities will include the removal, fitting and testing of a range of fire protection system components. The learner will be expected to use the approved procedure for correctly isolating the system or fitting extinguishing trip defeat mechanisms before testing/trouble shooting the protection system circuit. The learner will remove the required components and fit approved replacements, as appropriate. The learner will then need to test and adjust the completed system to meet the aircraft maintenance manual, change documentation (service bulletin) and airworthiness requirements<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the aircraft manual, change/service bulletin documentation and airworthiness requirements for the maintenance activities undertaken, and to report any problems with these requirements 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 are correctly accounted for on completion of the activities, and that all necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to aircraft fire protection systems. The learner will understand the removal, fitting and testing methods and procedures, and their application, along with the fire protection systems maintenance requirements. The learner will know how the equipment functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the equipment is maintained to the required standard.

The learner will understand the safety precautions required when working on aircraft fire protection systems. 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.

**Notes**: 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 26 Fire Protection. 2. To display competence in this unit, it is necessary to both remove and fit aircraft fire protection system components. The learner must remove components; however, they may fit a replacement component where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| Learning outcome |
| --- |
| The learner will:<br>1. Be able to maintain fire protection systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the maintenance of the aircraft fire protection system:<br>• ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures<br>• obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)<br>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates<br>• 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<br>• ensure the safe isolation of the fire protection equipment before breaking into the system circuit<br>• ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)<br>• where appropriate, apply electrostatic discharge (ESD) avoidance procedures<br>• use approved removal, fitting and testing techniques and procedures at all times<br>• leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from damage and foreign object debris<br>• return tools and equipment to the correct storage location on completion of the activities<br>• ensure that work carried out is correctly documented and recorded<br>• ensure that any outstanding tests are correctly documented<br>1.3 follow the relevant maintenance schedules to carry out the required work<br>1.4 carry out the maintenance activities within the limits of their personal authority<br>1.5 carry out maintenance on two of the following parts of an aircraft fire protection system:<br>• detection<br>• indicating<br>• extinguishing<br>• explosion suppression<br>1.6 carry out maintenance on fire protection systems operated by two |

of the following:

- thermal switch
- thermocouple
- continuous loop
- continuous element

1.7 carry out the maintenance activities in the specified sequence and in an agreed timescale

1.8 carry out fifteen of the following maintenance activities:

- removing access panels and covers to expose components to be removed
- carrying out fault diagnosis and system checks
- preparing the system for maintenance (such as isolating, fitting trip defeat mechanisms)
- inspecting on board fire protection equipment
- disconnecting electrical connections
- removal of bonding
- disconnect/removing hoses and pipes
- removing securing devices and mechanical fasteners
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing damaged/defective components
- replacing single use items such as seals, filters, gaskets
- refitting components in the correct position, orientation and alignment
- setting and adjusting replaced components (such as travel, working clearance)
- making mechanical connections
- making electrical connections
- carrying out bonding
- torque loading as required
- purging and replenishing extinguishing agent
- carrying out a system functional check
- ensuring that replacement components have the correct part numbers
- fitting blanks, labelling (and storing in the correct location) components that require repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)
- carrying out area inspections prior to task close down

1.9 remove and fit four different aircraft fire protection system components (at least two must be from group A):

group a:

- smoke detectors (optical)
- rate-of-temperature-rise detectors
- radiation sensing detectors

- carbon monoxide detectors
- combustible mixture detectors
- overheat detectors
- fibre-optic detectors
- sprays/nozzles
- fire bottles
- pumps
- thermal switches
- control valves
- fire wire

group b:

- pipes and hoses
- pyrotechnic cartridges
- foam suppressant
- sensors/transmitters
- wiring/switches/plugs
- nitrogen equipment
- gauges
- other specific components

1.10 service/check the aircraft fire protection system, to include carrying out three of the following:

- checking fire bottle contents
- checking operation of fire warning system
- checking cabin fire extinguisher contents
- checking cargo bays fire extinguishing system
- checking toilet smoke detector system
- inspecting engine fire wire detection system
- checking auto-shutdown function if installed (eg, APU)
- function testing of fire bottle activation circuits

1.11 carry out one of the following tests on the aircraft fire protection system:

- smoke test
- heat test
- 'no volts' test
- built in test equipment (BITE) test
- 'special-to-type' tests

1.12 carry out maintenance on aircraft fire protection systems in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Extended Range Twin-Engine Operations Procedures (ETOPS) (where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/approved change documentation (service bulletin)

1.13 report any instances where the maintenance activities cannot be

fully met or where there are identified defects outside the planned schedule

1.14 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:

- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.15 dispose of waste materials in accordance with safe working practices and approved procedures.

| **Learning outcome** |
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| The learner will:<br>2. Know how to maintain fire protection systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>2.1 explain the specific safety practices and procedures that they need to observe when working on aircraft fire protection systems<br>2.2 explain the importance of maintenance on aircraft fire protection systems, and impact upon ETOPS systems, Electrical Wiring Interconnect Systems (EWIS), legislation and local procedures<br>2.3 explain the need to check that cabin/cockpit switches, selectors and circuit breakers are in the correct position before applying any form of external power<br>2.4 describe the hazards associated with carrying out maintenance activities on aircraft fire protection systems, and with the tools and equipment used, and explain how to minimise them and reduce any risk<br>2.5 explain what protective equipment they need to use for both personal protection and protection of the aircraft<br>2.6 explain the importance of good aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft<br>2.7 explain how to extract and use information from aircraft manuals, log books, flight logs, charts, circuit and physical layouts, specifications, symbols used in aircraft fire protection systems, and other documents in the maintenance activities<br>2.8 explain how to carry out currency/issue checks on the specifications they are working with<br>2.9 explain the terminology used in aircraft fire protection systems, and the use of system diagrams and associated symbols<br>2.10 describe the various types of pipe and component that make up the aircraft fire protection system<br>2.11 describe the basic principles of operation of the aircraft fire protection system being worked on<br>2.12 explain the techniques used to remove components from aircraft fire protection systems without damage to the components or surrounding structure<br>2.13 describe the various mechanical fasteners to be removed and replaced, and explain their methods of removal and replacement |

2.14 describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections

2.15 explain the importance of applying electrostatic discharge (ESD) avoidance procedures when working on sensitive equipment or devices

2.16 explain the importance of ensuring that any exposed components, wires or pipe ends are correctly covered/protected

2.17 explain the need to label and store correctly components that require repair or overhaul, and to check that replacement components have the correct part/identification markings and accompanying release documentation

2.18 explain how to fit components into the circuit

2.19 explain how to make adjustments to components/assemblies to ensure that they function correctly

2.20 explain why securing devices need to be tightened to the correct torque, locked and labelled, and the different methods that are used

2.21 describe the tools and equipment used in the maintenance activities, and explain their calibration/care and control procedures

2.22 explain why tool/equipment control is critical, and what to do if a tool or piece of equipment is unaccounted for on completion of the activities

2.23 explain how to carry out routine checks and servicing of the aircraft fire detection system

2.24 explain what types of test need to be carried out on the aircraft fire protection system, and the test equipment to be used

2.25 explain the methods and procedures to be used to carry out the various tests on the fire protection system

2.26 explain the importance of carrying out tests in the specified sequence, checking readings and movements at each stage

2.27 explain how to record the results of each individual test, and the documentation that must be used

2.28 explain how to analyse the test results, and how to make valid decisions about the acceptability of the aircraft indicating and recording systems

2.29 explain the procedures to be followed if the equipment or system fails to meet the test specification

2.30 describe the procedure for the safe disposal of waste materials and scrap components

2.31 describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve.

# Unit 710 Maintaining fire protection systems on aircraft

Supporting information

## Guidance

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

2.3 (such as electrical, hydraulic, air or vacuum)

2.11 (such as rigid pipes; hoses; pipe connectors; pipe sealing and supporting devices; valves; pumps; mechanical and electrical control devices)

2.12 (such as thermal switch, thermocouple, continuous loop, continuous element; fire detection, and warning; sources and types of extinguishing agent; extinguishing agent control and distribution)

2.14 (such as threaded fasteners, special securing devices)

2.19 (such as the use of gaskets/seals and jointing/sealing compounds; ensuring the correct tightness of pipe fittings and connections; eliminating stress on pipework/connections; carrying out visual checks of all components)

2.24 (including checking content of fire bottles and extinguishers, replacing fire bottle squib, checking operation of warning system, checking operation of smoke detectors)

# Unit 711 Maintaining flight control systems on aircraft

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| **UAN:** | **F/601/6177** |
| **Level:** | 3 |
| **Credit value:** | 86 |
| **GLH:** | 168 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 311: Maintaining Flight Control Systems on Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft flight control systems, in accordance with the approved aircraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It includes units and components which manually control the flight, attitude and characteristics of the aircraft. The maintenance activities will include the removal, fitting and testing of a range of flight control components. The learner will be required to select the correct tools and equipment to use, based on the operations to be performed and the components to be removed, fitted and tested. The aircraft components will include items such as ailerons and tabs, horizontal stabilizer, elevator, rudder, flaps, spoilers/drag devices, gust locks and dampers, lift augmenting system components. The learner will remove the required components and fit approved replacements, as appropriate. The learner will then need to test and adjust the completed system to meet the aircraft maintenance manual, change documentation (service bulletin) and airworthiness requirements.<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the aircraft manual, change/service bulletin documentation and airworthiness requirements for the maintenance activities undertaken, and to report any problems with these requirements |

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 are correctly accounted for on completion of the activities, and that all necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to aircraft flight control systems. The learner will understand the removal, fitting and testing methods and procedures, and their application, along with the aircraft flight control system maintenance requirements. The learner will know how the aircraft flight controls function, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the equipment is maintained to the required standard.

The learner will understand the safety precautions required when working on aircraft flight control systems, especially those for isolating the equipment, and lifting and handling control components. 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.

**Notes**: 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 27 Flight Controls. 2. To display competence in this unit, it is necessary to both remove and fit aircraft flight control system components. The learner must remove components; however, they may fit a replacement component where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| Learning outcome |
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| The learner will:<br>1. Be able to maintain flight control systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the maintenance of the aircraft flight control system:<br>• ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures<br>• obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)<br>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates<br>• 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<br>• ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)<br>• ensure the safe isolation of the control system before commencing work on the equipment<br>• where appropriate, apply electrostatic discharge (ESD) avoidance procedures<br>• use approved removal, fitting and testing techniques and procedures at all times<br>• leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from damage and foreign object debris<br>• return tools and equipment to the correct storage location on completion of the activities<br>• ensure that work carried out is correctly documented and recorded<br>• ensure that any outstanding tests are correctly documented<br>1.3 follow the relevant maintenance schedules to carry out the required work<br>1.4 carry out the maintenance activities within the limits of their personal authority<br>1.5 carry out maintenance on two of the following aircraft flight control systems:<br>• spoiler, drag devices and variable aerodynamic fairings (such as air brakes, speed brakes)<br>• ailerons/tailerons and tab<br>• flaps/slats/flaperons<br>• lift augmenting devices |

- nose and body steering
- elevators and trim tabs
- rudder/yaw/ruddervator and tab
- horizontal stabilisers/stabilator/canards
- spoilers, air brakes, lift dumpers
- gust lock and damper
- throttles
- thrust reverser
- propeller controls

1.6 carry out the maintenance activities in the specified sequence and in an agreed timescale

1.7 carry out fifteen of the following maintenance activities:

- removing access panels and covers to expose components to be removed
- carrying out fault diagnosis and system checks
- preparing the system for maintenance (such as isolating, releasing stored pressure)
- disconnecting electrical connections
- removal of bonding
- removing securing devices and mechanical fasteners
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing damaged/defective components
- refitting components in the correct position, orientation and alignment
- setting and adjusting replaced components (such as freedom of movement, cable tension)
- making mechanical connections
- making electrical connections
- carrying out bonding
- torque loading as required
- carrying out functional checks of the system
- ensuring that replacement components have the correct part numbers
- labelling (and storing in the correct location) components that require repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)
- carrying out area inspections prior to task close down

1.8 remove and fit six different aircraft flight control system components (at least three must be from group A):

group a:

- horizontal stabiliser
- elevator
- aileron

- rudder
- flaps rudder pedals
- flap selectors
- control columns
- stick shaker units
- air/speed brake selectors
- trim wheels
- reaction control nozzles
- powered flying control units
- automatic stall recovery device
- auxiliary controls
- torque tubes
- boosters
- tab control wheel
- control surfaces
- spoilers
- drag devices
- gradient boxes
- actuators
- mixer units
- artificial feel units
- auxiliary servo equipment (ASE)
- primary servo jack
- primary flight computers (including actuator control electronic - ACE)

group b:

- cables and pulleys
- connecting rods
- position transmitters
- reaction control ducting
- levers and linkages
- pedal shakers
- actuators/motors/servos
- turnbuckles
- jack screws
- sensors
- locks and stops
- bell cranks
- other specific components

1.9 carry out five of the following types of test/check on the aircraft flight control systems:

- functional
- rigging check
- static friction check
- 'special-to-type' tests
- built in test equipment (BITE)

- timings
- cable tension check
- safety interlock test
- ground run tests
- range and freedom of movement
- leak test

using two of the following:

- built in test equipment (BITE)
- aircraft power source/displays and gauges
- ground support equipment
- use of safety locks
- 'special-to-type' test equipment
- measuring equipment

1.10 carry out maintenance on aircraft flight control systems in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Extended Range Twin-Engine Operations Procedures (ETOPS) (where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/approved change documentation (service bulletin)

1.11 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.12 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:

- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.13 dispose of waste materials in accordance with safe working practices and approved procedures.

| **Learning outcome** |
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| The learner will:<br>2. Know how to maintain flight control systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>2.1 explain the specific safety practices and procedures that they need to observe when working on aircraft flight control systems<br>2.2 explain the importance of maintenance on aircraft flight control systems, and impact upon ETOPS systems, Electrical Wiring Interconnect Systems (EWIS), legislation and local procedures<br>2.3 describe the hazards associated with removing, fitting and testing aircraft flight control system components, and with the tools and |

equipment used, and how to minimise them and reduce any risk

2.4 explain what protective equipment that they need to use for both personal protection and protection of the aircraft

2.5 explain the importance of good aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft

2.6 explain how to extract and use information from aircraft maintenance manuals, log books, flight logs, and other documents needed in the removal and replacement process

2.7 explain how to carry out currency/issue checks on the specifications they are working with

2.8 explain the terminology used in aircraft flight control systems, and the use of system diagrams and associated symbols

2.9 describe the basic principles of operation of the aircraft flight control system being worked on, and the function of the various units/components within the system

2.10 explain the techniques used to remove components from aircraft flight control systems without damage to the components or surrounding structure, and the need to protect the system integrity

2.11 describe the various mechanical fasteners to be removed and replaced, and explain their method of removal and replacement

2.12 describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections

2.13 explain the importance of applying electrostatic discharge (ESD) avoidance procedures when working on sensitive equipment or devices

2.14 explain the methods of lifting, handling and supporting the components/equipment during the maintenance activities

2.15 explain the methods of checking that components are fit for purpose, and how to identify defects and wear characteristics

2.16 explain the need to replace items such as seals and gaskets

2.17 explain the need to label and store correctly components that require repair or overhaul, and to check that replacement components have the correct part/identification markings and accompanying release documentation

2.18 explain how to replace and reconnect components into the system

2.19 explain how to make adjustments to components/assemblies to ensure that they function correctly

2.20 explain why electrical bonding is critical, and why it must be both mechanically and electrically secure

2.21 explain the purpose of symmetry and rigging checks; how they are carried out; how to locate the rigging points and faces; and the use of incidence boards

2.22 explain how to carry out routine checks and servicing of the aircraft flight control system

2.23 explain the need to check that cabin/cockpit switches, selectors and circuit breakers are in the correct position before applying any form of external power

2.24 explain what types of test need to be carried out on the aircraft flight control system, and the test equipment to be used

2.25 explain the methods and procedures to be used to carry out the various tests on the flight control system

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| 2.26 | explain the importance of carrying out the tests in the specified sequence, checking readings, and movements at each stage |
| 2.27 | explain how to record the results of each individual test, and the documentation that must be used |
| 2.28 | explain how to analyse the test results, and make valid decisions about the acceptability of the flight control systems |
| 2.29 | explain the procedures to be followed if the equipment or system fails to meet the test specification |
| 2.30 | explain why tool/equipment control is critical, and what to do if a tool or piece of equipment is unaccounted for on completion of the activities |
| 2.31 | describe the problems that can occur with flight control system maintenance operations, and explain how these can be overcome |
| 2.32 | explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation |
| 2.33 | describe the procedure for the safe disposal of waste materials and scrap components |
| 2.34 | describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve. |

# Unit 711 Maintaining flight control systems on aircraft

Supporting information

## Guidance

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

2.10 (such as release of pressures/force, proof marking, extraction of components) and the need to protect the system integrity (by fitting blanking plugs and ensuring that exposed components are correctly covered/protected)

2.11 (such as threaded fasteners, special securing devices)

2.18 (such as ensuring correct orientation, position and alignment; tightening securing devices to the required torque; replacing locking and securing devices; eliminating stress on pipework/connections; ensuring that pipework and cables are correctly supported at suitable intervals; carrying out visual checks of all components)

2.19 (such as setting working clearance, setting travel, preloading bearings)

2.23 (such as electrical, hydraulic, air or vacuum)

# Unit 712 Maintaining fuel systems on aircraft

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| **UAN:** | **L/601/6182** |
| **Level:** | 3 |
| **Credit value:** | 86 |
| **GLH:** | 168 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 312: Maintaining Fuel Systems on Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft fuel systems, in accordance with the approved aircraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It covers both fixed wing and rotary winged aircraft, and covers the units and components which store and deliver fuel to the engine. It includes engine driven fuel pumps for reciprocating engines, tanks (bladder), tanks (integral), tanks auxiliary, valves, boost pumps, fuel dump systems, fuel tank leak detection components, fuel draining, fuel tank capacitance units, float switches, float valves, temperature sensing, refuel diffuser systems, dip sticks, magnetic level indicators, fuel tank baffling, flame arrester components and tank venting systems.<br>The maintenance activities will include the removal, fitting and testing of a range of fuel system components. The learner will be expected to use the approved procedure for correctly isolating the system before breaking into the system circuit. The learner will remove the required components and fit approved replacements, as appropriate. The learner will then need to test and adjust the completed system to meet the aircraft maintenance manual, change documentation (service bulletin) and airworthiness requirements<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the aircraft manual, |

change/service bulletin documentation and airworthiness requirements for the maintenance activities undertaken, and to report any problems with these requirements 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 are correctly accounted for on completion of the activities, and that all necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to aircraft fuel systems. The learner will understand the removal, fitting and testing methods and procedures, and their application, along with the fuel system maintenance requirements. The learner will know how the equipment functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the equipment is maintained to the required standard.

The learner will need to understand the impact of the SFAR88 legislation and its impact, as well as the impact of CDCCL (Critical Design Configuration Control Limitations) requirements. The learner will need to be aware of the regulations appertaining to working in confined spaces and for working with flammable liquids and gases.

The learner will understand the safety precautions required when working on aircraft fuel systems, especially those for ensuring system cleanliness and the avoidance of spillage, fire and explosion. 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.

**Notes**: 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 28 Fuel. It does not include fuel flow rate sensing and transmitting or engine fuel flow or pressure which is covered in chapter 73 Engine Fuel and Control. 2. To display competence in this unit, it

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| | is necessary to both remove and fit aircraft fuel system components.<br>The learner must remove components; however, they may fit a replacement component where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation. |

**Learning outcome**

The learner will:

1. Be able to maintain fuel systems on aircraft

**Assessment criteria**

The learner can:

1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines

1.2 carry out all of the following during the maintenance of the aircraft fuel system:

- ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures
- obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)
- obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates
- adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment, breathing apparatus and other relevant safety regulations and procedures to realise a safe system of work
- ensure the safe isolation and ventilation of the fuel equipment before breaking into the system, and check that the aircraft and ground equipment to be used is electrically bonded
- ensure that the relevant safety devices, mechanical/physical locks and external signage are in place (where appropriate)
- use approved removal, fitting and testing techniques and procedures at all times
- leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from damage and foreign object debris
- return tools and equipment to the correct storage location on completion of the activities
- ensure that work carried out is correctly documented and recorded
- ensure that any outstanding tests are correctly documented

1.3 follow the relevant maintenance schedules to carry out the required work

1.4 carry out the maintenance activities within the limits of their

personal authority

1.5 carry out maintenance on two of the following parts of the aircraft fuel system:

- fuel storage
- distribution
- fuel drain
- in flight refuelling
- fuel indicating
- fuel jettison/dump

1.6 carry out the maintenance activities in the specified sequence and in an agreed timescale

1.7 carry out fifteen of the following maintenance activities:

- removing access panels and covers to expose components to be removed
- carrying out fault diagnosis and system checks
- preparing the system for maintenance (such as isolating, draining and removing fuel)
- disconnecting electrical connections
- removal of bonding
- disconnecting/removing hoses and pipes
- removing securing devices and mechanical fasteners
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing damaged/defective components
- replacing single use items such as seals, filters, gaskets
- refitting components in the correct position, orientation and alignment
- making mechanical connections
- making electrical connections
- carrying out bonding
- torque loading as required
- charging and bleeding the system
- carrying out a systems functional checks
- ensuring that replacement components have the correct part numbers
- fitting blanks, labelling (and storing in the correct location) components that require repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)
- carrying out area inspections prior to task close up

1.8 remove and fit four different aircraft fuel system components (at least one must be from group A):

group a:

- control valves (such as drain, bleed, change over, fire wall, dump)

- main fuel tanks/cells/bladders
- auxiliary fuel tank
- external/drop down fuel tanks
- pumps
- densitometer
- fuel cooling units
- fuel manifold
- refuel and de-fuel connections
- fuel selector
- high/low level shutoff
- jet pumps
- float switch
- float valve
- fuel flow regulators
- motors
- solenoids
- cell and tank inter-connectors
- sender unit

group b:

- pipes/hoses
- safety devices
- strainers
- fuel filters
- sensors
- gaskets and seals
- ventilating components
- pressure switches
- bleed valve
- over wing filler necks and caps
- other specific components

1.9 service/check the aircraft fuel system, to include carrying out three of the following:

- checking the system and tanks for leaks
- checking and cleaning/replacing filters
- checking calibration of fuel quantity gauges (labelling or other methods)
- checking operation of feed/selectors
- checking indicating systems (such as pressure drop, temperature warning, valve position and status)

1.10 carry out four of the following tests on the aircraft fuel system:

- leak test
- pressure test
- full system fuel flow
- reduced system fuel flow
- system flush
- system fuel flow functional test

- fuel transfer tests
- fuel level/contents check
- fuel capacity tests
- fuel sampling/check/fuel system icing inhibitor/water and record results
- built in test equipment (BITE) test
- 'special-to-type' tests

using one of the following:

- fuel sampling devices
- aircraft power source/system
- ground test rig
- 'special to type' test equipment

1.11 carry out maintenance on aircraft fuel systems in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Extended Range Twin-Engine Operations Procedures (ETOPS) (where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/approved change documentation (service bulletin)

1.12 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.13 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:

- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.14 dispose of waste materials in accordance with safe working practices and approved procedures.

| **Learning outcome** |
| --- |
| The learner will:<br>2. Know how to maintain fuel systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>2.1 explain the specific safety practices and procedures that they need to observe when carrying out maintenance activities on aircraft fuel systems<br>2.2 explain the importance of maintenance on aircraft fuel systems, and impact upon ETOPS systems, Electrical Wiring Interconnect Systems (EWIS), legislation and local procedures<br>2.3 explain the safety procedures that must be carried out before work is started on removing the fuel system components<br>2.4 describe the hazards associated with removing aircraft fuel system |

components, and with the tools and equipment used, and explain how to minimise them and reduce any risk

2.5 explain what protective equipment they need to use for both personal protection and protection of the aircraft

2.6 explain the importance of good aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft

2.7 explain how to extract and use information from aircraft manuals, log books, flight logs, charts, circuit and physical layouts, specifications, symbols used in aircraft fuel systems, and other documents needed in the maintenance process

2.8 explain how to carry out currency/issue checks on the specifications they are working with

2.9 explain the terminology used in aircraft fuel systems, and the use of system diagrams and associated symbols

2.10 describe the various types of pipe and components that make up the aircraft fuel system

2.11 describe the basic principles of operation of the aircraft fuel system being worked on, and the function of the various units/components within the system

2.12 explain the techniques used to remove components from aircraft fuel systems without damage to the components or surrounding structure

2.13 describe the various mechanical fasteners to be removed and replaced, and explain their method of removal and replacement

2.14 describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections

2.15 explain the methods of lifting, and supporting the components/equipment during the maintenance activities

2.16 explain the importance of ensuring that the work area is free from dirt, debris and foreign objects, and of ensuring that any exposed components or pipe ends are correctly covered/protected

2.17 explain how to recognise contaminants and the problems they can create; the effects and likely symptoms of contamination in the fuel system

2.18 explain the need to label and store correctly components that require repair or overhaul, and to check that replacement components have the correct part/identification markings and accompanying release documentation

2.19 explain how to fit components into the circuit

2.20 explain how to make adjustments to components/assemblies to ensure that they function correctly)

2.21 explain why electrical bonding is critical, and why it must be both mechanically and electrically secure

2.22 explain why securing devices need to be tightened to the correct torque, locked and labelled, and the methods to be used

2.23 explain how to carry out routine checks and servicing of the aircraft fuel system

2.24 explain what types of test need to be carried out on the aircraft fuel system, and the test equipment to be used

2.25 explain the methods and procedures to be used to carry out the various tests on the fuel system

| | |
|---|---|
| 2.26 | explain the importance of carrying out the tests in the specified sequence, checking readings, and movements at each stage |
| 2.27 | explain how to record the results of each individual test, and the documentation that must be used |
| 2.28 | explain how to analyse the test results, and how to make valid decisions about the acceptability of the aircraft fuel system |
| 2.29 | explain the procedures to be followed if the equipment or system fails to meet the test specification |
| 2.30 | explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation |
| 2.31 | describe the procedure for the safe disposal of waste materials, scrap components and waste fuel |
| 2.32 | describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve. |

# Unit 712 Maintaining fuel systems on aircraft

Supporting information

## Guidance

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

2.3 (such as displaying warning notices, ensuring adequate fire fighting equipment)

2.4, (such as handling fluids, flammable fluids, fire and explosion, misuse of tools)

2.10 (such as rigid pipes; flexible hoses; pipe connectors; pipe sealing and supporting devices; valves used for flow, change over, fuel dumping; fuel pumps; mechanical and electrical control devices)

2.12 (such as release of pressures/force, draining of fluids, proof marking, extraction of components and the need to protect the circuit integrity by fitting blanking plugs and labelling exposed circuits)

2.13 (such as threaded fasteners, special securing devices)

2.19 (such as the use of gaskets/seals and jointing/sealing compounds; ensuring correct tightness of pipe fittings and connections; eliminating stress on pipework/connections; carrying out visual checks of all components; checking security of joints and that the system is safe to refill)

2.20 (such as flow and pressure settings, and their effect on the system, travel and working clearance)

2.23 (including checking for leaks, checking and changing filters, checking calibration of fuel quantity gauges)

# Unit 713 Maintaining hydraulic systems on aircraft

| | |
|---|---|
| **UAN:** | **H/601/6186** |
| **Level:** | 3 |
| **Credit value:** | 86 |
| **GLH:** | 168 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 313: Maintaining Hydraulic Systems on Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft hydraulic systems, in accordance with the approved aircraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It covers both fixed wing and rotary winged aircraft, and covers the units and components which supply the hydraulic fluid under pressure (includes tanks, pumps, accumulators, valves, pipes, etc) to a common point (manifold) for redistribution to other defined systems. The maintenance activities will include the removal, fitting and testing of a range of hydraulic components. The learner will be expected to use the approved procedure for correctly isolating and de-pressurising the system, breaking into the system circuit and catching/containing any spilled fluids. The learner will remove the required components and fit approved replacements, as appropriate. The learner will then need to test and adjust the completed system to meet the aircraft maintenance manual, change documentation (service bulletin) and airworthiness requirements.<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the aircraft manual, change/service bulletin documentation and airworthiness requirements for the maintenance activities undertaken, and to report any problems with these requirements 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 are correctly accounted for on completion of the activities, and that all necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to aircraft hydraulic systems. The learner will understand the removal, fitting and testing methods and procedures, and their application, along with the hydraulic systems maintenance requirements. The learner will know how the equipment functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the equipment is maintained to the required standard.

The learner will understand the safety precautions required when working on aircraft hydraulic systems, especially those for handling hydraulic fluids, isolating and depressurising the equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

**Notes:** 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 29 Hydraulic Power. 2. To display competence in this unit, it is necessary to both remove and fit aircraft hydraulic system components. The learner must remove components; however, they may fit a replacement component where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| Learning outcome |
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| The learner will:<br>1. Be able to maintain hydraulic systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the maintenance of the aircraft hydraulic system:<br>• ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures<br>• obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)<br>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates<br>• 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<br>• ensure the safe isolation and depressurisation of the hydraulic equipment before breaking into the system<br>• ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)<br>• use approved removal, fitting and testing techniques and procedures at all times<br>• leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from fluid spillages, damage and foreign object debris<br>• return tools and equipment to the correct storage location on completion of the activities<br>• ensure that work carried out is correctly documented and recorded<br>• ensure that any outstanding tests are correctly documented<br>1.3 follow the relevant maintenance schedules to carry out the required work<br>1.4 carry out the maintenance activities within the limits of their personal authority<br>1.5 carry out maintenance on two of the following parts of the aircraft hydraulic system:<br>• hydraulic power supply<br>• main hydraulic system<br>• emergency/auxiliary system<br>• indicating system<br>1.6 carry out the maintenance activities in the specified sequence and in an agreed timescale<br>1.7 carry out fifteen of the following maintenance activities: |

- removing access panels and covers to expose components to be removed
- carrying out fault diagnosis and system checks
- preparing the system for maintenance (such as isolating, de-pressurising, draining fluids)
- disconnecting electrical connections
- disconnect/removing hoses and pipes
- removing securing devices and mechanical fasteners
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing damaged/defective components
- replacing single use items such as seals, filters, gaskets
- refitting components in the correct position, orientation and alignment
- setting and adjusting replaced components (such as travel, working clearance)
- making mechanical connections
- making electrical connections
- torque loading as required
- replacing fluids and bleeding the system
- re-pressurising the system
- carrying out system functional checks
- ensuring that replacement components have the correct part numbers
- fitting blanks, labelling (and storing in the correct location) components that require repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)
- carrying out area inspections prior to task close down

1.8 remove and fit four different aircraft hydraulic system components (at least one must be from group A):

group a:

- engine driven pump
- heat exchanger
- electric motor driven pump
- gearbox driven pump
- standby pump
- hand pump
- reservoirs/tanks
- primary servo jack/actuator
- accumulator
- manifold
- auxiliary servo equipment
- ram air turbine

group b:

- control valves
- check valve
- automatic cut-out valve
- ground connector
- pipes and hoses
- filters
- sensors/transmitters
- hydraulic fuses
- chip detectors
- gauges/wiring/switches/plugs
- in-flight refuelling components
- other specific components

1.9 service/check the aircraft hydraulic system, to include carrying out all of the following:

- visually checking the system for leaks
- checking for correct operation of valves
- checking filters
- checking the fluid content of reservoirs
- replenishing the hydraulic system
- charging the nitrogen accumulator
- checking accumulator gas/nitrogen pressure
- checking indicating systems

1.10 carry out three of the following tests on the aircraft hydraulic system:

- leak test
- pressure test
- fluid sampling test
- built in test equipment (BITE) test
- 'special-to-type' tests

using one of the following:

- aircraft power source/pumps
- ground test rig

1.11 carry out maintenance on aircraft hydraulic system components in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Extended Range Twin-Engine Operations Procedures (ETOPS) (where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/approved change documentation (service bulletin)

1.12 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.13 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:

- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.14 dispose of waste materials in accordance with safe working practices and approved procedures.

| **Learning outcome** |
| --- |
| The learner will:<br>2. Know how to maintain hydraulic systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>2.1 explain the specific safety practices and procedures that they need to observe when working on aircraft hydraulic systems and when using synthetic oils<br>2.2 explain the need to check that cabin/cockpit switches, selectors and circuit breakers are in the correct position before applying any form of external power<br>2.3 explain the importance of maintenance on aircraft hydraulic systems, and impact upon ETOPS systems, Electrical Wiring Interconnect Systems (EWIS), legislation and local procedures<br>2.4 describe the hazards associated with carrying out maintenance activities on aircraft hydraulic systems, and with the tools and equipment used, and explain how to minimise them and reduce any risk<br>2.5 explain what protective equipment they need to use for both personal protection and protection of the aircraft<br>2.6 explain the importance of good aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft<br>2.7 explain how to extract and use information from aircraft manuals, log books, flight logs, charts, circuit and physical layouts, specifications, symbols used in aircraft hydraulic systems, and other documents needed in the maintenance activities<br>2.8 explain how to carry out currency/issue checks on the specifications they are working with<br>2.9 explain the terminology used in aircraft hydraulic systems, and the use of fluid power diagrams and associated symbols<br>2.10 describe the various types of pipe and components that make up the aircraft hydraulic system<br>2.11 describe the basic principles of operation of the hydraulic system being worked on<br>2.12 describe the types and use of hydraulic fluids, and their interaction and effect on the integrity of other parts of the aircraft<br>2.13 explain the techniques used to remove components from aircraft hydraulic systems without damage to the components or surrounding structure<br>2.14 describe the various mechanical fasteners to be removed and replaced, and explain their methods of removal and replacement<br>2.15 describe the various types of electrical connector that are used, |

methods of unlocking, orientation indicators and locating and locking-in of the connections

2.16 explain the importance of ensuring that any exposed components or pipe ends are correctly covered/protected

2.17 explain how to recognise contaminants, and the problems they can create; the effects and likely symptoms of contamination in the hydraulic system

2.18 explain the need to label and store correctly components that require repair or overhaul, and to check that replacement components have the correct part/identification markings and accompanying release documentation

2.19 explain how to fit components into the circuit

2.20 explain how to make adjustments to components/assemblies to ensure that they function correctly

2.21 explain why securing devices need to be tightened to the correct torque, locked and labelled, and the different methods that are used

2.22 explain how to carry out routine checks and servicing of the aircraft hydraulic system

2.23 explain what types of test need to be carried out on the aircraft hydraulic system, and the test equipment to be used

2.24 explain the methods and procedures to be used to carry out the various tests on the hydraulic systems

2.25 explain the need to apply test pressures in incremental stages, and to check all readings and pressures at each stage

2.26 explain how to record the results of each individual test, and the documentation that must be used

2.27 explain how to analyse the test results, and how to make valid decisions about the acceptability of the aircraft

2.28 explain the procedures to be followed if the equipment or system fails to meet the test specification

2.29 explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation

2.30 describe the procedure for the safe disposal of waste materials, scrap components and hydraulic fluids

2.31 describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve.

# Unit 713 Maintaining hydraulic systems on aircraft

Supporting information

## Guidance

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

2.2 (such as electrical, hydraulic, air or vacuum)

2.4, (such as the safe release of pressurised systems, handling hydraulic fluids, traps from moving parts, misuse of tools)

2.10 (such as rigid pipes; hydraulic hoses; pipe connectors; pipe sealing and supporting devices; valves used for pressure relief, flow and directional control; pumps; pressure intensifiers, mechanical and electrical control devices)

2.11 (such as system layout, hydraulic fluids, the use of reservoirs and accumulators, pressure generation, pressure control and distribution, pressure indication and warning)

2.13 (such as release of pressures/force, draining of fluids, removal of components and the need to protect the circuit integrity by fitting blanking plugs and labelling exposed circuits)

2.14 (such as threaded fasteners, special securing devices)

2.19 (such as the use of gaskets/seals and jointing/sealing compounds; ensuring correct tightness of pipe fittings and pump connections; eliminating stress on pipework/connections; carrying out visual checks of all components; checking security of joints and that the system is safe to re-pressurise)

2.20 (such as pressure settings, and their effect on the system, travel and working clearance)

2.22 (including replenishing hydraulic fluid and accumulator charge)

# Unit 714 Maintaining ice and rain protection systems on aircraft

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|---|---|
| **UAN:** | **M/601/6188** |
| **Level:** | 3 |
| **Credit value:** | 86 |
| **GLH:** | 168 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 314: Maintaining Ice and Rain Protection Systems on Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft ice and rain protection systems, in accordance with the approved aircraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It covers both fixed wing and rotary winged aircraft, and covers the units and components which provide a means of preventing or disposing of ice and rain on various parts of the aircraft. The maintenance activities will include the removal, fitting and testing of a range of ice and rain protection system components associated with airfoil surfaces, air intakes and cowls, pitot static, windows and doors, antennas and radomes, propellers and rotors, water supply and drain lines, and ice detection and indicating systems. The learner will be expected to use the approved procedure for correctly isolating the system before breaking into the system circuit. The learner will remove the required components and fit approved replacements, as appropriate. The learner will then need to test and adjust the completed system to meet the aircraft maintenance manual, change documentation (service bulletin) and airworthiness requirements.<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the aircraft manual, change/service bulletin documentation and airworthiness requirements for the maintenance activities undertaken, and to report any |

problems with these requirements 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 are correctly accounted for on completion of the activities, and that all necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to aircraft ice and rain protection systems. The learner will understand the removal, fitting and testing methods and procedures, and their application, along with the ice and rain protection system maintenance requirements. The learner will know how the equipment functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the equipment is maintained to the required standard.

The learner will understand the safety precautions required when working on aircraft ice and rain protection systems, especially those involved with handling de-icing fluids. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

**Notes:** 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 30 Ice and Rain Protection. 2. To display competence in this unit, it is necessary to both remove and fit aircraft ice and rain protection system components. The learner must remove components; however, they may fit a replacement component where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| Learning outcome |
| --- |
| The learner will:<br>1. Be able to maintain ice and rain protection systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the maintenance of the aircraft ice and rain protection systems:<br>• ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures<br>• obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)<br>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates<br>• 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<br>• ensure that the system is safely isolated and, where appropriate, drain off fluid before breaking into the system<br>• ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)<br>• use approved removal, fitting and testing techniques and procedures at all times<br>• leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from damage and foreign object debris<br>• return tools and equipment to the correct storage location on completion of the activities<br>• ensure that work carried out is correctly documented and recorded<br>• ensure that any outstanding tests are correctly documented<br>1.3 follow the relevant maintenance schedules to carry out the required work<br>1.4 carry out the maintenance activities within the limits of their personal authority<br>1.5 carry out maintenance on two of the following parts of the aircraft ice and rain protection systems:<br>• aerofoil surfaces<br>• air intakes/cowlings<br>• pitot and static<br>• propellers/rotors<br>• windows/windshields<br>• doors |

- antennas and radomes
- water supply and drain lines
- ice detection and indicating

1.6 carry out maintenance on ice and rain protection systems operated by two of the following:

- mechanical/pneumatic actuation
- alcohol spray
- hot air
- electrically heated elements

1.7 carry out the maintenance activities in the specified sequence and in an agreed timescale

1.8 carry out fifteen of the following maintenance activities:

- removing access panels and covers to expose components to be removed
- carrying out fault diagnosis and system checks
- preparing the system for maintenance (such as isolating, draining fluids)
- disconnecting electrical connections
- removal of bonding
- disconnecting/removing hoses and pipes
- removing mechanical fasteners and securing devices
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing damaged/defective components
- replacing single use items such as seals, gaskets
- refitting components in the correct position, orientation and alignment
- setting and adjusting replaced components
- making mechanical connections
- making electrical connections
- carrying out bonding
- torque loading as required
- replenishing fluids
- carrying out system functional checks
- ensuring that replacement components have the correct part numbers
- fitting blanks, labelling (and storing in the correct location) components that require repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)
- carrying out area inspections prior to task close down

1.9 remove and fit four different aircraft ice and rain protection components (at least one must be from group A):

group a:

- pump

- manifold
- valves (such as check, de-icing, distributing)
- pressure regulator
- fluid reservoirs/tanks
- rubber de-icer boots
- solenoids
- wing heaters
- heated windshields
- nozzles (air or fluid)
- water line heaters
- electrical elements
- wiper motor
- pitot probes/pressure heads
- pitot heaters
- scoop heaters
- ice detectors

group b:

- windshield wipers
- sensors/transmitters
- timers
- temperature probes
- pipes and hoses
- air filters
- gauges
- electrical probes
- moisture drains/traps
- wiring/switches/plugs
- other specific components

1.10 service/check aircraft ice and rain protection systems, to include carrying out all of the following:

- checking the system for leaks
- replacing filters
- replenishing fluids (such as de-icing, rain repellent)
- checking and adjusting spray nozzles
- checking the operation of pitot, static and stall detection heating elements
- changing windshield wiper blades
- checking indicating systems

1.11 carry out three of the following tests on the aircraft ice and rain protection systems:

- leak test
- pressure test
- system charging
- reduced system test
- built in test equipment (BITE) test
- 'special-to-type' tests

using one of the following:

- aircraft pumps
- ground test rig
- aircraft electrical power

1.12 carry out maintenance on aircraft ice and rain protection systems in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Extended Range Twin-Engine Operations Procedures (ETOPS) (where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/approved change documentation (service bulletin)

1.13 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.14 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:

- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.15 dispose of waste materials in accordance with safe working practices and approved procedures

| **Learning outcome** |
| --- |
| The learner will:<br>2. Know how to maintain ice and rain protection systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>2.1 explain the specific safety practices and procedures that they need to observe when working on aircraft ice and rain protection systems<br>2.2 explain the need to check that cabin/cockpit switches, selectors and circuit breakers are in the correct position before applying any form of external power<br>2.3 explain the importance of maintenance on ice and rain protection systems, and impact upon ETOPS systems, Electrical Wiring Interconnect Systems (EWIS), legislation and local procedures<br>2.4 describe the hazards associated with carrying out maintenance activities on aircraft ice and rain protection systems, and with the tools and equipment used, and explain how to minimise them and reduce any risk<br>2.5 explain what protective equipment that they need to use for both personal protection and protection of the aircraft<br>2.6 explain the importance of good aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft |

2.7 explain how to extract and use information from aircraft manuals, log books, flight logs, charts, circuit and physical layouts, specifications, symbols used in aircraft ice and rain protection systems, and other documents needed in the maintenance activities

2.8 explain how to carry out currency/issue checks on the specifications they are working with

2.9 explain the terminology used in aircraft ice and rain protection systems, and the use of system diagrams and associated symbols

2.10 describe the various types of pipe and components that make up the aircraft ice and rain protection system

2.11 describe the basic principles of operation of the ice and rain protection system being worked on

2.12 explain the techniques used to remove components from aircraft ice and rain protection systems without damage to the components or surrounding structure

2.13 describe the various mechanical fasteners to be removed and replaced, and explain their methods of removal and replacement

2.14 describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections

2.15 explain the need to label and store correctly components that require repair or overhaul, and to check that replacement components have the correct part/identification markings and accompanying release documentation

2.16 explain how to fit components into the circuit

2.17 explain how to make adjustments to components/assemblies to ensure that they function correctly (such as flow settings, travel and working clearance)

2.18 explain why securing devices need to be tightened to the correct torque, locked and labelled, and the methods to be used

2.19 explain how to carry out routine checks and servicing of the aircraft ice and rain protection system

2.20 explain what types of test need to be carried out on the aircraft ice and rain protection system, and the test equipment to be used

2.21 explain the methods and procedures to be used to carry out the various tests on the ice and rain protection system

2.22 explain the importance of carrying out tests in the specified sequence, checking readings and movements at each stage

2.23 explain how to record the results of each individual test, and the documentation that must be used

2.24 explain how to analyse the test results, and how to make valid decisions about the acceptability of the aircraft ice and rain protection system

2.25 explain the procedures to be followed if the equipment or system fails to meet the test specification

2.26 explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation

2.27 describe the procedure for the safe disposal of waste materials and scrap components

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

# Unit 714 Maintaining ice and rain protection systems on aircraft

Supporting information

## Guidance

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

2.2 (such as electrical, hydraulic, air or vacuum)

2.4, (such as the safe release of fluids, misuse of tools)

2.10 (such as rigid pipes; air hoses; rubber de-icing boots; heating elements; valves; pumps; mechanical and electrical control devices)

2.11 (such as hot air, electrically heated elements, mechanically/pneumatic operated rubber de-icing boots, alcohol spray and water repellent systems; ice indication and warning)

2.12 (such as release of fluids, removal of components and the need to protect the circuit integrity by fitting blanking plugs and labelling exposed circuits)

2.13 (such as threaded fasteners, special securing devices)

2.16 (such as ensuring the correct tightness of fastenings, fittings and pump connections; eliminating stress on pipework/connections; correctly making electrical connections; carrying out visual checks of all components)

2.19 (including checking for leaks, checking and changing filters, replenishing fluids, changing windshield wiper blades)

2.20 (such as testing operation of pitot, static and stall detectors)

# Unit 715 Maintaining indicating and recording systems on aircraft

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|---|---|
| **UAN:** | **A/601/6193** |
| **Level:** | 3 |
| **Credit value:** | 86 |
| **GLH:** | 168 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 315: Maintaining Indicating and Recording Systems on Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft indicating and recording systems, in accordance with the approved aircraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It covers both fixed wing and rotary winged aircraft, and includes visual display units, instruments, instrument panels and control of those systems which give visual or aural warning of conditions in unrelated systems. It also covers units which record, store or compute data from unrelated systems, and includes systems/units which integrate indicating instruments into a central display system and instruments not related to any specific system. The maintenance activities will include the removal, fitting and testing of a range of aircraft indicating and recording system components. The learner will be expected to use the approved procedure for correctly isolating the circuit/system. The learner will remove the required components and fit approved replacements, as appropriate. The learner will then need to test and adjust the completed system to meet the aircraft maintenance manual, change documentation (service bulletin) and airworthiness requirements.<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the aircraft manual, change/service bulletin documentation and |

airworthiness requirements for the maintenance activities undertaken, and to report any problems with these requirements 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 are correctly accounted for on completion of the activities, and that all necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to aircraft indicating and recording systems. The learner will understand the removal, fitting and testing methods and procedures, and their application, along with the indicating and recording system maintenance requirements. The learner will know how the equipment functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the equipment is maintained to the required standard.

The learner will understand the safety precautions required when working on aircraft indicating and recording systems. 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.

**Notes:** 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 31 Indicating and Recording Systems. 2. To display competence in this unit, it is necessary to both remove and fit aircraft indicating and recording system components. The learner must remove components; however, they may fit a replacement component where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| Learning outcome |
| --- |
| The learner will:<br>1. Be able to maintain indicating and recording systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the maintenance of the aircraft indicating and recording systems:<br>• ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures<br>• obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)<br>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates<br>• 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<br>• ensure the safe isolation of the indicating and recording systems before breaking into the system circuit<br>• ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)<br>• where appropriate, apply electrostatic discharge (ESD) avoidance procedures<br>• use approved removal, fitting and testing techniques and procedures at all times<br>• leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from damage and foreign object debris<br>• return tools and equipment to the correct storage location on completion of the activities<br>• ensure that work carried out is correctly documented and recorded<br>• ensure that any outstanding tests are correctly documented<br>1.3 follow the relevant maintenance schedules to carry out the required work<br>1.4 carry out the maintenance activities within the limits of their personal authority<br>1.5 carry out maintenance on two of the following parts of aircraft indicating and recording systems:<br>• instrument and control panels (such as instruments, switches, circuit breakers)<br>• independent instruments (such as clocks, inclinometers)<br>• recorders (such as flight recorders, cockpit voice recorders, maintenance recorders) |

- central computers (such as Digital Core Avionic Systems (DCAS), stored checklists, integrated instrument systems)
- central warning system (such as master warning or flight warning systems, central instrument warning, tone generators, annunciators)
- central display systems (such as those that give visual display of conditions in unrelated systems)
- automatic data reporting systems (such as ASDAR systems)

1.6 carry out the maintenance activities in the specified sequence and in an agreed timescale

1.7 carry out fifteen of the following maintenance activities:

- removing access panels and covers to expose components to be removed
- carrying out fault diagnosis and system checks
- preparing the system for maintenance (such as isolating)
- disconnecting electrical connections
- removal of bonding
- removing cable securing devices
- removing securing devices and mechanical fasteners
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing damaged/defective components
- refitting components in the correct position, orientation and alignment
- setting and adjusting replaced components (such as zero, range, travel, clearance)
- making mechanical connections
- making electrical connections
- carrying out bonding
- torque loading
- installing cable securing devices
- carrying out functional checks of the system
- ensuring that replacement components have the correct part numbers
- labelling (and storing in the correct location) components that require repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)
- carrying out area inspections prior to task close down

1.8 remove and fit four different indicating and recording system components (at least two must be from group A):

group a:

- flight data recorder (FDR)
- cockpit voice recorder
- master caution unit

- performance/maintenance recorders
- Digital Core Avionic Systems (DCAS)
- generators (such as pulse, speed/taco, tone)
- independent instruments (such as clocks)
- display units
- inclinometer
- QAR

group b:

- transmitters (such as position, flow, pressure, level)
- switches (such as micro, proximity)
- input and follow-up potentiometers
- actuators
- motors
- computers
- relays
- transducers/sensors
- circuit breakers
- gauges/indicators
- capacitance units
- wires/cables
- plugs/sockets

1.9 carry out two of the following tests on the aircraft indicating and recording systems:

- continuity check
- voltage check
- compass swing
- comparison check
- BITE test
- 'special-to-type' tests
- check swing

using three of the following:

- measuring equipment
- external power source (such as electrical/hydraulic)
- pitot/static pump/digital air data test equipment
- 'special-to-type' test sets
- aircraft power source (such as electrical/hydraulic)

1.10 carry out maintenance on aircraft indicating and recording systems in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Extended Range Twin-Engine Operations Procedures (ETOPS) (where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/approved change documentation (service bulletin)

1.11 report any instances where the maintenance activities cannot be

fully met or where there are identified defects outside the planned schedule

1.12 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:

- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.13 dispose of waste materials in accordance with safe working practices and approved procedures.

**Learning outcome**

The learner will:

2. Know how to maintain indicating and recording systems on aircraft

**Assessment criteria**

The learner can:

2.1 explain the specific safety practices and procedures that they need to observe when working on aircraft indication and recording systems

2.2 explain the need to check that cabin/cockpit switches, selectors and circuit breakers are in the correct position before applying any form of external power

2.3 explain the importance of maintenance on Indicating and Recording Systems and the impact upon ETOPS systems, Electrical Wiring interconnect Systems (EWIS), legislation and local procedures

2.4 describe the hazards associated with carrying out maintenance activities on aircraft indication and recording systems, and with the tools and equipment used, and explain how to minimise them and reduce any risk

2.5 explain what protective equipment they need to use for both personal protection and protection of the aircraft

2.6 explain the importance of good aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft

2.7 explain how to extract and use information from aircraft manuals, log books, flight logs, charts, circuit and physical layouts, specifications, symbols used in aircraft indication and recording systems, and other documents needed in the maintenance activities

2.8 explain how to carry out currency/issue checks on the specifications they are working with

2.9 explain the terminology used in aircraft indication and recording systems, and the use of system diagrams and associated symbols

2.10 describe the basic principles of operation of the indicating and recording system being worked on, and the function of the various units that make up the system

2.11 explain the techniques used to remove components from aircraft indicating and recording systems without damage to the components or surrounding structure

2.12 describe the various mechanical fasteners to be removed and

replaced, and explain their methods of removal and replacement

2.13 describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections

2.14 explain the importance of applying electrostatic discharge (ESD) avoidance procedures when working on sensitive equipment or devices

2.15 explain the need to label and store correctly components that require repair or overhaul, and to check that replacement components have the correct part/identification markings and accompanying release documentation

2.16 explain how to fit equipment and components into the system

2.17 explain how to make adjustments to components/assemblies to ensure that they function correctly

2.18 explain why securing devices need to be tightened to the correct torque, locked and labelled, and the methods to be used

2.19 describe the tools and equipment used in the maintenance activities, and explain their calibration/care and control procedures

2.20 explain why tool/equipment control is critical, and what to do if a tool or piece of equipment is unaccounted for on completion of the activities

2.21 explain why electrical bonding is critical, and why it must be both mechanically and electrically secure

2.22 explain how to carry out routine checks and servicing of the aircraft indicating and recording system

2.23 explain what types of test need to be carried out on the aircraft indicating and recording system, and the test equipment to be used

2.24 explain the methods and procedures to be used to carry out the various tests on the indicating and recording system

2.25 explain the importance of carrying out tests in the specified sequence, checking all readings and movements at each stage

2.26 explain how to record the results of each individual test, and the documentation that must be used

2.27 explain how to analyse the test results, and how to make valid decisions about the acceptability of the aircraft indicating and recording systems

2.28 explain the procedures to be followed if the equipment or system fails to meet the test specification

2.29 explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation

2.30 describe the procedure for the safe disposal of waste materials and scrap components

2.31 describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve.

# Unit 715 Maintaining indicating and recording systems on aircraft

Supporting information

## Guidance

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

2.2 (such as electrical, hydraulic, air or vacuum)

2.11 (such as removal of components and the need to protect the circuit integrity by labelling and covering exposed circuits)

2.12 (such as threaded fasteners, special securing devices)

2.16 (such as ensuring correct position and orientation; ensuring the correct tightness of fastenings; eliminating stress on cables; correctly making electrical connections; carrying out visual checks of all components)

2.17 (such as zero, range, travel and working clearance)

2.22 (including checking for security of equipment, changing filters, inspecting for HIRF requirements)

2.23 (such as continuity, voltage and soak tests)

# Unit 716 Maintaining landing gear on aircraft

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| **UAN:** | **J/601/6195** |
| **Level:** | 3 |
| **Credit value:** | 86 |
| **GLH:** | 168 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 316: Maintaining Landing Gear on Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft landing gear, in accordance with the approved aircraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It covers both fixed wing and rotary winged aircraft, and covers the units and components which provide a means of supporting and steering the aircraft on the ground or water, and which make it possible to retract and store the landing gear in flight (including main gear and nose wheel, tail skid assemblies, brakes, wheels, floats, skids, skis, doors, shock struts, tyres, linkages and indicating and warning systems). The maintenance activities will include the removal, fitting and testing of a range of landing gear components. The learner will be expected to use the approved procedure for correctly isolating and, where appropriate, de-pressurising the system, before breaking into the system circuit. The learner will remove the required components and fit approved replacements, as appropriate. The learner will then need to test and adjust the completed system to meet the aircraft maintenance manual, change documentation (service bulletin) and airworthiness requirements.<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the aircraft manual, change/service bulletin documentation and airworthiness requirements for the maintenance |

activities undertaken, and to report any problems with these requirements 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 are correctly accounted for on completion of the activities, and that all necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to aircraft landing gear. The learner will understand the removal, fitting and testing methods and procedures, and their application, along with the landing gear maintenance requirements. The learner will know how the equipment functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the landing gear is maintained to the required standard.

The learner will understand the safety precautions required when working on aircraft landing gear, especially those for ensuring that the undercarriage locks are in place, and when isolating and depressurising the equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

**Notes:** 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 32 Landing Gear. 2. To display competence in this unit, it is necessary to both remove and fit aircraft landing gear components. The learner must remove components; however, they may fit a replacement component where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| Learning outcome |
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| The learner will:<br>1. Be able to maintain landing gear on aircraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the maintenance of the aircraft landing gear:<br>• ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures<br>• obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)<br>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates<br>• 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<br>• ensure the safe isolation and depressurisation of the hydraulic lines before breaking into the system<br>• ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)<br>• use approved removal, fitting and testing techniques and procedures at all times<br>• leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from fluid spillages, damage and foreign object debris<br>• return tools and equipment to the correct storage location on completion of the activities<br>• ensure that work carried out is correctly documented and recorded<br>• ensure that any outstanding tests are correctly documented<br>1.3 follow the relevant maintenance schedules to carry out the required work<br>1.4 carry out the maintenance activities within the limits of their personal authority<br>1.5 carry out maintenance on three of the following parts of aircraft landing gear:<br>• main gear<br>• nose gear<br>• tail gear<br>• extension and retraction system<br>• landing gear door mechanism<br>• supplementary gear (skis, floats) |

- wheels and brakes
- nose wheel steering
- gear position, warning and ground safety devices

1.6 carry out the maintenance activities in the specified sequence and in an agreed timescale

1.7 carry out fifteen of the following maintenance activities:

- removing access panels and covers to expose components to be removed
- carrying out fault diagnosis and system checks
- preparing the system for maintenance (such as isolating, de-pressurising, draining fluids)
- disconnecting electrical connections
- removal of bonding
- disconnecting/removing hoses and pipes
- removing securing devices and mechanical fasteners
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing damaged/defective components
- replacing single use items (such as seals, filters, gaskets)
- refitting components in the correct position, orientation and alignment
- setting and adjusting replaced components (such as travel, working clearance)
- making mechanical connections
- making electrical connections
- carrying out bonding
- torque loading as required
- replacing fluids and bleeding the system
- re-pressurising the system
- carrying out system functional checks
- ensuring that replacement components have the correct part numbers
- fitting blanks, labelling (and storing in the correct location) components that require repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)
- carrying out area inspections prior to task close down

1.8 remove and fit four different aircraft landing gear components (at least two must be from group A):

group a:

- shock struts
- bogie axles
- drag struts
- swivel glands
- brake master cylinder

- brake units/components
- nose gear actuators
- main gear actuators
- bogie trim
- operating controls
- de-boosters
- shimmy damper
- gear selector valve
- motors
- bearings
- anti-skid devices
- skis/floats
- emergency landing devices

group b:

- linkages
- attachment bolts
- bungees
- tyres
- seals
- sensors
- nose and main gear locking mechanisms
- cables
- pipes and hoses
- pressure indicators
- pressure switch
- brake control valve
- relays
- solenoids
- wiring/switches/plugs
- indicators and warning devices
- wheel well fire loops
- other specific components

1.9 service/check aircraft landing gear, to include carrying out eight of the following:

- visually checking the system for leaks
- inspecting tyres for wear, impact damage and creep
- replacing wheels
- checking and cleaning the braking system
- replacing brake units/components
- bleeding the braking system
- rigging the steering
- adjusting microswitches
- charging struts
- checking the indicating and warning systems
- charging the braking accumulator
- checking the oleo extension

1.10 carry out three of the following tests on the aircraft landing gear:

- leak test
- pressure test
- functional
- rigging check
- static friction check
- testing outbreak system
- landing gear door functional testing
- built in test equipment (BITE) test
- 'special-to-type' tests
- cable tension check
- safety interlock test
- freedom and range of movement
- testing anti-skid unit

using two of the following:

- aircraft power source/pumps
- measuring equipment
- ground test rig
- built in test equipment (BITE)

1.11 carry out maintenance on aircraft landing gear components in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Extended Range Twin-Engine Operations Procedures (ETOPS) (where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/approved change documentation (service bulletin)

1.12 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.13 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:

- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.14 dispose of waste materials in accordance with safe working practices and approved procedures.

| Learning outcome |
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| The learner will:<br>2. Know how to maintain landing gear on aircraft |
| **Assessment criteria** |
| The learner can:<br>2.1 explain the specific safety practices and procedures that they need to observe when working on aircraft landing gear systems (including any specific legislation, regulations/codes of practice for the activities, equipment or materials)<br>2.2 explain the need to check that cabin/cockpit switches, selectors and circuit breakers are in the correct position before applying any form of external power (such as electrical, hydraulic, air or vacuum)<br>2.3 explain the importance of maintenance of aircraft landing gear, and impact upon ETOPS systems, Electrical Wiring Interconnect Systems (EWIS), legislation and local procedures<br>2.4 describe the hazards associated with carrying out maintenance activities on aircraft landing gear, and with the tools and equipment used , and explain how to minimise them and reduce any risk<br>2.5 explain what protective equipment they need to use for both personal protection and protection of the aircraft<br>2.6 explain the importance of good aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft<br>2.7 explain how to extract and use information from aircraft manuals, log books, flight logs, charts, circuit and physical layouts, specifications, symbols used in aircraft landing gear systems, and other documents needed in the maintenance activities<br>2.8 explain how to carry out currency/issue checks on the specifications they are working with<br>2.9 explain the terminology used in aircraft landing gear systems, and the use of system diagrams and associated symbols<br>2.10 describe the various types of pipe and components that make up the aircraft landing gear system<br>2.11 describe the basic principles of operation of the landing gear being worked on, and the function of the units that make up the system<br>2.12 explain the techniques used to remove components from aircraft landing gear systems without damage to the components or surrounding structure<br>2.13 describe the various mechanical fasteners that will need to be removed and replaced, and explain their methods of removal and replacement<br>2.14 describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections<br>2.15 explain the importance of ensuring that the aircraft and work area is maintained free from dirt, debris and foreign objects, and of ensuring that any exposed components or pipe ends are correctly covered/protected<br>2.16 explain the need to label and store correctly components that require repair or overhaul, and to check that replacement components have the correct part/identification markings and |

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| | accompanying release documentation |
| 2.17 | explain how to fit landing gear components safely and correctly |
| 2.18 | explain how to make adjustments to components/assemblies to ensure that they function correctly |
| 2.19 | explain why securing devices need to be tightened to the correct torque, locked and labelled, and the methods to be used |
| 2.20 | describe the tools and equipment used in the maintenance activities, and explain their calibration/care and control procedures |
| 2.21 | explain why tool/equipment control is critical, and what to do if a tool or piece of equipment is unaccounted for on completion of the activities |
| 2.22 | explain how to carry out routine checks and servicing of the aircraft landing gear |
| 2.23 | explain what types of test need to be carried out on the aircraft landing gear, and the test equipment to be used |
| 2.24 | explain the methods and procedures to be used to carry out the various tests on the landing gear |
| 2.25 | explain the importance of carrying out the tests in the specified sequence, checking readings and movements at each stage |
| 2.26 | explain how to record the results of each individual test, and the documentation that must be used |
| 2.27 | explain how to analyse the test results, and ho to make valid decisions about the acceptability of the aircraft landing gear |
| 2.28 | explain the procedures to be followed if the equipment or system fails to meet the test specification |
| 2.29 | explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation |
| 2.30 | describe the procedure for the safe disposal of waste materials, scrap components and fluids |
| 2.31 | describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve. |

# Unit 716 Maintaining landing gear on aircraft

Supporting information

## Guidance

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

2.4 (such as the safe release of pressurised systems, traps from moving parts, misuse of tools)

2.10 (such as rigid pipes; hydraulic hoses; valves; struts, steering and braking mechanisms; extension and retraction mechanisms; mechanical and electrical control devices)

2.12 (such as release of pressures/force, draining of fluids, removal of components and the need to protect the circuit integrity by fitting blanking plugs and labelling exposed circuits)

2.13 (such as chalk lines on the floor, levelling plates in the aircraft floor)

2.17 (such as use of lifting and handling equipment; ensuring the correct tightness of connections; eliminating stress on pipework/connections; carrying out visual checks of all components)

2.18 (such as travel and working clearance)

2.22 (including checking tyres and braking systems)

# Unit 717 Maintaining lighting systems on aircraft

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| **UAN:** | **L/601/6201** |
| **Level:** | 3 |
| **Credit value:** | 86 |
| **GLH:** | 168 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 317: Maintaining Lighting Systems on Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft lighting systems, in accordance with the approved aircraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It covers both fixed wing and rotary winged aircraft, and includes electrically powered units and components which provide for external and internal illumination, such as landing lights, taxi lights, position lights, rotating lights, ice lights, master warning lights, passenger reading and cabin dome lights, as applicable to the aircraft type. It does not include warning lights for individual systems or self illuminating signs. The maintenance activities will include the removal, fitting and testing of a range of lighting system components. The learner will be required to select the correct tools and equipment to use, based on the operations to be performed and the components to be removed or replaced. The aircraft lighting system components will include items such as light fixtures and fittings, rotating beacons, switches and wiring. The learner will remove the required components and fit approved replacements, as appropriate. The learner will then need to test and adjust the completed system to meet the aircraft maintenance manual, change documentation (service bulletin) and airworthiness requirements.<br>The learner's responsibilities will require them to comply with the specific practices and |

procedures identified in the aircraft manual, change/service bulletin documentation and airworthiness requirements for the maintenance activities undertaken, and to report any problems with these requirements 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 are correctly accounted for on completion of the activities, and that all necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to the aircraft lighting systems. The learner will understand the removal, fitting and testing methods and procedures, and their application, along with the system maintenance requirements. The learner will know how the equipment functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the equipment is maintained to the required standard

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

**Notes:** 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 33 Lights. 2. To display competence in this unit, it is necessary to both remove and fit aircraft lighting system components. The learner must remove components; however, they may fit a replacement component where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| Learning outcome |
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| The learner will:<br>1. Be able to maintain lighting systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the maintenance of the aircraft lighting system:<br>• ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures<br>• obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)<br>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates<br>• 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<br>• ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)<br>• where appropriate, apply electrostatic discharge (ESD) avoidance procedures<br>• use approved removal, fitting and testing techniques and procedures at all times<br>• leave the aircraft and equipment in a safe and appropriate condition, and ensure components and surrounding structures are maintained free from damage and foreign object debris<br>• return tools and equipment to the correct storage location on completion of the activities<br>• ensure that work carried out is correctly documented and recorded<br>• ensure that any outstanding tests are correctly documented<br>1.3 follow the relevant maintenance schedules to carry out the required work<br>1.4 carry out the maintenance activities within the limits of their personal authority<br>1.5 carry out maintenance on three of the following parts of aircraft lighting systems:<br>• flight compartment and annunciator panel (such as direct and indirect illumination of work areas, panels and instruments)<br>• passenger compartment (such as cabin dome lights, reading lights, toilet, galley, lounges and coat rooms)<br>• cargo and service compartments<br>• exterior lighting (such as landing, navigation, wing illumination, position indicating, rotating, taxi and courtesy) |

- additional lighting (such as search lights, spot lights, flood lights)
- emergency lighting (such as low level, inertia flashlights, lanterns)

1.6 carry out the maintenance activities in the specified sequence and in an agreed timescale

1.7 carry out fifteen of the following maintenance activities:

- removing access panels and covers to expose components to be removed
- carrying out fault diagnosis and system checks
- preparing the system for maintenance (such as isolating)
- disconnecting electrical connections
- removal of bonding
- removing cable securing devices
- removing securing devices and mechanical fasteners
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components and wires
- checking components for serviceability
- replacing damaged/defective components
- refitting components in the correct position, orientation and alignment
- setting and adjusting replaced components
- making mechanical connections
- making electrical connections
- carrying out bonding
- installing cable securing devices
- torque loading as required
- carrying out functional checks of the system
- carrying out area inspections prior to task close down

1.8 remove and fit six different lighting system components (at least four must be from group A):

group a:

- rotating beacon
- strobe light
- landing lights
- wing illumination lights
- position lights
- navigation lights
- taxi lights
- courtesy lights
- low level emergency lights
- portable emergency torches
- ice lights
- strobe anti-collision lights and power/synchronising units
- master warning lights/attention getters
- cabin dome lights

- reading lights
- illuminated signs

group b:

- switches
- inertia flash lights
- light fixtures
- dimming equipment
- wires/cables
- batteries
- relays
- connectors/plugs/sockets
- other specific components

1.9 service/check aircraft lighting systems, to include carrying out two of the following:

- perform emergency lighting system check
- check all flight compartment and passenger compartment lights and replace any found defective
- check all cargo and service compartment lights and replace any found defective
- check all exterior lighting and replace any found defective
- check portable emergency torch lights

1.10 carry out two of the following tests/checks on aircraft lighting systems:

- functional check
- emergency power failure checks
- BITE test
- 'special-to-type' tests

using two of the following:

- external power source
- aircraft power source
- 'special-to-type' test sets

1.11 carry out maintenance on aircraft lighting systems in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Extended Range Twin-Engine Operations Procedures (ETOPS) (where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/approved change documentation (service bulletin)

1.12 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.13 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:

- job cards/work sheets
- computer records

- aircraft technical log
- aircraft cabin log
- aircraft log book

1.14 dispose of waste materials in accordance with safe working practices and approved procedures .

| **Learning outcome** |
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| The learner will:<br>2. Know how to maintain lighting systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>2.1 explain the specific safety practices and procedures that they need to observe when working with aircraft lighting systems<br>2.2 explain the importance of maintenance on aircraft lighting systems, and impact upon ETOPS systems, Electrical Wiring Interconnect Systems (EWIS), legislation and local procedures<br>2.3 describe the hazards associated with removing, fitting and testing aircraft lighting system components, and with the tools and equipment used, and how to minimise them and reduce any risk<br>2.4 explain what protective equipment they need to use for both personal protection and protection of the aircraft<br>2.5 explain the importance of good aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft<br>2.6 explain how to extract and use information from aircraft manuals, log books, flight logs, charts, circuit and physical layouts, specifications, symbols used in aircraft lighting systems, and other documents needed in the maintenance process<br>2.7 explain how to carry out currency/issue checks on the specifications they are working with<br>2.8 explain the terminology used in aircraft lighting systems, and the use of system diagrams and associated symbols<br>2.9 describe the basic principles of operation of the lighting system being worked on, and the function of the various units within the system<br>2.10 describe the various mechanical fasteners that are used, and explain their methods of removal and replacement<br>2.11 explain the importance of using the specified fasteners for the particular installation, and why they must not substitute others<br>2.12 describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections<br>2.13 explain the techniques used to remove components from aircraft lighting systems without damage to the components or surrounding structure<br>2.14 explain the importance of applying electrostatic discharge (ESD) avoidance procedures when working on sensitive equipment or devices<br>2.15 explain the techniques used to position, align, adjust and secure the replaced components to the aircraft without damage to the components or surrounding structure |

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| 2.16 | explain the need to check that replacement components have the correct part/identification markings and accompanying release documentation |
| 2.17 | explain the procedures for ensuring that they have the correct tools, equipment, components and fasteners for the activities |
| 2.18 | explain why electrical bonding is critical, and why it must be both mechanically and electrically secure |
| 2.19 | describe the tools and equipment used in the maintenance activities, and explain their calibration/care and control procedures |
| 2.20 | explain why tool/equipment control is critical, and what to do if a tool or piece of equipment is unaccounted for on completion of the activities |
| 2.21 | describe the problems that can occur with the maintenance operations, and explain how these can be overcome |
| 2.22 | explain how to recognise defects in the lighting systems |
| 2.23 | explain how to carry out routine checks and servicing of the aircraft lighting system |
| 2.24 | explain the need to check that cabin/cockpit switches, and circuit breakers are in the correct position before applying any form of external power |
| 2.25 | explain what types of test need to be carried out on the aircraft lighting system, and the test equipment to be used |
| 2.26 | explain the methods and procedures to be used to carry out the various tests on the lighting system |
| 2.27 | explain how to record the results of each individual test, and the documentation that must be used |
| 2.28 | explain how to analyse the test results, and how to make valid decisions about the acceptability of the lighting system |
| 2.29 | explain the procedures to be followed if the equipment or system fails to meet the test specification |
| 2.30 | explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation |
| 2.31 | describe the procedure for the safe disposal of waste materials and scrap components |
| 2.32 | describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve |

# Unit 717 Maintaining lighting systems on aircraft

Supporting information

## Guidance

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

2.10 (such as threaded fasteners, special securing devices)

2.22 (such as faulty switches, incorrectly seated plugs and sockets, ineffective fasteners, foreign object damage or contamination)

2.23 (including emergency lighting checks)

2.24 (such as electrical, hydraulic, air or vacuum)

# Unit 718 Maintaining navigation systems on aircraft

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| **UAN:** | **R/601/6202** |
| **Level:** | 3 |
| **Credit value:** | 86 |
| **GLH:** | 168 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 318: Maintaining Navigation Systems on Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft navigation systems, in accordance with the aircraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It covers both fixed wing and rotary winged aircraft, and includes units and components which provide aircraft navigational information, as applicable to the aircraft type. The maintenance activities will include the removal, fitting and testing of a range of navigational components. The learner will be required to select the correct tools and equipment to use, based on the operations to be performed and the components to be removed or replaced. The aircraft system components will include items such as air data computers, pitot/static, distance measuring equipment (DME), very high frequency omnidirectional range (VOR), instrument landing (ILS), auto direction finder (ADF), global positioning (GPS), Doppler, long range navigation (LORAN), homing, inertial navigation system (INS), compasses and other devices, as applicable to the aircraft type. The learner will remove the required components and fit approved replacements, as appropriate. The learner will then need to test and adjust the completed system to meet the aircraft maintenance manual, change documentation (service bulletin) and airworthiness requirements.<br>The learner's responsibilities will require them to comply with the specific practices and |

procedures identified in the aircraft manual, change/service bulletin documentation and airworthiness requirements for the maintenance activities undertaken, and to report any problems with these activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner must ensure that all tools, equipment and materials used are correctly accounted for on completion of the activities, and that all necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to aircraft navigational systems. The learner will understand the removal, fitting and testing methods and procedures, and their application, along with the navigational system maintenance requirements. The learner will know how the equipment functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the equipment is maintained to the required standard.

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

**Notes:** 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 34 Navigation. 2. To display competence in this unit, it is necessary to both remove and fit aircraft navigation system components. The learner must remove components; however, they may fit a replacement component where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| Learning outcome |
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| The learner will:<br>1. Be able to maintain navigation systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the maintenance of the aircraft navigation system:<br>• ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures<br>• obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)<br>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates<br>• 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<br>• ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)<br>• where appropriate, apply electrostatic discharge (ESD) avoidance procedures<br>• use approved removal, fitting and testing techniques and procedures at all times<br>• leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from damage and foreign object debris<br>• return tools and equipment to the correct storage location on completion of the activities<br>• ensure that work carried out is correctly documented and recorded<br>• ensure that any outstanding tests are correctly documented<br>1.3 follow the relevant maintenance schedules to carry out the required work<br>1.4 carry out the maintenance activities within the limits of their personal authority<br>1.5 carry out maintenance on three of the following parts of aircraft navigation systems:<br>• flight environment data (such as central air data computers, pitot/static, rate-of-climb, air speed, high speed warning, altitude, altitude reporting, altimeter correction, air disturbance detection, air temperature)<br>• attitude and direction (such as magnetic compasses, vertical and directional references, magnetic heading systems, attitude director systems, symbol generators, turn and bank, rate of turn) |

- landing and taxiing aids (such as localizer, glide slope, instrument landing systems (ILS), markers and paravisual director ground guidance systems, microwave landing systems (MLS), radio altimeter
- independent position determining (such as inertial guidance systems, weather radar, Doppler, enhanced ground proximity warning system (EGPWS), traffic collision avoidance system (TCAS))
- dependant position determining (such as distant measuring equipment (DME), long range navigation (LORAN), very high frequency omnidirectional range (VOR), auto direction finder (ADF), global positioning system (GPS)
- flight management computing (such as course computers, flight management, performance data computers)

1.6 carry out the maintenance activities in the specified sequence and in an agreed timescale

1.7 carry out fifteen of the following maintenance activities:

- removing access panels and covers to expose components to be removed
- carrying out fault diagnosis and system checks
- preparing the system for maintenance (such as isolating)
- disconnecting electrical connections
- removal of bonding
- removing cable securing devices
- removing securing devices and mechanical fasteners
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing damaged/defective components
- refitting components in the correct position, orientation and alignment
- setting and adjusting/tuning replaced components (such as power output, voltage)
- making mechanical connections
- making electrical connections
- carrying out bonding
- installing cable securing devices
- torque loading as required
- checking the function of equipment
- ensuring that replacement components have the correct part numbers
- labelling (and storing in the correct location) components that require repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)

1.8 remove and fit six different aircraft navigation system components (at least four must be from group A):

group a:

- airspeed indicator
- altimeter
- vertical speed indicator
- satellite beacons
- ATC and DME transponders
- compensation units
- compass flux valve
- standby compass
- radio altimeter
- pitot/static probes/plates/sensors
- air data computer
- VHF nav receiver
- ADF receiver
- transmitter units
- control units
- interface units
- DME indicator
- receiver units
- aerials
- analogue/digital converters (A-D/D-A)
- navigation display units (including head-up)
- horizontal situation indicator unit (HSI)
- computers (eg, FMS, EGPWS,TCAS)
- heading and vertical reference gyro
- attitude/direction indicator (ADI)
- radio magnetic indicator
- standby/artificial horizon
- weather radar Tx/Rx
- weather radar antenna

group b:

- batteries
- switches
- relays
- circuit breakers
- unit trays
- instruments/gauges/indicators
- wires/cables/antenna
- feeder/waveguide
- plugs/sockets
- transformers
- line replacement units (LRU)
- other specific components

1.9 service/check aircraft navigation systems, to include carrying out six of the following:

- checking calibration of magnetic direction indicator
- checking pitot static system for leaks

- checking of pitot static instruments
- checking operation of directional directional/vertical reference gyros and indication systems
- checking calibration of pressure altitude reporting system
- checking instrument landing systems
- checking marker systems
- checking the satcom system
- checking GPS
- checking of radar altimeter
- functional check FMS
- functional check weather radar
- functional check Doppler
- functional check TCAS
- functional check DME
- functional check of VOR
- functional check ATC transponder
- functional check stand-alone flight director system
- functional check inertial navigation/reference system
- carrying out FMS/ EGPWS database update
- functional check ADF

1.10 carry out four of the following types of test/check on aircraft navigation systems:

- functional check
- bonding tests
- standard serviceability checks
- applying a dummy load
- voltage standing wave ratio (VSWR) checks
- distortion checks
- BITE test
- power output
- compass swing
- distant object test
- signal injection tests
- signal-to-noise checks
- continuity checks
- 'special-to-type' tests
- TDR checks
- receiver sensitivity

using four of the following:

- multimeter
- bonding tester
- 'special to type' test equipment
- radio frequency (RF) signal generators
- external power source (electrical/hydraulic)
- aircraft power source (electrical/hydraulic)
- vacuum systems

- headset
- oscilloscope
- reference gyros
- delay lines
- time-domain reflectometer (TDR) equipment
- voltage standing wave ratio (VSWR) equipment

1.11 carry out maintenance on aircraft navigation systems in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Extended Range Twin-Engine Operations Procedures (ETOPS) (where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/approved change documentation (service bulletin)

1.12 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.13 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:

- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.14 dispose of waste materials in accordance with safe working practices and approved procedures

| **Learning outcome** |
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| The learner will:<br>2. Know how to maintain navigation systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>2.1 explain the specific safety practices and procedures that they need to observe when working with aircraft navigation systems<br>2.2 explain the importance of maintenance on aircraft navigation systems and equipment, and the impact upon ETOPS systems, RVSM requirements, Autoland systems/status requirements, Elementary and Enhanced Mode 'S' Surveillance, Electrical Wiring Interconnect Systems (EWIS), legislation and local/company/customer procedures<br>2.3 describe the hazards associated with removing, fitting and testing aircraft navigation system components, and with the tools and equipment used, and how to minimise them and reduce any risk<br>2.4 explain what protective equipment they need to use for both personal protection and protection of the aircraft<br>2.5 explain the importance of good aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications |

of FOD to the safety of the aircraft

2.6 explain how to extract and use information from aircraft manuals, log books, flight logs, charts, circuit and physical layouts, specifications and other documents needed in the maintenance process

2.7 explain how to carry out currency/issue checks on the specifications they are working with

2.8 explain the terminology used in aircraft navigation systems, and the use of system diagrams and associated symbols

2.9 describe the basic principles of operation of the aircraft navigation system being worked on, and the function of the various units within the system

2.10 describe the various mechanical fasteners that are used, and explain their methods of removal and replacement

2.11 explain the importance of using the specified fasteners for the installation, and why they must not substitute others

2.12 explain why securing devices need to be locked and labelled, and the different methods that are used to remove and install them

2.13 explain the torque loading requirements on the fasteners, and what to do if these loadings are exceeded or not achieved

2.14 describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections

2.15 explain the techniques used to remove components from aircraft navigation systems without damage to the components or surrounding structure

2.16 explain the importance of applying electrostatic discharge (ESD) avoidance procedures when working on sensitive equipment or devices

2.17 explain the need to label and store correctly components that require repair or overhaul, and to check that replaced components have the correct part/identification markings and accompanying release documentation

2.18 explain the techniques used to position, align, adjust and secure the replaced components to the aircraft without damage to the components or surrounding structure

2.19 explain the methods of lifting, handling and supporting the components/equipment during the maintenance activities

2.20 explain why electrical bonding is critical, and why it must be both mechanically and electrically secure

2.21 describe the tools and equipment used in the maintenance activities, and explain their calibration/care and control procedures

2.22 explain why tool/equipment control is critical, and what to do if a tool or piece of equipment is unaccounted for on completion of the activities

2.23 explain how to recognise defects

2.24 explain how to carry out routine checks and servicing of the aircraft navigation system

2.25 explain the need to check that cabin/cockpit switches, selectors and circuit breakers are in the correct position before applying any form of external power

2.26 explain what types of test need to be carried out on the aircraft navigation system, and the test equipment to be used

2.27 explain the methods and procedures to be used to carry out the

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| | various tests on the navigation system |
| 2.28 | explain the importance of carrying out the tests in the specified sequence, checking readings/movements at each stage |
| 2.29 | explain how to record the results of each individual test, and the documentation that must be used |
| 2.30 | explain how to analyse the test results, and make valid decisions about the acceptability of the aircraft navigation systems |
| 2.31 | explain the procedures to be followed if the equipment or system fails to meet the test specification |
| 2.32 | describe the problems that can occur with the aircraft navigation system maintenance operations, and explain how these can be overcome |
| 2.33 | explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation |
| 2.34 | describe the procedure for the safe disposal of waste materials and scrap components |
| 2.35 | describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve |

# Unit 718 Maintaining navigation systems on aircraft

Supporting information

## Guidance

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

2.10 (such as threaded fasteners, special securing devices)

2.15 (such as proof marking, the need to protect the circuit integrity by covering and labelling exposed circuits)

2.23 (such as incorrectly seated plugs and sockets, ineffective fasteners, foreign object damage or contamination)

2.25 (such as electrical, hydraulic, air or vacuum

# Unit 719 Maintaining oxygen systems on aircraft

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| **UAN:** | **M/601/6210** |
| **Level:** | 3 |
| **Credit value:** | 86 |
| **GLH:** | 168 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 319: Maintaining Oxygen Systems on Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft oxygen systems, in accordance with the aircraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It covers both fixed wing and rotary winged aircraft, and covers the units and components which store, regulate and deliver oxygen to the passengers and crew, including bottles, relief valves, shut-off valves, outlets, regulators, masks, walk-around bottles, etc. The maintenance activities will include the removal, fitting and testing of a range of oxygen components. The learner will be expected to use the approved procedure for correctly isolating the system before breaking into the system circuit. The learner will remove the required components and fit approved replacements, as appropriate. The learner will then need to recharge the system, and test and adjust the completed system to meet the aircraft maintenance manual, change documentation (service bulletin) and airworthiness requirements.<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the aircraft manual, change/service bulletin documentation and airworthiness requirements for the maintenance activities undertaken, and to report any problems with these activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The |

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

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to aircraft oxygen systems. The learner will understand the removal, fitting and testing methods and procedures, and their application, along with the oxygen system maintenance requirements. The learner will know how the equipment functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the equipment is maintained to the required standard.

The learner will understand the safety precautions required when working on aircraft oxygen systems, especially those for ensuring system cleanliness and the avoidance of hydrocarbon contamination. 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.

**Notes:** 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 35 Oxygen. 2. To display competence in this unit, it is necessary to both remove and fit aircraft oxygen system components. The learner must remove components; however, they may fit a replacement component where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| **Learning outcome** |
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| The learner will:<br>1. Be able to maintain oxygen systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>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 maintenance of the aircraft oxygen system:

- ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures
- obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)
- obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates
- adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
- ensure the safe isolation of the oxygen equipment before breaking into the system
- ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)
- use approved removal, fitting and testing techniques and procedures at all times
- leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from damage and foreign object debris
- return tools and equipment to the correct storage location on completion of the activities
- ensure that work carried out is correctly documented and recorded
- ensure that any outstanding tests are correctly documented

1.3 follow the relevant maintenance schedules to carry out the required work

1.4 carry out the maintenance activities within the limits of their personal authority

1.5 carry out maintenance on two of the following parts of the aircraft oxygen system:

- oxygen supply
- crew supply
- passenger supply
- portable LOX equipment
- indicating
- emergency

1.6 carry out the maintenance activities in the specified sequence and in an agreed timescale

1.7 carry out fifteen of the following maintenance activities:

- removing access panels and covers to expose components to be removed
- carrying out fault diagnosis and system checks
- preparing the system for maintenance (such as isolating, de-pressurising)

- inspecting on board oxygen equipment
- disconnecting electrical connections
- removal of bonding
- disconnecting/removing hoses and pipes
- removing securing devices and mechanical fasteners
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing damaged/defective components
- replacing single use items such as seals, filters, gaskets
- refitting components in the correct position, orientation and alignment
- setting and adjusting replaced components (such as travel, working clearance)
- making mechanical connections
- making electrical connections
- carrying out bonding
- torque loading
- purging and recharging oxygen system
- carrying out system functional checks
- ensuring that replacement components have the correct part numbers
- fitting blanks, labelling (and storing in the correct location) components that require repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)

1.8 remove and fit four different aircraft oxygen system components (at least one must be from group A):

group a:

- oxygen generator
- LOX converter/pack
- oxygen cylinder
- oxygen regulator
- concentrator
- oxygen candle
- portable LOX equipment
- manifold
- fill build-up and vent valve

group b:

- therapeutic masks
- face mask and allied equipment
- filter
- control valves
- check valve
- ground connector

- pipes and hoses
- walk-round set
- sensors/transmitters
- gauges/wiring/switches/plugs
- other specific components

1.9 service/check the aircraft oxygen system, to include carrying out all of the following:

- checking the system for leaks
- replacing filters
- testing the crew oxygen system
- performing auto oxygen system deployment check
- testing the passenger oxygen system
- checking the indicating systems (such as pressure drop, temperature warning)

1.10 carry out three of the following tests on the aircraft oxygen system:

- leak test
- pressure test
- system charging
- reduced system test
- built in test equipment (BITE) test
- 'special-to-type' tests

using one of the following:

- aircraft power source/system
- ground test rig

1.11 carry out maintenance on aircraft oxygen system components in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Extended Range Twin-Engine Operations Procedures (ETOPS) (where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/approved change documentation (service bulletin)

1.12 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.13 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:

- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.14 dispose of waste materials in accordance with safe working practices and approved procedures

| Learning outcome |
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| The learner will:<br>2. Know how to maintain oxygen systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>2.1 explain the specific safety practices and procedures that they need to observe when working on aircraft oxygen systems<br>2.2 explain the need to check that cabin/cockpit switches, selectors and circuit breakers are in the correct position before applying any form of external power<br>2.3 explain the importance of maintenance on aircraft oxygen systems, and impact upon ETOPS systems, Electrical Wiring Interconnect Systems (EWIS), legislation and local procedures<br>2.4 describe the hazards associated with carrying out maintenance activities on aircraft oxygen systems, and with the tools and equipment used, and explain how to minimise them and reduce any risk<br>2.5 explain what protective equipment they need to use for both personal protection and protection of the aircraft<br>2.6 explain the importance of good aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft<br>2.7 explain how to extract and use information from aircraft manuals, log books, flight logs, charts, circuit and physical layouts, specifications, symbols used in aircraft oxygen systems, and other documents needed in the maintenance activities<br>2.8 explain how to carry out currency/issue checks on the specifications they are working with<br>2.9 explain the terminology used in aircraft oxygen systems, and the use of system diagrams and associated symbols<br>2.10 describe the various types of pipe and components that make up the aircraft oxygen system<br>2.11 describe the basic principles of operation of the oxygen system being worked on<br>2.12 explain the techniques used to remove components from aircraft oxygen systems without damage to the components or surrounding structure<br>2.13 describe the various mechanical fasteners that will need to be removed and replaced, and explain their methods of removal and replacement<br>2.14 describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections<br>2.15 explain the importance of ensuring that any components or pipe ends are correctly covered/protected<br>2.16 explain how to recognise contaminants and the problems they can create; the effects and likely symptoms of contamination in the system<br>2.17 explain the need to label and store correctly components that require repair or overhaul, and to check that replacement components have the correct part/identification markings and |

accompanying release documentation

2.18 explain how to fit components into the circuit

2.19 explain how to make adjustments to components/assemblies to ensure that they function correctly

2.20 explain why securing devices need to be tightened to the correct torque, locked and labelled, and the methods to be used

2.21 describe the tools and equipment used in the maintenance activities, and explain their calibration/care and control procedures

2.22 explain why tool/equipment control is critical, and what to do if a tool or piece of equipment is unaccounted for on completion of the activities

2.23 explain how to carry out routine checks and servicing of the aircraft oxygen system

2.24 explain what types of test need to be carried out on the aircraft oxygen system, and the test equipment to be used

2.25 explain the methods and procedures to be used to carry out the various tests on the oxygen system

2.26 explain the need to apply test pressures in incremental stages, and to check all readings and pressures at each stage

2.27 explain how to record the results of each individual test, and the documentation that must be used

2.28 explain how to analyse the test results, and make valid decisions about the acceptability of the aircraft oxygen system

2.29 explain the procedures to be followed if the equipment or system fails to meet the test specification

2.30 explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation

2.31 describe the procedure for the safe disposal of waste materials and scrap components

2.32 describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve.

# Unit 719 Maintaining oxygen systems on aircraft

Supporting information

## Guidance

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

2.2 (such as electrical, hydraulic, air or vacuum)

2.10 (such as rigid pipes; air hoses; pipe connectors; pipe sealing and supporting devices; valves used for pressure relief, flow and directional control; pumps; mechanical and electrical control devices)

2.11 (such as system layout, sources of oxygen (such as bottles, chemical generators, ground supply); oxygen control and distribution; oxygen indication and warning))

2.12 (such as removal of components and the need to protect the circuit integrity by fitting blanking plugs and labelling exposed circuits)

2.13 (such as threaded fasteners, special securing devices)

2.16 (especially hydrocarbons in oxygen systems)

2.18 (such as the use of gaskets/seals and jointing/sealing compounds; ensuring the correct tightness of pipe fittings and connections; eliminating stress on pipework/connections; carrying out visual checks of all components; checking security of joints and that the system is safe to re-charge)

2.19 (such as pressure deployment settings and their effect on the system, travel and working clearance)

2.23 (including checking for leaks, checking and changing filters, changing masks and adjusting or replacing regulator)

# Unit 720 Maintaining pneumatic systems on aircraft

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|---|---|
| **UAN:** | **L/601/6215** |
| **Level:** | 3 |
| **Credit value:** | 86 |
| **GLH:** | 168 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 320: Maintaining Pneumatic Systems on Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft pneumatic systems, in accordance with the aircraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It covers both fixed wing and rotary winged aircraft, and covers the units and components which deliver large volumes of compressed air from a power source to connecting points for other systems, such as air conditioning, pressurization, de-icing, etc. The maintenance activities will include the removal, fitting and testing of a range of pneumatic components. The learner will be expected to use the approved procedure for correctly isolating and de-pressurising the system before breaking into the system circuit. The learner will remove the required components and fit approved replacements, as appropriate. The learner will then need to pressurise the system, and test and adjust the completed system to meet the aircraft maintenance manual, change documentation (service bulletin) and airworthiness requirements.<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the aircraft manual, change/service bulletin documentation and airworthiness requirements for the maintenance activities undertaken, and to report any problems with these activities that they cannot personally resolve, or that are outside their |

permitted authority, to the relevant people. The learner must ensure that all tools, equipment and materials used are correctly accounted for on completion of the activities, and that all necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to aircraft pneumatic systems. The learner will understand the removal, fitting and testing methods and procedures, and their application, along with the pneumatic system maintenance requirements. The learner will know how the equipment functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the equipment is maintained to the required standard.

The learner will understand the safety precautions required when working on aircraft pneumatic systems, especially those for isolating and depressurising the equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

**Notes:** 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 36 Pneumatic. 2. To display competence in this unit, it is necessary to both remove and fit aircraft pneumatic system components. The learner must remove components; however, they may fit a replacement component where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| Learning outcome |
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| The learner will:<br>1. Be able to maintain pneumatic systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the maintenance of the aircraft pneumatic system:<br>• ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures<br>• obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)<br>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates<br>• 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<br>• ensure the safe isolation and depressurisation of the pneumatic equipment before breaking into the system<br>• ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)<br>• use approved removal, fitting and testing techniques and procedures at all times<br>• leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from damage and foreign object debris<br>• return tools and equipment to the correct storage location on completion of the activities<br>• ensure that work carried out is correctly documented and recorded<br>• ensure that any outstanding tests are correctly documented<br>1.3 follow the relevant maintenance schedules to carry out the required work<br>1.4 carry out the maintenance activities within the limits of their personal authority<br>1.5 carry out maintenance on two of the following parts of the aircraft pneumatic system:<br>• pneumatic supply<br>• distribution<br>• indicating<br>• gauging<br>1.6 carry out the maintenance activities in the specified sequence and in an agreed timescale<br>1.7 carry out fifteen of the following maintenance activities: |

- removing access panels and covers to expose components to be removed
- carrying out fault diagnosis and system checks
- preparing the system for maintenance (such as isolating, de-pressurising)
- disconnecting electrical connections
- removal of bonding
- disconnecting/removing hoses and pipes
- removing securing devices and mechanical fasteners
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing damaged/defective components
- replacing single use items such as seals, filters, gaskets
- refitting components in the correct position, orientation and alignment
- setting and adjusting replaced components (such as travel, working clearance)
- making mechanical connections
- making electrical connections
- carrying out bonding
- torque loading as required
- re-pressurising the system
- carrying out system functional checks
- ensuring that replacement components have the correct part numbers
- fitting blanks, labelling (and storing in the correct location) components that require repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)

1.8 remove and fit four different aircraft pneumatic system components (at least one must be from group A):

group a:

- pump
- compressors
- standby pump
- air reservoirs/tanks
- accumulator
- oil and water trap
- manifold
- desiccators
- heat exchangers

group b:

- control valves
- check valve

- ground connector
- pressure relief valve
- actuators
- control mechanisms
- pipes and hoses
- ducting
- air filters
- sensors/transmitters
- gauges
- wiring/switches/plugs
- pressure regulating valve
- warning devices (temperature, pressure)
- other specific components

1.9 service/check the aircraft pneumatic system, to include carrying out four of the following:

- checking the system for leaks
- replacing filters
- recharging desiccators
- checking and adjusting pressure regulator
- checking the indicating systems (such as pressure, temperature warning)

1.10 carry out three of the following tests on the aircraft pneumatic system:

- leak test
- pressure test
- system charging
- air line vapour tests
- reduced system test
- movement tests (such as range, timing, sequencing)
- built in test equipment (BITE) test
- 'special-to-type' tests

using one of the following:

- aircraft power source/pumps
- ground test rig

1.11 carry out maintenance on aircraft pneumatic system components in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Extended Range Twin-Engine Operations Procedures (ETOPS) (where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/approved change documentation (service bulletin)

1.12 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.13 complete the relevant maintenance records accurately and pass

them on to the appropriate person, to include one of the following:

- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.14 dispose of waste materials in accordance with safe working practices and approved procedures .

| **Learning outcome** |
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| The learner will:<br>2. Know how to maintain pneumatic systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>2.1 explain the specific safety practices and procedures that they need to observe when working on aircraft pneumatic systems<br>2.2 explain the need to check that cabin/cockpit switches, selectors and circuit breakers are in the correct position before applying any form of external power<br>2.3 explain the importance of maintenance on aircraft pneumatic systems, and impact upon ETOPS systems, Electrical Wiring Interconnect Systems (EWIS), legislation and local procedures<br>2.4 describe the hazards associated with carrying out maintenance activities on aircraft pneumatic systems, and with the tools and equipment used, and explain how to minimise them and reduce any risk<br>2.5 explain what protective equipment they need to use for both personal protection and protection of the aircraft<br>2.6 explain the importance of good aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft<br>2.7 explain how to extract and use information from aircraft manuals, log books, flight logs, charts, circuit and physical layouts, specifications, symbols used in aircraft pneumatic systems, and other documents in the maintenance activities<br>2.8 explain how to carry out currency/issue checks on the specifications they are working with<br>2.9 explain the terminology used in aircraft pneumatic systems, and the use of system diagrams and associated symbols<br>2.10 describe the various types of pipe and components that make up the aircraft pneumatic system<br>2.11 describe the basic principles of operation of the pneumatic system being worked on<br>2.12 explain the techniques used to remove components from aircraft pneumatic systems without damage to the components or surrounding structure<br>2.13 describe the various mechanical fasteners that will need to be removed and replaced, and explain their methods of removal and replacement<br>2.14 describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and |

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| | locking-in of the connections |
| 2.15 | explain how to recognise contaminants and the problems they can create; the effects and likely symptoms of contamination in the pneumatic system |
| 2.16 | explain the need to label and store correctly components that require repair or overhaul, and to check that replacement components have the correct part/identification markings and accompanying release documentation |
| 2.17 | explain how to fit components into the circuit |
| 2.18 | describe the tools and equipment used in the maintenance activities, and explain their calibration/care and control procedures |
| 2.19 | explain why tool/equipment control is critical, and what to do if a tool or piece of equipment is unaccounted for on completion of the activities |
| 2.20 | explain how to make adjustments to components/assemblies to ensure that they function correctly |
| 2.21 | explain why securing devices need to be tightened to the correct torque, locked and labelled, and the methods to be used |
| 2.22 | explain how to carry out routine checks and servicing of the aircraft pneumatic system |
| 2.23 | explain what types of test need to be carried out on the aircraft pneumatic system, and the test equipment to be used |
| 2.24 | explain the methods and procedures to be used to carry out the various tests on the pneumatic system |
| 2.25 | explain the need to apply test pressures in incremental stages, and to check all readings and pressures at each stage |
| 2.26 | explain how to record the results of each individual test, and the documentation that must be used |
| 2.27 | explain how to analyse the test results, and make valid decisions about the acceptability of the aircraft pneumatic system |
| 2.28 | explain the procedures to be followed if the equipment or system fails to meet the test specification |
| 2.29 | explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation |
| 2.30 | describe the procedure for the safe disposal of waste materials and scrap components |
| 2.31 | describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve |

# Unit 720 Maintaining pneumatic systems on aircraft

Supporting information

## Guidance

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

2.2 (such as electrical, hydraulic, air or vacuum)

2.4 (such as the safe release of pressurised systems, traps from moving parts, misuse of tools)

2.10 (such as rigid pipes; air hoses; pipe connectors; pipe sealing and supporting devices; valves used for pressure relief, flow and directional control; pumps; pressure intensifiers, mechanical and electrical control devices)

2.11 (such as system layout, sources of air pressure (such as engine, compressor, ground supply); the use of air reservoirs/tanks; pressure control and distribution; pressure indication and warning)

2.12 (such as release of pressures/force, removal of components and the need to protect the circuit integrity by ensuring that any exposed components or pipe ends are correctly covered/protected)

2.13 (such as threaded fasteners, special securing devices)

2.17 (such as the use of gaskets/seals and jointing/sealing compounds; ensuring the correct tightness of pipe fittings and pump connections; eliminating stress on pipework/connections; carrying out visual checks of all components; checking the security of joints and that the system is safe to re-pressurise)

2.20 (such as pressure settings and their effect on the system, travel and working clearance)

2.22 (including checking for leaks, checking and changing air filters, charging desiccators, checking and adjusting pressure regulator)

# Unit 721 Maintaining vacuum systems on aircraft

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| **UAN:** | **D/601/6221** |
| **Level:** | 3 |
| **Credit value:** | 86 |
| **GLH:** | 168 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 321: Maintaining Vacuum Systems on Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft vacuum systems, in accordance with the aircraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It covers both fixed wing and rotary winged aircraft, and covers the units and components used to generate, deliver and regulate negative air pressure, including pumps, regulators, lines, etc, through and including the manifold. The maintenance activities will include the removal, fitting and testing of a range of vacuum components. The learner will be expected to use the approved procedure for correctly isolating and bringing the system to atmospheric pressure before breaking into the system circuit. The learner will remove the required components and fit approved replacements, as appropriate. The learner will then need to pressurise the system and test and adjust the completed system to meet the aircraft maintenance manual, change documentation (service bulletin) and airworthiness requirements.<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the aircraft manual, change/service bulletin documentation and airworthiness requirements for the maintenance activities undertaken, and to report any problems with these activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The |

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

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to aircraft vacuum systems. The learner will understand the removal, fitting and testing methods and procedures, and their application, along with the vacuum system maintenance requirements. The learner will know how the equipment functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the equipment is maintained to the required standard.

The learner will understand the safety precautions required when working on aircraft vacuum systems, especially those for isolating and depressurising the equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

**Notes:** 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 37 Vacuum. 2. To display competence in this unit, it is necessary to both remove and fit aircraft vacuum system components. The learner must remove components; however, they may fit a replacement component where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| **Learning outcome** |
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| The learner will:<br>1. Be able to maintain vacuum systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>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 maintenance of the aircraft vacuum system:

- ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures
- obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)
- obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates
- adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
- ensure the safe isolation and return to atmospheric pressure before breaking into the system
- ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)
- use approved removal, fitting and testing techniques and procedures at all times
- leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from damage and foreign object debris
- return tools and equipment to the correct storage location on completion of the activities
- ensure that work carried out is correctly documented and recorded
- ensure that any outstanding tests are correctly documented

1.3 follow the relevant maintenance schedules to carry out the required work

1.4 carry out the maintenance activities within the limits of their personal authority

1.5 carry out maintenance on two of the following parts of the aircraft vacuum system:

- vacuum generation
- distribution
- indicating
- gauging

1.6 carry out the maintenance activities in the specified sequence and in an agreed timescale

1.7 carry out fifteen of the following maintenance activities:

- removing access panels and covers to expose components to be removed
- carrying out fault diagnosis and system checks
- preparing the system for maintenance (such as isolating, bringing to atmospheric pressure)
- disconnecting electrical connections
- removal of bonding

- disconnecting/removing hoses and pipes
- removing securing devices and mechanical fasteners
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing damaged/defective components
- replacing single use items such as seals, filters, gaskets
- refitting components in the correct position, orientation and alignment
- setting and adjusting replaced components (such as travel, working clearance)
- making mechanical connections
- making electrical connections
- carrying out bonding
- torque loading as required
- re-pressurising the system
- carrying out system functional checks
- ensuring that replacement components have the correct part numbers
- fitting blanks, labelling (and storing in the correct location) components that require repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)

1.8 remove and fit four different aircraft vacuum system components (at least one must be from group A):

group a:

- vacuum pump
- regulator valve
- standby pump
- manifold

group b:

- control valves
- check valve
- ground connector
- reducing valve
- pipes and hoses
- air filters
- sensors/transmitters
- venturi
- gauges/wiring/switches/plugs
- oil separator
- suction relief valve
- other specific components

1.9 service/check the aircraft vacuum system, to include carrying out all of the following:

- checking the system for leaks
- replacing filters
- recharging desiccators
- checking and adjusting the pressure regulator
- checking the indicating systems (such as pressure, temperature warning)

1.10 carry out three of the following tests on the aircraft vacuum system:

- leak test
- vacuum pressure test
- vacuum line vapour tests
- reduced system test
- movement tests (such as range, timing, sequencing)
- built in test equipment (BITE) test
- 'special-to-type' tests

using one of the following:

- aircraft power source/pumps
- ground test rig

1.11 carry out maintenance on aircraft vacuum system components in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Extended Range Twin-Engine Operations Procedures (ETOPS) (where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/approved change documentation (service bulletin)

1.12 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.13 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:

- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.14 dispose of waste materials in accordance with safe working practices and approved procedures

| **Learning outcome** |
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| The learner will:<br>2. Know how to maintain vacuum systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>2.1 explain the specific safety practices and procedures that they need to observe when working on aircraft vacuum systems |

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| 2.2 | explain the need to check that cabin/cockpit switches, selectors and circuit breakers are in the correct position before applying any form of external power |
| 2.3 | explain the importance of maintenance on aircraft vacuum systems, and impact upon ETOPS systems, Electrical Wiring Interconnect Systems (EWIS), legislation and local procedures |
| 2.4 | describe the hazards associated with carrying out maintenance activities on aircraft vacuum systems, and with the tools and equipment used, and explain how to minimise them and reduce any risk |
| 2.5 | explain what protective equipment they need to use for both personal protection and protection of the aircraft |
| 2.6 | explain the importance of good aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft |
| 2.7 | explain how to extract and use information from aircraft manuals, log books, flight logs, charts, circuit and physical layouts, specifications and other documents needed in the maintenance activities |
| 2.8 | explain how to carry out currency/issue checks on the specifications they are working with |
| 2.9 | explain the terminology used in aircraft vacuum systems, and the use of system diagrams and associated symbols |
| 2.10 | describe the various types of pipe and components that make up the aircraft vacuum system |
| 2.11 | describe the basic principles of operation of the vacuum system being worked on |
| 2.12 | explain the techniques used to remove components from aircraft vacuum systems without damage to the components or surrounding structure |
| 2.13 | describe the various mechanical fasteners to be removed and replaced, and explain their methods of removal and replacement |
| 2.14 | describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections |
| 2.15 | explain how to recognise contaminants and the problems they can create; the effects and likely symptoms of contamination in the vacuum system |
| 2.16 | explain the need to label and store correctly components that require repair or overhaul, and to check that replacement components have the correct part/identification markings and accompanying release documentation |
| 2.17 | explain how to fit components into the circuit |
| 2.18 | explain how to make adjustments to components/assemblies to ensure that they function correctly |
| 2.19 | explain why securing devices need to be tightened to the correct torque, locked and labelled, and the methods to be used |
| 2.20 | describe the tools and equipment used in the maintenance activities, and explain their calibration/care and control procedures |
| 2.21 | explain why tool/equipment control is critical, and what to do if a tool or piece of equipment is unaccounted for on completion of the activities |
| 2.22 | explain how to carry out routine checks and servicing of the aircraft |

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| | vacuum system |
| 2.23 | explain what types of test need to be carried out on the aircraft vacuum system, and the test equipment to be used |
| 2.24 | explain the methods and procedures to be used to carry out the various tests on the vacuum system |
| 2.25 | explain the need to apply test pressures in incremental stages, and to check all readings and pressures at each stage |
| 2.26 | explain how to record the results of each individual test, and the documentation that must be used |
| 2.27 | explain how to analyse the test results, and make valid decisions about the acceptability of the aircraft vacuum system |
| 2.28 | explain the procedures to be followed if the equipment or system fails to meet the test specification |
| 2.29 | explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation |
| 2.30 | describe the procedure for the safe disposal of waste materials and scrap components |
| 2.31 | describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve |

# Unit 721 Maintaining vacuum systems on aircraft

Supporting information

## Guidance

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

2.2 (such as electrical, hydraulic, air or vacuum)

2.4 (such as safely bringing the system to atmospheric pressure, traps from moving parts, misuse of tools)

2.10 (such as rigid pipes; hoses; pipe connectors; pipe sealing and supporting devices; valves used for pressure relief, flow and directional control; pumps; pressure intensifiers, mechanical and electrical control devices)

2.11 (such as system layout, sources of vacuum pressure (such as engine, compressor, ground supply); the use of vacuum reservoirs/tanks; pressure control and distribution; pressure indication and warning)

2.12 (such as bringing system up to atmospheric pressure; removal of components and the need to protect the circuit integrity by ensuring any exposed components or pipe ends are correctly covered/protected)

2.13 (such as threaded fasteners, special securing devices)

2.17 (such as the use of gaskets/seals and jointing/sealing compounds; ensuring the correct tightness of pipe fittings and pump connections; eliminating stress on pipework/connections; carrying out visual checks of all components; checking security of joints and that the system is safe to re-pressurise)

2.18 (such as pressure settings and their effect on the system, travel and working clearance)

2.22 (including checking for leaks, checking and changing air filters, charging desiccators, checking and adjusting pressure regulator)

# Unit 722 Maintaining water and waste systems on aircraft

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| **UAN:** | **T/601/6225** |
| **Level:** | 3 |
| **Credit value:** | 86 |
| **GLH:** | 168 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 322: Maintaining Water and Waste Systems on Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft water and waste systems, in accordance with the aircraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It covers both fixed wing and rotary winged aircraft, and covers the units and components which store and deliver for use, fresh water and those fixed components which store and provide a means of removing water and waste. The maintenance activities will include the removal, fitting and testing of a range of water and waste system components, such as wash basins, toilet assemblies, water and waste tanks, valves and pipes. The learner will be expected to use the approved procedure for correctly isolating the system before breaking into the system circuit. The learner will remove the required components and fit approved replacements, as appropriate. The learner will then need to test and adjust the completed system to meet the aircraft maintenance manual, change documentation (service bulletin) and airworthiness requirements.<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the aircraft manual, change/service bulletin documentation and airworthiness requirements for the maintenance activities undertaken, and to report any problems with these activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The |

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

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to aircraft water and waste systems. The learner will understand the removal, fitting and testing methods and procedures, and their application, along with the water and waste systems maintenance requirements. The learner will know how the equipment functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the equipment is maintained to the required standard.

The learner will understand the safety precautions required when working on aircraft water and waste systems, especially those involved with working on pressurised systems. 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.

**Notes:** 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 38 Water and Waste. 2. To display competence in this unit, it is necessary to both remove and fit aircraft water and waste system components. The learner must remove components; however, they may fit a replacement component where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| Learning outcome |
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| The learner will:<br>1. Be able to maintain water and waste systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the maintenance of the aircraft water and waste system:<br>• ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures<br>• obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)<br>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates<br>• 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<br>• ensure the system is safely isolated and depressurised and (where appropriate) drain off fluid before breaking into the system<br>• ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)<br>• use approved removal, fitting and testing techniques and procedures at all times<br>• leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from damage and foreign object debris<br>• return tools and equipment to the correct storage location on completion of the activities<br>• ensure that work carried out is correctly documented and recorded<br>• ensure that any outstanding tests are correctly documented<br>1.3 follow the relevant maintenance schedules to carry out the required work<br>1.4 carry out the maintenance activities within the limits of their personal authority<br>1.5 carry out maintenance on two of the following parts of the aircraft water and waste systems:<br>• potable<br>• wash<br>• waste disposal<br>• air supply<br>1.6 carry out the maintenance activities in the specified sequence and in an agreed timescale |

1.7 carry out fifteen of the following maintenance activities:

- removing access panels and covers to expose components to be remove
- carrying out fault diagnosis and system checks
- preparing the system for maintenance (such as isolating, draining)
- disconnecting electrical connections
- removal of bonding
- disconnecting/removing hoses and pipes
- removing mechanical fasteners and securing devices
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing damaged/defective components
- replacing single use items (such as seals, gaskets)
- refitting components in the correct position, orientation and alignment
- setting and adjusting replaced components
- making mechanical connections
- making electrical connections
- carrying out bonding
- torque loading
- carrying out system functional checks
- ensuring that replacement components have the correct part numbers
- fitting blanks, labelling (and storing in the correct location) components that require repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)

1.8 remove and fit four different aircraft water and waste system components (at least two must be from group A):

group a:

- water pump
- toilet pump
- valves
- water pressure regulator
- solenoids
- fresh water tanks
- waste water tanks
- toilet assemblies
- flushing systems
- water heaters
- electrical elements
- taps
- wash basins

group b:

- sensors/transmitters
- temperature probes
- water pipes and hoses
- wiring/switches/plugs
- water filters
- drains/traps
- portable toilet
- other specific components

1.9 service/check aircraft water and waste systems, to include carrying out all of the following:

- checking system for leaks
- replacing water filters
- checking and adjusting supply water pressure
- checking tank content indicating systems

1.10 carry out three of the following tests on the aircraft water and waste systems:

- leak test
- pressure test
- system charging
- reduced system test
- built in test equipment (BITE) test
- 'special-to-type' tests

using one of the following:

- aircraft power source/pumps
- ground test rig

1.11 carry out maintenance on aircraft water and waste system components in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Extended Range Twin-Engine Operations Procedures (ETOPS) (where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/approved change documentation (service bulletin)

1.12 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.13 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:

- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.14 dispose of waste materials in accordance with safe working practices and approved procedures

| Learning outcome |
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| The learner will:<br>2. Know how to maintain water and waste systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>2.1 explain the specific safety practices and procedures that they need to observe when working on aircraft water and waste systems<br>2.2 explain the importance of maintenance on aircraft waste and water systems, and impact upon ETOPS systems, Electrical Wiring Interconnect Systems (EWIS), legislation and local procedures<br>2.3 explain the need to check that cabin/cockpit switches, selectors and circuit breakers are in the correct position before applying any form of external power<br>2.4 describe the hazards associated with carrying out maintenance activities on aircraft water and waste systems, and with the tools and equipment used, and explain how to minimise them and reduce any risk<br>2.5 explain what protective equipment that they need to use for both personal protection and protection of the aircraft<br>2.6 explain the importance of good aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft<br>2.7 explain how to extract and use information from aircraft manuals, log books, flight logs, charts, circuit and physical layouts, specifications, symbols used in aircraft water and waste systems, and other documents needed in the maintenance activities<br>2.8 explain how to carry out currency/issue checks on the specifications they are working with<br>2.9 explain the terminology used in aircraft water and waste systems, and the use of system diagrams and associated symbols<br>2.10 describe the various types of pipe and components that make up the aircraft water and waste system<br>2.11 describe the basic principles of operation of the water and waste system being worked on, and the function of the various units that make up the system<br>2.12 explain the techniques used to remove components from aircraft water and waste systems without damage to the components or surrounding structure<br>2.13 describe the various mechanical fasteners to be removed and replaced, and their methods of removal and replacement<br>2.14 describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections<br>2.15 explain the need to label and store correctly components that require repair or overhaul, and to check that replacement components have the correct part/identification markings and accompanying release documentation<br>2.16 explain how to fit components into the system<br>2.17 explain how to make adjustments to components/assemblies to ensure that they function correctly<br>2.18 explain why securing devices need to be tightened to the correct |

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| | torque, locked and labelled, and the different methods that are used |
| 2.19 | explain how to carry out routine checks and servicing of the aircraft water and waste system |
| 2.20 | explain what types of test to be carried out on the aircraft water and waste system, and the test equipment to be used |
| 2.21 | explain the methods and procedures to be used to carry out the various tests on the water and waste system |
| 2.22 | explain the importance of carrying out the tests in the specified sequence, checking all readings and movements at each stage |
| 2.23 | explain how to record the results of each individual test, and the documentation that must be used |
| 2.24 | explain how to analyse the test results, and how to make valid decisions about the acceptability of the aircraft water and waste system |
| 2.25 | explain the procedures to be followed if the equipment or system fails to meet the test specification |
| 2.26 | explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation |
| 2.27 | describe the procedure for the safe disposal of waste materials and scrap components |
| 2.28 | describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve |

# Unit 722 Maintaining water and waste systems on aircraft

Supporting information

## Guidance

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

2.3 (such as electrical, hydraulic, air or vacuum)

2.10 (such as pipes; pumps; valves; water heaters; taps; toilet units; mechanical and electrical control devices)

2.12 (such as release of fluids, removal of components and the need to protect the circuit integrity by fitting blanking plugs and labelling exposed circuits)

2.13 (such as threaded fasteners, special securing devices)

2.16 (such as ensuring the correct tightness of fastenings, fittings and pump connections; eliminating stress on pipework/connections; correctly making electrical connections; carrying out visual checks of all components)

2.17 (such as flow settings, travel and working clearance)

2.19 (including checking for leaks, checking and changing filters)

# Unit 723 Maintaining cabin systems on aircraft

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| **UAN:** | **L/601/6232** |
| **Level:** | 3 |
| **Credit value:** | 86 |
| **GLH:** | 168 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 323: Maintaining Cabin Systems on Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft cabin systems, in accordance with the aircraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It includes units and components which provide a means of entertaining the passengers and providing communication within the aircraft. It also includes the means by which passengers and cabin crew can access communications equipment to exchange data and messages with other air or ground stations.<br>The maintenance activities will include the removal, fitting and testing of a range of cabin system components. The learner will be required to select the correct tools and equipment to use, based on the operations to be performed and the components to be removed or replaced. The cabin system will include units and components associated with in-flight entertainment systems, active noise control, passenger address, interphone, audio and video security monitoring, as applicable to the aircraft type. The learner will remove the required components and fit approved replacements, as appropriate. The learner will then need to test the completed system to meet the aircraft maintenance manual, change documentation (service bulletin) and airworthiness requirements.<br>The learner's responsibilities will require them to comply with the specific practices and |

procedures identified in the aircraft manual, change/service bulletin documentation and airworthiness requirements for the maintenance activities undertaken, and to report any problems with these activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner must ensure that all tools, equipment and materials used are correctly accounted for on completion of the activities, and that all necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to aircraft cabin systems. The learner will understand the removal, fitting and testing methods and procedures, and their application, along with the system maintenance requirements. The learner will know how the equipment functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the equipment is maintained to the required standard.

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

**Notes:** 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 44 Cabin Systems. 2. To display competence in this unit, it is necessary to both remove and fit aircraft cabin system components. The learner must remove components; however, they may fit a replacement component where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| Learning outcome |
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| The learner will:<br>1. Be able to maintain cabin systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the maintenance of the aircraft cabin system equipment:<br>• ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures<br>• obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)<br>• 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<br>• 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<br>• ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)<br>• where appropriate, apply electrostatic discharge (ESD) avoidance procedures<br>• use approved removal, fitting and testing techniques and procedures at all times<br>• leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from damage and foreign object debris<br>• return tools and equipment to the correct storage location on completion of the activities<br>• ensure that work carried out is correctly documented and recorded<br>• ensure that any outstanding tests are correctly documented<br>1.3 follow the relevant maintenance schedules to carry out the required work<br>1.4 carry out the maintenance activities within the limits of their personal authority<br>1.5 carry out maintenance on three of the following parts of the aircraft cabin systems:<br>• cabin core system (such as active noise control)<br>• in-flight entertainment (such as audio, video, information, games)<br>• external communication (such as access to telecommunications, telefaxes, modems AM/FM radio units)<br>• passenger address and interphone (such as internal communications) |

- cabin mass memory system (such as configuration data, multimedia programs)
- cabin monitoring (such as surveillance cameras, passenger conversation/movement)

1.6 carry out the maintenance activities in the specified sequence and in an agreed timescale

1.7 carry out fifteen of the following maintenance activities:

- removing access panels and covers to expose components to be removed
- carrying out fault diagnosis and system checks
- preparing the system for maintenance (such as isolating)
- disconnecting electrical connections
- removal of bonding
- removing cable securing devices
- removing securing devices and mechanical fasteners
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing damaged/defective components
- refitting components in the correct position, orientation and alignment
- making mechanical connections
- making electrical connections
- carrying out bonding
- installing cable securing devices
- torque loading as required
- carrying out functional checks of the system
- ensuring that replacement components have the correct part numbers
- labelling (and storing in the correct location) components that require repair or overhaul
- setting, and adjusting/tuning replaced components (such as power output)
- applying bolt locking methods (such as split pins, wire locking, lock nuts)

1.8 remove and fit four different cabin system components (at least two must be from group A):

group a:

- control units
- cabin control panels
- AM/FM radio units
- audio equipment
- video equipment
- telephones
- modems
- keyboards

- disc drives
- printers
- cameras
- monitors
- display panels

group b:

- batteries
- switches
- relays
- circuit breakers
- headsets
- handsets
- electronic signs
- loudspeakers
- instruments/gauges/indicators
- wires/cables
- plugs/sockets
- transformers

1.9 service/check aircraft cabin systems, to include carrying out three of the following:

- checking operation of interphone system
- checking operation of external communication system
- checking operation of passenger address system
- checking entertainment system
- checking active noise control system
- checking operation of audio and video monitoring system

1.10 carry out three of the following types of test/check on aircraft cabin systems:

- continuity check
- bonding tests
- power output
- BITE test
- distortion checks
- signal-to-noise checks
- 'special-to-type' tests

using two of the following:

- 'special to type' test equipment
- multimeter
- bonding tester
- headset
- aircraft power source
- external power source

1.11 carry out maintenance on aircraft cabin systems in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Extended Range Twin-Engine Operations Procedures (ETOPS)

(where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/approved change documentation (service bulletin)

1.12 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.13 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:
- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.14 dispose of waste materials in accordance with safe working practices and approved procedures

| **Learning outcome** |
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| The learner will:<br>2. Know how to maintain cabin systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>2.1 explain the specific safety practices and procedures that they need to observe when working with aircraft cabin systems<br>2.2 explain the importance of maintenance on aircraft cabin systems, and impact upon ETOPS systems, Electrical Wiring Interconnect Systems (EWIS), legislation and local procedures<br>2.3 describe the hazards associated with removing, fitting and testing aircraft cabin system components, and with the tools and equipment used, and explain how to minimise them and reduce any risk<br>2.4 explain what protective equipment they need to use for both personal protection and protection of the aircraft<br>2.5 explain the importance of aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft<br>2.6 explain how to extract and use information from aircraft manuals, log books, flight logs, charts, circuit and physical layouts, specifications, symbols used in aircraft cabin systems, and other documents needed in the maintenance process<br>2.7 explain how to carry out currency/issue checks on the specifications they are working with<br>2.8 explain the terminology used in aircraft cabin systems, and the use of system diagrams and associated symbols<br>2.9 describe the basic principles of operation of the cabin system being worked on, and the function of the various units that make up the system<br>2.10 describe the various mechanical fasteners that are used, and explain their methods of removal and replacement<br>2.11 explain the importance of using the specified fasteners for the |

installation, and why they must not substitute others

2.12 explain why securing devices need to be locked and labelled, and the different methods that are used to remove and install them

2.13 explain the torque loading requirements on the fasteners, and what to do if these loadings are exceeded or not achieved

2.14 describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections

2.15 explain the techniques used to remove components from aircraft cabin systems without damage to the components or surrounding structure

2.16 explain the importance of applying electrostatic discharge (ESD) avoidance procedures when working on sensitive equipment or devices

2.17 explain the need to label and store correctly components that require repair or overhaul, and to check that replaced components have the correct part/identification markings and accompanying release documentation

2.18 explain the techniques used to position, align, adjust and secure the replaced components to the aircraft without damage to the components or surrounding structure

2.19 explain the methods of lifting, handling and supporting the components/equipment during the maintenance activities

2.20 explain why electrical bonding is critical, and why it must be both mechanically and electrically secure

2.21 describe the tools and equipment used in the maintenance activities, and explain their calibration/care and control procedures

2.22 explain why tool/equipment control is critical, and what to do if a tool or piece of equipment is unaccounted for on completion of the activities

2.23 explain how to recognise defects

2.24 explain how to carry out routine checks and servicing of the aircraft cabin system equipment

2.25 explain the need to check that cabin/cockpit switches, selectors and circuit breakers are in the correct position before applying any form of external power

2.26 explain what types of test need to be carried out on the aircraft cabin systems, and the test equipment to be used

2.27 explain the methods and procedures to be used to carry out the various tests on the cabin systems

2.28 explain how to record the results of each individual test, and the documentation that must be used

2.29 explain how to analyse the test results, and how to make valid decisions about the acceptability of the cabin systems

2.30 explain the procedures to be followed if the equipment or system fails to meet the test specification

2.31 explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation

2.32 describe the procedure for the safe disposal of waste materials and scrap components

2.33 describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve

# Unit 723 Maintaining cabin systems on aircraft

Supporting information

## Guidance

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

2.10 (such as threaded fasteners, special securing devices)

2.15 (such as the need to protect the circuit integrity by covering and labelling exposed circuits)

2.23 (such as incorrectly seated plugs and sockets, ineffective fasteners, foreign object damage or contamination)

2.24 (including checking function of radios and passenger address system)

2.25 (such as electrical, hydraulic, air or vacuum)

# Unit 724 Maintaining airborne auxiliary power systems on aircraft

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| **UAN:** | **M/601/6238** |
| **Level:** | 3 |
| **Credit value:** | 86 |
| **GLH:** | 168 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 324: Maintaining Airborne Auxiliary Power Systems on Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft auxiliary power systems, in accordance with the aircraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It covers both fixed wing and rotary winged aircraft, and covers the units and components of airborne auxiliary power units which are installed on the aircraft for the purpose of supplying a single type or combination of auxiliary electric, hydraulic, pneumatic or other power. It includes the power and drive section, fuel, ignition and control systems, wiring, indicators, plumbing, valves and ducts up to the power unit. It does not include generators, alternators, hydraulic pumps or their connecting systems, which supply and deliver power to their respective aircraft systems, unless directly associated with the APU. The maintenance activities will include the removal, fitting and testing of a range of airborne auxiliary power system components. The learner will remove the required components and fit approved replacements, as appropriate. The learner will then need to test and adjust the completed system to meet the aircraft maintenance manual, change documentation (service bulletin) and airworthiness requirements.<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the aircraft manual, change/service bulletin documentation and |

airworthiness requirements for the maintenance activities undertaken, and to report any problems with these activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner must ensure that all tools, equipment and materials used are correctly accounted for on completion of the activities, and that all necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to aircraft airborne auxiliary power systems. The learner will understand the component removal, fitting and testing methods and procedures, and their application, along with the auxiliary power systems maintenance requirements. The learner will know how the equipment functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the airborne auxiliary power system is maintained to the required standard.

The learner will understand the safety precautions required when working on the airborne auxiliary power system, especially those for ensuring that the power system, and its fuel supply, is safely and correctly isolated. 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.

**Notes:** 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 49 Airborne Auxiliary Power. 2. To display competence in this unit, it is necessary to both remove and fit airborne auxiliary power system components. The learner must remove components; however, they may fit a replacement component where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| Learning outcome |
| --- |
| The learner will:<br>1. Be able to maintain airborne auxiliary power systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the maintenance of the aircraft airborne auxiliary power system:<br>• ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures<br>• obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)<br>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates<br>• 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<br>• ensure the safe isolation and draining of fluid lines before breaking into the system<br>• ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)<br>• use approved removal, fitting and testing techniques and procedures at all times<br>• leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from fluid spillages, damage and foreign object debris<br>• return tools and equipment to the correct storage location on completion of the activities<br>• ensure that work carried out is correctly documented and recorded<br>• ensure that any outstanding tests are correctly documented<br>1.3 follow the relevant maintenance schedules to carry out the required work<br>1.4 carry out the maintenance activities within the limits of their personal authority<br>1.5 carry out maintenance on three of the following parts of the aircraft auxiliary power system:<br>• cowling/containment<br>• power plant<br>• engine<br>• fuel and control<br>• fire detection<br>• starting and ignition |

- exhaust
- oil system
- engine controls
- indicating
- bleed air system
- APU hydraulic system
- APU generating system and wiring

1.6 carry out the maintenance activities in the specified sequence and in an agreed timescale

1.7 carry out fifteen of the following maintenance activities:

- removing the cowling and containment covers to expose components to be removed
- carrying out fault diagnosis and system checks
- preparing the system for maintenance (such as isolating, draining fluids)
- disconnecting electrical connections
- removal of bonding
- disconnecting/removing hoses and pipes
- removing securing devices and mechanical fasteners
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing damaged/defective components
- replacing single use items such as seals, filters, gaskets
- refitting components in the correct position, orientation and alignment
- setting and adjusting replaced components (such as travel, working clearance)
- making mechanical connections
- making electrical connections
- carrying out bonding
- torque loading as required
- replenishing fluid systems
- carrying out system functional checks
- ensuring that replacement components have the correct part numbers
- fitting blanks, labelling (and storing in the correct location) components that require repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)

1.8 remove and fit four different aircraft auxiliary power system components (at least two must be from group A):

group a:

- air Intake
- exhaust unit
- exciter ignition unit

- coolers (air, oil, fuel)
- starter motor
- engine control units
- starter clutch assembly
- cooling fan
- heat exchangers (oil, fuel)
- pumps (fuel, oil)
- fuel manifolds
- fuel control unit
- fuel flow divider
- fuel metering units
- fuel nozzle
- ignition unit
- hydraulic pump
- valves/valve mechanisms
- actuators
- torque converters
- thermocouple
- tacho generator/speed sensor
- data modules
- electronic control boxes
- fire seals and shrouds
- generator

group b:

- cowling/containment covers
- engine mounts
- vibration dampers
- battery
- rod assemblies/levers and linkages
- damper/connector arm
- tube assemblies
- attachment bolts
- seals
- igniters
- filters (fuel, oil, air)
- sensors
- pressure switches
- magnetic chip detectors
- cables
- pipes and hoses
- thermostat
- relays
- cable harness/wiring/switches/plugs
- indicators and warning devices
- solenoids

- fire detection units
- fire wire
- transducers
- fire bottle
- other specific components

1.9 service/check aircraft airborne auxiliary power systems, to include carrying out five of the following:

- visually checking the system for damage and leaks
- inspecting hot section
- inspecting magnetic chip indicators
- changing filters (fuel, oil, air)
- visually checking cable harnesses, pipe work and fittings for correct gaps/clearances and signs of chafing
- checking power take-off shaft(s) for correct connection and alignment
- visually inspect APU bay for condition and damage
- checking exhaust components for security of attachment
- checking heat shields for damage and security
- checking indicating and warning systems
- replacing the battery
- servicing and replenishing the oil system
- inspecting the intake door system

1.10 carry out three of the following tests on the aircraft auxiliary power system:

- checking that ground start mechanisms operate correctly
- checking aux/APU battery condition prior to APU start up
- checking that the APU cuts out at correct time (emergency shut down)
- fuel flow is operating correctly
- engine pressure ratios are within specification
- engine temperature is within specification
- the bleed air system functions correctly
- hydraulic pressures are attained
- electrical generation equipment functions correctly
- normal operating RPM is achieved and maintained under load
- fire detection and protection equipment is functioning

1.11 carry out maintenance on aircraft airborne auxiliary power systems in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Extended Range Twin-Engine Operations Procedures (ETOPS) (where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/approved change documentation (service bulletin)

1.12 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned

schedule

1.13 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:
- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.14 dispose of waste materials in accordance with safe working practices and approved procedures

**Learning outcome**

The learner will:

2. Know how to maintain airborne auxiliary power systems on aircraft

**Assessment criteria**

The learner can:

2.1 explain the specific safety practices and procedures that they need to observe when working on aircraft airborne auxiliary power systems

2.2 explain the need to check that cabin/cockpit switches, selectors and circuit breakers are in the correct position before applying any form of external power

2.3 explain the importance of maintenance on aircraft auxiliary power systems, and impact upon ETOPS systems, Electrical Wiring Interconnect Systems (EWIS), legislation and local procedures

2.4 describe the hazards associated with carrying out maintenance activities on aircraft airborne auxiliary power systems, and with the tools and equipment used, and explain how to minimise them and reduce any risk

2.5 explain what protective equipment they need to use for both personal protection and protection of the aircraft

2.6 explain the importance of good aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft

2.7 explain how to extract and use information from aircraft manuals, log books, flight logs, charts, system and physical layouts, specifications, symbols used in aircraft auxiliary power unit systems, and other documents needed in the maintenance activities

2.8 explain how to carry out currency/issue checks on the specifications they are working with

2.9 explain the terminology used in aircraft airborne auxiliary power systems, and the use of system diagrams and associated symbols

2.10 describe the basic principles of operation of the airborne auxiliary power system being worked on, and the function of the units that make up the system

2.11 explain the techniques used to remove components from aircraft auxiliary power system without damage to the components or surrounding structure

2.12 describe the various mechanical fasteners that will need to be removed and replaced, and their methods of removal and

replacement

2.13 describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections

2.14 explain the need to label and store correctly components that require repair or overhaul, and to check that replacement components have the correct part/identification markings and accompanying release documentation

2.15 explain how to fit auxiliary power unit components safely and correctly

2.16 explain how to make adjustments to components/assemblies to ensure that they function correctly

2.17 explain why securing devices need to be tightened to the correct torque, locked and labelled, and the methods to be used

2.18 describe the tools and equipment used in the maintenance activities, and explain their calibration/care and control procedures

2.19 explain why tool/equipment control is critical, and what to do if a tool or piece of equipment is unaccounted for on completion of the activities

2.20 explain how to carry out routine checks and servicing of the aircraft auxiliary power system

2.21 explain what types of test need to be carried out on the aircraft auxiliary power system, and the test equipment to be used

2.22 explain the methods and procedures to be used to carry out the various tests on the auxiliary power system

2.23 explain the importance of carrying out the tests in the specified sequence, checking all readings and movements at each stage

2.24 explain how to record the results of each individual test, and the documentation that must be used

2.25 explain how to analyse the test results, and how to make valid decisions about the acceptability of the aircraft auxiliary power system

2.26 explain the procedures to be followed if the equipment or system fails to meet the test specification

2.27 explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation

2.28 describe the procedure for the safe disposal of waste materials, scrap components and fuel/fluids

2.29 describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve

# Unit 724 Maintaining airborne auxiliary power systems on aircraft

Supporting information

## Guidance

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

2.2 (such as electrical, hydraulic, air or vacuum)

2.4 (such as handling oils, aviation fuel, the safe release of fuel and other fluids, traps from moving parts, hot parts of engines, misuse of tools)

2.10 (such as power plant, starting and ignition, fuel and control, oil, exhaust, engine control, indicating)

2.11 (such as release of pressures/force, draining of fuel/fluids, removal of components, and the need to protect the system integrity by fitting blanking plugs and ensuring exposed components are correctly covered/protected)

2.12 (such as threaded fasteners, special securing devices)

2.15 (such as use of lifting and handling equipment; ensuring the correct tightness of connections; eliminating stress on pipework/connections; carrying out visual checks of all components)

2.16 (such as travel and working clearance)

# Unit 725 Maintaining cargo and accessory compartments on aircraft

| | |
|---|---|
| **UAN:** | **L/601/6246** |
| **Level:** | 3 |
| **Credit value:** | 55 |
| **GLH:** | 133 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 325: Maintaining Cargo and Accessory Compartments on Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft cargo and accessory compartments, in accordance with the aircraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It covers both fixed wing and rotary winged aircraft, and includes equipment mounted on the aircraft and/or contained in the cargo and accessory compartments. The maintenance activities will include the removal, fitting and, where appropriate, testing of a range of equipment. The learner will be required to select the correct tools and equipment to use, based on the operations to be performed and the equipment to be removed or fitted. The aircraft equipment will include cargo/baggage handling equipment, cargo restraints, sound and heat insulation, removable and fixed cabinets, fire suppressant equipment and other similar equipment. The learner will remove the required components and fit approved replacements, as appropriate. The learner will then need to check and adjust the equipment to meet the aircraft maintenance manual, change documentation (service bulletin) and airworthiness requirements.<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the aircraft manual, change/service bulletin documentation and airworthiness requirements for the maintenance activities undertaken, and to report any |

problems with these activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner must ensure that all tools, equipment and materials used are correctly accounted for on completion of the activities, and that all necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to aircraft cargo and accessory compartments and equipment. The learner will understand the removal, fitting and testing/checking methods and procedures, and their application, along with the equipments maintenance requirements. The learner will know how the equipment functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the equipment is maintained to the required standard.

The learner will understand the safety precautions required when working on the aircraft cargo and accessory compartment equipment, and when using the associated tools and equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

**Notes:** 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 50 Cargo and Accessory Compartments. 2. To display competence in this unit, it is necessary to both remove and fit aircraft cargo and accessory compartment equipment/components. The learner must remove equipment/components; however, they may fit replacement equipment/components where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| Learning outcome |
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| The learner will:<br>1. Be able to maintain cargo and accessory compartments on aircraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the maintenance of the aircraft cargo and accessory compartments:<br>• ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures<br>• obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)<br>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates<br>• 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<br>• ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)<br>• use approved removal, fitting and testing techniques and procedures at all times<br>• leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from damage and foreign object debris<br>• return tools and equipment to the correct storage location on completion of the activities<br>• ensure that work carried out is correctly documented and recorded<br>• ensure that any outstanding tests are correctly documented<br>1.3 follow the relevant maintenance schedules to carry out the required work<br>1.4 carry out the maintenance activities within the limits of their personal authority<br>1.5 carry out maintenance on three of the following parts of aircraft cargo and accessory compartments:<br>• cargo compartments<br>• accessory compartments<br>• cargo loading system<br>• cargo related systems<br>• insulation barriers<br>1.6 carry out the maintenance activities in the specified sequence and in an agreed timescale<br>1.7 remove and fit four different aircraft cargo and accessory compartment equipment/components: |

- removable and fixed cabinets
- cargo/baggage handling rollers/drive equipment
- cargo restraint equipment
- sound proofing
- pallet locking system
- panels and fairings
- blow-out panels
- cargo restraint nets
- insulation materials
- liner replacement
- Kevlar/armour plating
- fire equipment
- galley equipment
- other specific components

1.8 carry out fifteen of the following maintenance activities:

- removing access panels and covers to expose components/fastenings to be removed
- carrying out fault diagnosis and system checks
- preparing the equipment for maintenance (such as isolating)
- disconnecting electrical connections
- removing securing devices and mechanical fasteners
- removal of bonding
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- carrying out any required structural repairs
- replacing damaged/defective components
- refitting components in the correct position, orientation and alignment
- positioning and aligning replaced equipment
- making mechanical connections
- making electrical connections
- carrying out bonding
- torque loading as required
- carrying out equipment functional checks
- ensuring that replacement equipment is of the correct type (have the correct part numbers)
- labelling (and storing in the correct location) equipment that requires repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)

1.9 service/check aircraft cargo and accessory compartments, to include carrying out four of the following:

- checking the associated structure for integrity
- checking for evidence of leakage or spills

- function check of cargo loading/movement system (such as rollers/drive equipment, locking mechanisms)
- function check of cargo restraint system (such as restraint nets, baggage restraints)
- examining panel systems for damage
- examining insulation systems for damage
- examining seating/stretcher equipment for security and damage
- checking emergency equipment (axe/cutters, etc)
- security and condition of panels and fairings
- security and condition of galley equipment
- security and condition of fixed cabinets
- checking placard and marking load requirements
- checking lighting systems
- fire and smoke detection and extinguishing systems
- compartment sealing requirements to smother potential fire sources

1.10 carry out maintenance on aircraft cargo and accessory compartments in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Extended Range Twin-Engine Operations Procedures (ETOPS) (where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/approved change documentation (service bulletin)

1.11 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.12 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:

- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.13 dispose of waste materials in accordance with safe working practices and approved procedures

| **Learning outcome** |
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| The learner will:<br>2. Know how to maintain cargo and accessory compartments on aircraft |
| **Assessment criteria** |
| The learner can:<br>2.1 explain the specific safety practices and procedures that they need to observe when carrying out maintenance activities on aircraft cargo and accessory compartments<br>2.2 explain the importance of maintenance on aircraft cargo and |

accessory compartments, and impact upon ETOPS systems, legislation and local procedures

2.3 describe the hazards associated with removing and fitting aircraft cargo and accessory compartment equipment and components, and with the tools and equipment used, and explain how to minimise them and reduce any risk

2.4 explain what protective equipment they need to use for both personal protection and protection of the aircraft

2.5 explain the importance of good aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft

2.6 explain how to extract and use information from aircraft manuals, log books, flight logs, and other documents needed in the maintenance process

2.7 explain how to carry out currency/issue checks on the specifications they are working with

2.8 describe the range of cargo and accessory compartment equipment that may need to be maintained/replaced

2.9 describe the various mechanical fasteners that are used to hold the equipment in place, and explain their methods of removal and replacement

2.10 explain the importance of using the specified fasteners for the particular installation, and why they must not substitute others

2.11 explain why securing devices need to be locked and labelled, and the different methods that are used to remove and install them

2.12 explain the torque loading requirements on the fasteners, and what to do if these loadings are exceeded or not achieved

2.13 describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections

2.14 explain the need to take care when removing equipment so as not to cause damage to the equipment or surrounding structure

2.15 explain the need to label and store correctly components that require repair or overhaul, and to check that replaced components have the correct part/identification markings and accompanying release documentation

2.16 explain the need to position, align, adjust and secure correctly the replaced equipment in the aircraft, without damage to the components or surrounding structure

2.17 explain the methods of lifting, handling and supporting the components/equipment during the maintenance activities

2.18 explain why electrical bonding is critical, and why it must be both mechanically and electrically secure

2.19 explain how to carry out routine checks of the aircraft cargo and accessory compartments

2.20 explain why tool/equipment control is critical, and what to do if a tool or piece of equipment is unaccounted for on completion of the activities

2.21 describe the problems that can occur with the maintenance operations, and explain how these can be overcome

2.22 explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the

| | |
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| | documentation |
| 2.23 | describe the procedure for the safe disposal of waste materials and scrap components |
| 2.24 | describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve |

# Unit 725 Maintaining cargo and accessory compartments on aircraft

Supporting information

## Guidance

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

2.9 (such as threaded fasteners, special securing devices)

2.19 (such as checking the condition and security of cargo restraint equipment)

# Unit 726 Maintaining doors on aircraft

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|---|---|
| **UAN:** | **K/601/6254** |
| **Level:** | 3 |
| **Credit value:** | 86 |
| **GLH:** | 168 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 326: Maintaining Doors on Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft doors, in accordance with the approved aircraft maintenance manual, structural repair manual, approved change documentation (service bulletin) and airworthiness requirements. It covers both fixed wing and rotary winged aircraft, and includes those removable units used for entrance or exit, and for enclosing other structure contained within the fuselage. The maintenance activities will include the removal, fitting and, where appropriate, testing of a range of doors/door equipment, and making repairs to primary and secondary airframe/door structures, as appropriate to the aircraft type.<br>The learner will be required to select the correct tools and equipment to use, based on the operations to be performed and the door equipment to be removed or fitted. The aircraft doors will include those used for entrance and exit of passenger and crew to and from the aircraft, emergency exits that are not normally used and are there to facilitate evacuation of the aircraft, exterior doors used to gain access to cargo compartments and for servicing of the aircraft, interior doors inside the fuselage installed in fixed partitions, stairs which operate with but are not an integral part of entrance doors. It also includes the electrical and hydraulic systems associated with door control and warning systems. The learner will remove the required door components and fit approved replacements, as appropriate. The learner will then need to test and adjust the completed system to meet the aircraft maintenance manual, structural repair manual, change |

documentation (service bulletin) and airworthiness requirements.

The learner's responsibilities will require them to comply with the specific practices and procedures identified in the aircraft manual, structural repair manual, change/service bulletin documentation and airworthiness requirements for the maintenance activities undertaken, and to report any problems with these requirements 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 are correctly accounted for on completion of the activities, and that all necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to aircraft doors and door equipment. The learner will understand the removal, fitting and testing/checking methods and procedures, and their application, along with the equipment maintenance requirements. The learner will know how the door equipment functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the aircraft doors are maintained to the required standard.

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

**Notes:** 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 52 Doors. 2. To display competence in this unit, it is necessary to both remove and fit aircraft door equipment. The learner must remove the door components; however, they may fit replacement components where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe

condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| **Learning outcome** |
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| The learner will:<br>1. Be able to maintain doors on aircraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the maintenance of the aircraft doors:<br>• ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures<br>• obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)<br>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates<br>• 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<br>• ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)<br>• use approved removal, fitting and testing techniques and procedures at all times<br>• leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from damage and foreign object debris<br>• return tools and equipment to the correct storage location on completion of the activities<br>• ensure that work carried out is correctly documented and recorded<br>• ensure that any outstanding tests are correctly documented<br>1.3 follow the relevant maintenance schedules to carry out the required work<br>1.4 carry out the maintenance activities within the limits of their personal authority<br>1.5 carry out maintenance on three of the following aircraft doors/door equipment:<br>• passenger<br>• crew<br>• cargo/baggage<br>• emergency exit<br>• tail cone<br>• landing gear<br>• service<br>• galley |

- accessory compartment
- auxiliary power unit (APU) doors
- entrance stairs
- fixed interior doors
- door warning equipment
- door wiring
- escape equipment
- door arming equipment
- power plant doors
- teleflex

1.6 undertake three of the following structural repair activities:

- insertion repair
- primary structure repair
- secondary structure repair
- tertiary structure repair
- damage assessment and evaluation
- overlay patch repair
- composite repair
- blend repair
- reworking of aluminium structures and limitations forming
- NDT inspection requirements (post damage removal)

1.7 carry out the maintenance activities in the specified sequence and in an agreed timescale

1.8 Use six of the following during the structural repair activities:

- marking out airframe materials
- making holes in airframe materials
- cutting/shaping airframe materials
- bending and forming materials
- drilling extremities of cracks
- profiling
- countersinking
- deburring
- riveting
- securing and locking components
- using adhesives and sealants
- anti-corrosive treatment
- blending out permissible damage to structural components

1.9 carry out fifteen of the following maintenance activities:

- removing/refitting linings and covers to expose components/fastenings to be removed
- carrying out fault diagnosis and system checks
- carrying out safety checks and isolation on automatic systems prior to the commencement of maintenance activities
- preparing the equipment for maintenance (such as isolating, disarming escape systems, pressure relief and automatic systems disconnections)
- disconnecting electrical connections

- removing securing devices and mechanical fasteners
- removal of bonding
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing damaged/defective components
- refitting components in the correct position, orientation and alignment
- positioning and aligning replaced equipment
- setting and adjusting replaced components
- replacing seals and sealants
- making mechanical connections
- making electrical connections
- carrying out bonding
- torque loading as required
- re connecting/rearming escape systems
- carrying out equipment functional checks
- removal and refitting of door dams (ditching requirements on some aircraft)
- ensuring that replacement equipment is of the correct type (has the correct part numbers)
- labelling (and storing in the correct location) equipment that requires repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)
- carrying out area inspections prior to task close down

1.10 remove and fit six different aircraft door equipment components (at least three must be from group A):

group a:

- door structure
- door seals
- handle assembly
- lock assembly
- integral steps
- gearbox
- damper
- counter balance
- escape slide
- door mounted life rafts
- ramps
- lining
- cargo door jack
- controls
- electric power lift unit
- actuating mechanisms (such as linear, rotary)

- pneumatic cylinder
- hydraulic cylinder
- latching mechanisms and interlocks
- pressure relief doors and gates
- torque tubes (aircraft and door)
- door abutments

group b:

- insulation
- trim
- handles
- brackets
- door hinges
- levers/linkages
- door snubber/damper
- hand rails
- switches
- sensors
- interlock
- push rods
- attached fittings
- security locking devices
- warning devices (such as lights, bells horns)
- cable harness/wiring/switches/plugs sensors
- viewing devices
- other specific components

1.11 service/check aircraft doors to include carrying out four of the following:

- checking door seals for damage
- checking handles for correct operation
- checking latching mechanisms for correct operation
- rigging/adjusting the locking mechanism
- adjusting air stair system
- checking operation of emergency exits
- checking door assemblies for deterioration, de-lamination, wear (mechanical or otherwise)
- checking critical fastenings for security
- lubricating door mechanisms
- checking and adjustment of door abutments
- checking of water drains
- testing door warning system
- check dents and scratches on door skin/structure against manufacturer's tolerances

1.12 carry out maintenance on aircraft doors in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Extended Range Twin-Engine Operations Procedures (ETOPS)

(where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/structural repair manual/approved change documentation (service bulletin)

1.13 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.14 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:
- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.15 dispose of waste materials in accordance with safe working practices and approved procedures

**Learning outcome**

The learner will:

2. Know how to maintain doors on aircraft

**Assessment criteria**

The learner can:

2.1 explain the specific safety practices and procedures that they need to observe when carrying out maintenance activities on aircraft doors

2.2 explain the importance of maintenance on aircraft doors, and impact upon ETOPS systems, legislation and local procedures

2.3 describe the hazards associated with removing and fitting aircraft doors and door components, and with the tools and equipment used, and explain how to minimise them and reduce any risk

2.4 explain what protective equipment they need to use for both personal protection and protection of the aircraft

2.5 explain the importance of good aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft

2.6 explain how to extract and use information from aircraft manuals, log books, flight logs, and other documents needed in the maintenance process

2.7 explain how to carry out currency/issue checks on the specifications they are working with

2.8 describe the range of door equipment and components that may need to be maintained/replaced/repaired

2.9 explain what preparations need to be undertaken on the door structure, prior to maintenance/repair

2.10 explain the interconnection between door systems and other emergency equipment

2.11 explain the repair methods and procedures to be used, and the importance of adhering to these procedures

2.12 explain the application of sealants and adhesives within the repair

activities, and the precautions that must be taken when working with them

2.13 explain how to conduct any necessary checks to ensure the accuracy and quality of the repair

2.14 explain how to recognise defects

2.15 describe the various mechanical fasteners that are used to hold the equipment in place, and explain their methods of removal and replacement

2.16 explain the importance of using the specified fasteners for the particular installation, and why they must not substitute others

2.17 explain why securing devices need to be locked and labelled, and the different methods that are used to remove and install them

2.18 explain the torque loading requirements on the fasteners, and what to do if these loadings are exceeded or not achieved

2.19 describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections

2.20 explain the need to take care when removing doors, door equipment and furnishings so as not to cause damage to the equipment or surrounding structure

2.21 explain the need to label and store correctly components that require repair or overhaul, and to check that replaced components have the correct part/identification markings and accompanying release documentation

2.22 explain the need to position, align, adjust and secure correctly the replaced door equipment on the aircraft, without damage to the components or surrounding structure

2.23 explain the methods of lifting, handling and supporting the components/equipment during the removal and fitting activities

2.24 explain why electrical bonding is critical, and why it must be both mechanically and electrically secure

2.25 explain how to carry out routine checks of the aircraft doors and door equipment

2.26 explain why tool/equipment control is critical, and what to do if a tool or piece of equipment is unaccounted for on completion of the activities

2.27 describe the problems that can occur with the maintenance operations, and explain how these can be overcome

2.28 explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation

2.29 describe the procedure for the safe disposal of waste materials and scrap components

2.30 describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve

## Guidance

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

2.9 (including disarming of escape slides and door rafts)

2.10 (slides, rafts and door dams for ditching)

2.14 (such as skin blemishes, poor skin lines, ineffective fasteners, foreign object damage)

2.15 (such as threaded fasteners, special securing devices)

2.25 (such as checking the condition of door seals, checking correct operation of air stairs and emergency exits, checking door warning devices)

# Unit 727 Maintaining fuselage, nacelles and pylons on aircraft

| | |
|---|---|
| **UAN:** | **J/601/6259** |
| **Level:** | 3 |
| **Credit value:** | 71 |
| **GLH:** | 147 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 327: Maintaining Fuselage, Nacelles and Pylons on Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft fuselage, nacelles and pylons, in accordance with the approved aircraft maintenance manual, structural repair manual, approved change documentation (service bulletin) and airworthiness requirements. It covers both fixed wing and rotary winged aircraft, and includes structural units and associated components which make up the compartments for equipment, passengers, crew and cargo/baggage, and structural units and associated components which provide a means of mounting and housing the power plant or rotor assembly. The maintenance activities will include the removal, fitting and, where appropriate, testing of a range of fuselage components. The learner will be required to select the correct tools and equipment to use, based on the operations to be performed and the components to be removed or fitted. The fuselage maintenance activities will include removing the required components, fitting approved replacements, and making repairs to primary and secondary airframe structures, as appropriate to the aircraft type.<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the aircraft manual, structural repair manual, change/service bulletin documentation and airworthiness requirements for the maintenance activities undertaken, and to report any problems with these requirements |

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 are correctly accounted for on completion of the activities, and that all necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to the aircraft fuselage, nacelles and pylons. The learner will understand the removal, refitting and repair methods and procedures, and their application, along with the fuselage maintenance requirements. The learner will know the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the fuselage, nacelles and pylons are maintained to the required standard.

The learner will understand the safety precautions required when working on the aircraft fuselage, nacelles and pylons, and when using the associated tools and equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

**Notes:** 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 53 Fuselage and Chapter 54 Nacelles/Pylons. 2. To display competence in this unit, it is necessary to both remove and fit fuselage and nacelles/pylon components. The learner must remove fuselage and/or nacelles/pylon components; however, they may fit replacement components where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| Learning outcome |
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| The learner will:<br>1. Be able to maintain fuselage, nacelles and pylons on aircraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the maintenance of the aircraft fuselage, nacelles and pylons:<br>• ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures<br>• obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)<br>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates<br>• 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<br>• ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)<br>• use approved removal, fitting and repair techniques and procedures at all times<br>• leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from damage and foreign object debris<br>• return tools and equipment to the correct storage location on completion of the activities<br>• ensure that work carried out is correctly documented and recorded<br>• ensure that any outstanding tests are correctly documented<br>1.3 follow the relevant maintenance schedules to carry out the required work<br>1.4 carry out the maintenance activities within the limits of their personal authority<br>1.5 carry out maintenance/repairs on three of the following areas of the aircraft fuselage:<br>• fuselage sections<br>• skins<br>• floor beams<br>• floor<br>• stringers<br>• fin<br>• nose<br>• tail |

- tail cone
- cockpit/cabin
- pressure dome
- scuppers
- hatches
- bulkheads
- mission consoles
- engine nacelle
- pylons
- box sections
- avionics cabinets
- drains

1.6 undertake three of the following structural repair activities:

- insertion repair
- primary structure repair
- secondary structure repair
- tertiary structure repair
- damage assessment and evaluation
- overlay patch repair
- composite repair
- blend repair
- reworking of aluminium structures and limitations forming
- NDT inspection requirements (post damage removal)

1.7 carry out the maintenance activities in the specified sequence and in an agreed timescale

1.8 Use six of the following during the structural repair activities:

- marking out airframe materials
- making holes in airframe materials
- cutting/shaping airframe materials
- bending and forming materials
- drilling the extremities of cracks
- profiling
- countersinking
- deburring
- riveting
- securing and locking components
- using adhesives and sealants
- anti-corrosive treatment
- blending out permissible damage to structural components

1.9 carry out fifteen of the following maintenance activities:

- removing access panels and covers to expose components/fastenings to be removed
- preparing the fuselage for the maintenance/repair activities (such as isolating, depressurising/draining systems that need disconnecting)
- disconnecting electrical connections

- removal of bonding
- removing securing devices and mechanical fasteners
- disconnecting/removing hoses and pipes
- supporting components to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- fitting securing devices and mechanical fasteners
- replacing damaged/defective components
- ensuring the correct specification of replacement material
- refitting components in the correct position, orientation and alignment
- positioning and aligning replaced equipment
- setting and adjusting replaced components
- making mechanical connections
- making electrical connections
- carrying out bonding
- torque loading as required
- ensuring that replacement equipment is of the correct type (have the correct part numbers)
- labelling (and storing in the correct location) components that requires repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)
- carrying out area inspections prior to task close down

1.10 check aircraft fuselage components, to include carrying out three of the following:

- checking structural components for signs of corrosion
- checking components for fatigue cracks
- checking for lightning strike damage
- checking critical fastenings for security
- checking hoses and looms for security and chafing
- checking surface protection (such as paint finish, polish)
- checking for de-bonding of aircraft structure
- checking for oil canning
- checking dents, scratches/scoring on skin/structure against manufacturers tolerances
- checking aircraft structure for distortion (panting, quilting, etc)
- checking components for wear (mechanical or otherwise) or damage
- checking for illegal repairs
- checking RVSM requirements
- carrying out symmetry and rigging checks

1.11 carry out maintenance/repairs on aircraft fuselage components in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)

- Extended Range Twin-Engine Operations Procedures (ETOPS) (where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/structural repair manual/approved change documentation (service bulletin)

1.12 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.13 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:

- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.14 dispose of waste materials in accordance with safe working practices and approved procedures.

**Learning outcome**

The learner will:

2. Know how to maintain fuselage, nacelles and pylons on aircraft

**Assessment criteria**

The learner can:

2.1 explain the specific safety practices and procedures that they need to observe when carrying out maintenance activities on the aircraft fuselage and nacelles/pylons

2.2 explain the importance of maintenance on aircraft fuselage systems, and impact upon ETOPS systems, legislation and local procedures

2.3 describe the hazards associated with repairing airframes, removing and fitting aircraft fuselage components, and with the tools and equipment used, and explain how to minimise them and reduce any risk

2.4 explain what protective equipment they need to use for both personal protection and protection of the aircraft

2.5 explain the importance of good aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft

2.6 explain how to extract and use information from aircraft manuals, log books, flight logs, and other documents needed in the maintenance process

2.7 explain how to carry out currency/issue checks on the specifications they are working with

2.8 explain what preparations need to be undertaken on the fuselage or nacelles/pylons, prior to repair

2.9 explain the repair methods and procedures to be used, and the importance of adhering to these procedures

2.10 describe the various mechanical fasteners that are used to hold the equipment in place, and explain their methods of removal and

replacement

2.11 explain the application of sealants and adhesives within the repair activities, and the precautions that must be taken when working with them

2.12 describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections

2.13 explain the importance of using the specified fasteners for the particular repair, and why they must not substitute others

2.14 explain why securing devices need to be locked and labelled, and the different methods that are used to remove and install them

2.15 explain the torque loading requirements on the fasteners, and what to do if these loadings are exceeded or not achieved

2.16 explain the need to take care when removing fuselage components so as not to cause damage to the equipment or surrounding structure

2.17 explain the need to check that replaced components have the correct part/identification markings and accompanying release documentation

2.18 explain the need to position, align, adjust and secure correctly the replaced equipment in the aircraft, without damage to the components or surrounding structure

2.19 explain the methods of lifting, handling and supporting the components during the maintenance activities

2.20 explain why electrical bonding is critical, and why it must be both mechanically and electrically secure

2.21 explain how to carry out routine checks of the fuselage

2.22 explain how to conduct any necessary checks to ensure the accuracy and quality of the repair

2.23 explain how to recognise defects

2.24 explain why tool/equipment control is critical, and what to do if a tool or piece of equipment is unaccounted for on completion of the activities

2.25 describe the problems that can occur with the maintenance/repair operations, and explain how these can be overcome

2.26 explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation

2.27 describe the procedure for the safe disposal of waste materials and scrap components

2.28 describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve

# Unit 727 Maintaining fuselage, nacelles and pylons on aircraft

Supporting information

## Guidance

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

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

2.21 (such as checking for corrosion, stress/fatigue cracks, torque on critical fastenings)

2.23 (such as skin blemishes, poor skin lines, ineffective fasteners, foreign object damage)

# Unit 728 Maintaining stabilisers on aircraft

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|---|---|
| **UAN:** | **R/601/6264** |
| **Level:** | 3 |
| **Credit value:** | 77 |
| **GLH:** | 154 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 328: Maintaining Stabilisers on Aircraft (Suite 3) |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft stabilisers, in accordance with the approved aircraft maintenance manual, structural repair manual, approved change documentation (service bulletin) and airworthiness requirements. The maintenance activities will include the removal, fitting and testing of a range of aircraft stabiliser components, and making repairs to primary and secondary airframe/stabiliser structures, as appropriate to the aircraft type.<br>The learner will be required to select the correct tools and equipment to use, based on the operations to be performed and the components to be removed, fitted and tested. The aircraft stabiliser components will include items such as horizontal stabiliser/stabilator or canard, vertical stabiliser, elevator/elevon, rudder/ruddevator, and associated components. The learner will remove the required stabiliser components and fit approved replacements, as appropriate. The learner will then need to test and adjust the completed system to meet the aircraft maintenance manual, change documentation (service bulletin) and airworthiness requirements.<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the aircraft manual, structural repair manual, change/service bulletin documentation and airworthiness requirements for the maintenance activities undertaken, and to report any problems with these requirements 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 are correctly accounted for on completion of the activities, and that all necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to aircraft stabilisers. The learner will understand the removal, fitting and testing methods and procedures, and their application, along with the aircraft stabiliser maintenance requirements. The learner will know how the aircraft stabiliser functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the equipment is maintained to the required standard.

The learner will understand the safety precautions required when working on aircraft stabiliser systems, especially those for isolating the equipment, lifting and handling stabiliser components. 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.

**Notes:** 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 55 Stabilisers. 2. To display competence in this unit, it is necessary to both remove and fit aircraft stabiliser components. The learner must remove components; however, they may fit a replacement component where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| Learning outcome |
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| The learner will:<br>1. Be able to maintain stabilisers on aircraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the maintenance of the aircraft stabilisers:<br>• ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures<br>• obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)<br>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates<br>• 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<br>• ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)<br>• ensure the safe isolation of the control system before commencing work on the equipment<br>• use approved removal, fitting and testing techniques and procedures at all times<br>• leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from damage and foreign object debris<br>• return tools and equipment to the correct storage location on completion of the activities<br>• ensure that work carried out is correctly documented and recorded<br>• ensure that any outstanding tests are correctly documented<br>1.3 follow the relevant maintenance schedules to carry out the required work<br>1.4 carry out the maintenance activities within the limits of their personal authority<br>1.5 carry out maintenance on two of the following aircraft stabilisers:<br>• horizontal stabilisers/stabilator/canards<br>• vertical stabiliser<br>• trim tab<br>• elevator/elevon<br>• rudder/yaw/ruddervator<br>• tailerons<br>1.6 undertake three of the following structural repair activities: |

- insertion repair
- primary structure repair
- secondary structure repair
- tertiary structure repair
- damage assessment and evaluation
- overlay patch repair
- composite repair
- blend repair
- reworking of aluminium structures and limitations forming
- NDT inspection requirements (post damage removal)

1.7 carry out the maintenance activities in the specified sequence and in an agreed timescale

1.8 Use six of the following during the structural repair activities:

- marking out airframe materials
- making holes in airframe materials
- cutting/shaping airframe materials
- bending and forming materials
- drilling the extremities of cracks
- profiling
- countersinking
- deburring
- riveting
- securing and locking components
- using adhesives and sealants
- anti-corrosive treatment
- blending out permissible damage to structural components

1.9 carry out fifteen of the following maintenance activities:

- removing access panels and covers to expose components to be removed
- carrying out fault diagnosis and system checks
- preparing the system for maintenance (such as isolating, releasing stored pressure)
- disconnecting electrical connections
- removal of bonding
- removing securing devices and mechanical fasteners
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing damaged/defective components
- refitting components in the correct position, orientation and alignment
- replacing items (such as seals, gaskets, sealants)
- setting and adjusting replaced components (such as freedom of movement, travel)
- making mechanical connections

- making electrical connections
- carrying out bonding
- torque loading as required
- carrying out functional checks of the system
- ensuring that replacement components have the correct part numbers
- labelling (and storing in the correct location) components that require repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)
- carrying out area inspections prior to task close down

1.10 remove and fit four different aircraft stabiliser components (at least two must be from group A):

group a:

- horizontal stabiliser
- vertical stabiliser
- stabiliser leading edge
- stabiliser tip
- stabiliser seals
- upper rudder
- lower rudder
- splice ribs
- panel stiffeners
- access doors/panels
- inboard elevator
- tailerons
- outboard elevator
- stabiliser screw jack
- attachement fittings

group b:

- pivot hinge assembly
- bonding jumpers
- pivot pin assembly
- bearing assemblies
- anti-rotation plate
- static wick discharger

1.11 carry out three of the following types of test/check on the aircraft stabilisers:

- checking bonding jumpers for tightness, corrosion, melted strands, electrical resistance
- checking ground leads for security and electrical continuity
- checking components for wear (mechanical or otherwise) damage
- check stabiliser skins for dents and scratches against manufacturer's tolerances
- checking structural components for signs of cracking, corrosion or de-bonding

- checking stabilisers for range and freedom of movement
- checking critical fastenings for security
- checking surface protection (such as paint finish, polish)
- carrying out 'special-to-type' tests
- carrying out rigging checks

using two of the following:

- mechanical measuring equipment
- electrical measuring equipment
- ground support equipment
- use of safety locks
- 'special-to-type' test equipment

1.12 carry out maintenance on aircraft stabilisers in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Extended Range Twin-Engine Operations Procedures (ETOPS) (where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/structural repair manual/approved change documentation (service bulletin)

1.13 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.14 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:

- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.15 dispose of waste materials in accordance with safe working practices and approved procedures

| **Learning outcome** |
| --- |
| The learner will:<br>2. Know how to maintain stabilisers on aircraft |
| **Assessment criteria** |
| The learner can:<br>2.1 explain the specific safety practices and procedures that they need to observe when working on aircraft stabilisers<br>2.2 explain the importance of maintenance on, and impact upon ETOPS systems, legislation and local procedures<br>2.3 describe the hazards associated with removing, fitting and testing aircraft stabiliser components, and with the tools and equipment used, and explain how to minimise them and reduce any risk<br>2.4 explain what protective equipment they need to use for both personal protection and protection of the aircraft<br>2.5 explain the importance of good aircraft husbandry and of ensuring |

that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft

2.6 explain how to extract and use information from aircraft maintenance manuals, log books, flight logs, and other documents needed in the maintenance process

2.7 explain how to carry out currency/issue checks on the specifications they are working with

2.8 explain the terminology used in aircraft stabiliser systems, and the use of system diagrams and associated symbols

2.9 describe the basic principles of operation of the aircraft stabiliser being worked on, and the function of the various units/components

2.10 explain what preparations need to be undertaken on the aircraft stabilisers, prior to repair

2.11 explain the repair methods and procedures to be used, and the importance of adhering to these procedures

2.12 explain the application of sealants and adhesives within the repair activities, and the precautions that must be taken when working with them

2.13 explain how to conduct any necessary checks to ensure the accuracy and quality of the repair

2.14 explain how to recognise defects

2.15 explain the techniques used to remove components from aircraft stabilisers without damage to the components or surrounding structure

2.16 describe the various mechanical fasteners to be removed and replaced, and their methods of removal and replacement

2.17 describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections

2.18 explain the methods of lifting, handling and supporting the components/equipment during the removal and fitting activities

2.19 explain the methods of checking that components are fit for purpose, and how to identify defects and wear characteristics

2.20 explain the need to replace items such as seals and gaskets

2.21 explain the need to label and store correctly components that require repair or overhaul, and to check that replacement components have the correct part/identification markings and accompanying release documentation

2.22 explain how to replace and reconnect components into the system

2.23 explain how to make adjustments to components/assemblies to ensure they function correctly

2.24 explain why electrical bonding is critical, and why it must be both mechanically and electrically secure

2.25 explain the purpose of symmetry and rigging checks; how they are carried out; how to locate the rigging points and faces; and the use of incidence boards

2.26 explain how to carry out routine checks and servicing of the aircraft stabilisers

2.27 explain the need to check that cabin/cockpit switches, selectors and circuit breakers are in the correct position before removing stabiliser components

2.28 explain what types of test need to be carried out on the aircraft stabiliser, and the test equipment to be used

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| 2.29 | explain the methods and procedures to be used to carry out the various tests |
| 2.30 | explain the importance of carrying out the tests in the specified sequence, checking all readings and movements at each stage |
| 2.31 | explain how to record the results of each individual test, and the documentation that must be used |
| 2.32 | explain how to analyse the test results, and how to make valid decisions about the acceptability of the stabiliser system |
| 2.33 | explain the procedures to be followed if the equipment or system fails to meet the test specification |
| 2.34 | explain why tool/equipment control is critical, and what to do if a tool or piece of equipment is unaccounted for on completion of the activities |
| 2.35 | describe the problems that can occur with the aircraft stabiliser maintenance operations, and explain how these can be overcome |
| 2.36 | explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation |
| 2.37 | describe the procedure for the safe disposal of waste materials and scrap components |
| 2.38 | describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve |

# Unit 728 Maintaining stabilisers on aircraft

Supporting information

## Guidance

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

2.14 (such as skin blemishes, poor skin lines, ineffective fasteners, foreign object damage)

2.15 (such as release of pressures/force, proof marking, extraction of components, and the need to protect the system integrity by fitting blanking plugs and ensuring exposed components are correctly covered/protected)

2.16 (such as threaded fasteners, special securing devices)

2.22 (such as ensuring correct orientation, position and alignment; tightening securing devices to the required torque; replacing locking and securing devices; eliminating stress on pipework/connections; ensuring that pipework and cables are correctly supported at suitable intervals; carrying out visual checks of all components)

2.23 (such as setting working clearance, setting travel)

# Unit 729 Maintaining windows on aircraft

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| **UAN:** | **K/601/6268** |
| **Level:** | 3 |
| **Credit value:** | 77 |
| **GLH:** | 154 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 329: Maintaining Windows on Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft windows, in accordance with the approved aircraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It covers both fixed wing and rotary winged aircraft, and includes fuselage and crew compartment windows and windshields including windows installed in doors. The maintenance activities will include the removal, fitting and where appropriate testing of a range of windows. The learner will be required to select the correct tools and equipment to use, based on the operations to be performed and the window equipment to be removed or fitted. The aircraft windows include items such as the transparent material and frame of sliding and fixed windows and windshields, frost shields, handles, latching mechanisms. The learner will remove the required window components and fit approved replacements, as appropriate. The learner will then need to test and adjust the completed system to meet the aircraft maintenance manual, change documentation (service bulletin) and airworthiness requirements.<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the aircraft manual, change/service bulletin documentation and airworthiness requirements for the maintenance activities undertaken, and to report any problems with these requirements |

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 are correctly accounted for on completion of the activities, and that all necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to aircraft windows. The learner will understand the removal, fitting and testing/checking methods and procedures, and their application, along with the window maintenance requirements. The learner will know how the window equipment functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the aircraft windows are maintained to the required standard.

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

**Notes:** 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 56 Windows. 2. To display competence in this unit, it is necessary to both remove and fit aircraft windows. The learner must remove windows; however, they may fit a replacement where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| Learning outcome |
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| The learner will:<br>1. Be able to maintain windows on aircraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the maintenance of the aircraft windows:<br>• ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures<br>• obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)<br>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates<br>• 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<br>• ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)<br>• use approved removal, fitting and testing techniques and procedures at all times<br>• leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from damage and foreign object debris<br>• return tools and equipment to the correct storage location on completion of the activities<br>• ensure that work carried out is correctly documented and recorded<br>• ensure that any outstanding tests are correctly documented<br>1.3 follow the relevant maintenance schedules to carry out the required work<br>1.4 carry out the maintenance activities within the limits of their personal authority<br>1.5 carry out maintenance on two of the following aircraft windows:<br>• flight compartment<br>• passenger/cargo compartment<br>• door<br>• inspection and observation<br>• window heating/wiring system<br>1.6 carry out the maintenance activities in the specified sequence and in an agreed timescale<br>1.7 carry out fifteen of the following maintenance activities:<br>• removing linings and covers to expose components/fastenings |

to be removed
- carrying out fault diagnosis and system checks
- preparing the equipment for maintenance
- disconnecting electrical connections
- removing securing devices and mechanical fasteners
- supporting components to be removed
- refitting components in the correct position, orientation and alignment
- positioning and aligning replaced equipment
- setting and adjusting replaced components
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing damaged/defective components
- replacing seals and sealants
- making mechanical connections
- making electrical connections
- torque loading as required
- carrying out equipment functional checks
- ensuring that replacement equipment is of the correct type (have the correct part numbers)
- labelling (and storing in the correct location) equipment that requires repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)
- carrying out area inspections prior to task close down

1.8 remove and fit four different aircraft window components (at least two must be from group A):

group a:
- windshield
- fixed windows
- sliding windows
- landing gear and cargo bay inspection windows
- cabin window assembly
- rear window
- ice inspection window
- canopy
- window seals

group b:
- handle assembly
- lock assembly
- window latching mechanisms
- windscreen wiper blades
- trim
- window blind
- lift block

- window slide
- warning devices (such as lights, bells horns)
- cable harness/wiring/switches/plugs sensors
- other specific components

1.9 service/check aircraft windows, to include carrying out three of the following:

- checking window seals for damage
- checking cleanliness
- applying rain repellent
- checking window condition (such as delamination, cracking, crazing, chips)
- checking latching mechanisms for correct operation
- checking critical fastenings for security
- rigging/adjusting the latching mechanism
- testing window heating elements

1.10 carry out maintenance on aircraft windows in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Extended Range Twin-Engine Operations Procedures (ETOPS) (where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/approved change documentation (service bulletin)

1.11 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.12 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:

- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.13 dispose of waste materials in accordance with safe working practices and approved procedures

| **Learning outcome** |
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| The learner will:<br>2. Know how to maintain windows on aircraft |
| **Assessment criteria** |
| The learner can:<br>2.1 explain the specific safety practices and procedures that they need to observe when carrying out maintenance activities on aircraft windows<br>2.2 explain the importance of maintenance on aircraft windows, and impact upon ETOPS systems, legislation and local procedures<br>2.3 describe the hazards associated with removing and fitting aircraft |

windows, and with the tools and equipment used, and explain how to minimise them and reduce any risk

2.4 explain what protective equipment they need to use for both personal protection and protection of the aircraft

2.5 explain the importance of good aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft

2.6 explain how to extract and use information from aircraft manuals, log books, flight logs, and other documents needed in the maintenance process

2.7 explain how to carry out currency/issue checks on the specifications they are working with

2.8 describe the range of windows and window components that may need to be maintained/replaced

2.9 describe the various mechanical fasteners that are used to hold the equipment in place, and explain their methods of removal and replacement

2.10 explain the importance of using the specified fasteners for the particular installation, and why they must not substitute others

2.11 explain why securing devices need to be locked and labelled, and the different methods that are used to remove and install them

2.12 explain the torque loading requirements on the fasteners, and what to do if these loadings are exceeded or not achieved

2.13 describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections

2.14 explain the need to take care when removing windows so as not to cause damage to the equipment or surrounding structure

2.15 explain the need to label and store correctly components that require repair or overhaul, and to check that replaced components have the correct part/identification markings and accompanying release documentation

2.16 explain the need to position, align, adjust and secure correctly the replaced windows on the aircraft, without damage to the components or surrounding structure

2.17 explain the methods of lifting, handling and supporting the components/equipment during the maintenance activities

2.18 explain why electrical bonding is critical, and why it must be both mechanically and electrically secure

2.19 explain how to carry out routine checks of the aircraft windows

2.20 explain why tool/equipment control is critical, and what to do if a tool or piece of equipment is unaccounted for on completion of the activities

2.21 describe the problems that can occur with the maintenance operations, and explain how these can be overcome

2.22 explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation

2.23 describe the procedure for the safe disposal of waste materials and scrap components

2.24 describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve

# Unit 729 Maintaining windows on aircraft

Supporting information

## Guidance

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

2.9 (such as threaded fasteners, special securing devices)

2.19 (such as checking condition of seals, checking correct operation of sliding windows and window locking mechanisms, checking window warning devices)

# Unit 730 Maintaining wings on aircraft

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| **UAN:** | **K/601/6271** |
| **Level:** | 3 |
| **Credit value:** | 86 |
| **GLH:** | 168 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 330: Maintaining Wings on Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft wings, in accordance with the approved aircraft maintenance manual, structural repair manual, approved change documentation (service bulletin) and airworthiness requirements. The maintenance activities will include the removal, fitting and testing of a range of aircraft wing components, and making repairs to primary and secondary airframe/wing structures, as appropriate to the aircraft type.<br>The learner will be required to select the correct tools and equipment to use, based on the operations to be performed and the components to be removed, fitted and tested. The aircraft wing components will include items such as centre wing and outer wing structural units and associated components and members that support the aircraft in flight, and covers flaps, slats, ailerons or elevons, tabs, spoilers and wing folding systems. The learner will remove the required wing components and fit approved replacements, as appropriate. The learner will then need to test and adjust the completed system to meet the aircraft maintenance manual, change documentation (service bulletin) and airworthiness requirements.<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the aircraft manual, structural repair manual, change/service bulletin documentation and airworthiness requirements for the maintenance activities undertaken, and to report any problems with |

these requirements 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 are correctly accounted for on completion of the activities, and that all necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to aircraft wings. The learner will understand the removal, fitting and testing methods and procedures, and their application, along with the aircraft wing maintenance requirements. The learner will know how the aircraft wing functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the wing is maintained to the required standard.

The learner will understand the safety precautions required when working on aircraft wings, especially those for isolating the equipment, lifting and handling wing components. 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.

**Notes:** 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 57 Wings. 2. To display competence in this unit, it is necessary to both remove and fit aircraft wing components. The learner must remove components; however, they may fit a replacement component where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| Learning outcome |
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| The learner will:<br>1. Be able to maintain wings on aircraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the maintenance of the aircraft wings:<br>• ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures<br>• obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)<br>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates<br>• 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<br>• ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)<br>• ensure the safe isolation of the control system before commencing work on the equipment<br>• use approved removal, fitting and testing techniques and procedures at all times<br>• leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from damage and foreign object debris<br>• return tools and equipment to the correct storage location on completion of the activities<br>• ensure that work carried out is correctly documented and recorded<br>• ensure that any outstanding tests are correctly documented<br>1.3 follow the relevant maintenance schedules to carry out the required work<br>1.4 carry out the maintenance activities within the limits of their personal authority<br>1.5 carry out maintenance/repairs on two of the following parts of the aircraft wing:<br>• centre section<br>• outer section<br>• wing tip/winglets<br>• flaps<br>• spars<br>• integral fuel tanks |

- leading edge and leading edge devices
- trailing edge and trailing edge devices
- inboard and outboard ailerons
- Krueger flaps
- ailerons
- spoilers
- wing folding system
- elevons
- slats
- tabs
- lift dumpers

1.6 undertake three of the following structural repair activities:

- insertion repair
- primary structure repair
- secondary structure repair
- tertiary structure repair
- damage assessment and evaluation
- overlay patch repair
- composite repair
- blend repair
- reworking of aluminium structures and limitations forming
- NDT inspection requirements (post damage removal)

1.7 carry out the maintenance activities in the specified sequence and in an agreed timescale

1.8 Use six of the following during the structural repair activities:

- marking out airframe materials
- making holes in airframe materials
- cutting/shaping airframe materials
- bending and forming materials
- drilling the extremities of cracks
- profiling
- countersinking
- deburring
- riveting
- securing and locking components
- using adhesives and sealants
- anti-corrosive treatment
- blending out permissible damage to structural components

1.9 carry out fifteen of the following maintenance activities:

- removing access panels and covers to expose components to be removed
- carrying out fault diagnosis and system checks
- preparing the system for maintenance (such as isolating, fitting physical locks, stress jacking, releasing stored pressure)
- disconnecting electrical connections
- removal of bonding

- removing securing devices and mechanical fasteners
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing damaged/defective components
- replacing items such as seals, gaskets, sealant
- refitting components in the correct position, orientation and alignment
- setting and adjusting replaced components (such as freedom of movement, travel)
- making mechanical connections
- making electrical connections
- carrying out bonding
- torque loading as required
- carrying out metal repairs
- carrying out composite repairs
- ensuring that replacement components have the correct part numbers
- labelling (and storing in the correct location) components that require repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)
- carrying out area inspections prior to task close down

1.10 remove and fit four different aircraft wing components (at least two must be from group A):

group a:

- wing tip/winglets
- wing rib
- wing skin repair
- ailerons
- spoilers
- wing folding system
- elevons
- slats
- variable camber flaps
- flaps (fore, mid, aft)
- leading edge and leading edge devices
- trailing edge and trailing edge devices
- inboard and outboard ailerons
- Krueger flaps
- lift dumpers
- airbrakes
- swing wing
- tabs
- lift dumpers

group b:

- wing attachement fittings
- seals
- actuators
- lever/linkage assemblies
- spring assemblies
- access panels
- wing plates
- landing gear attachment fittings
- locks
- flap track assembly
- gearboxes
- carriage assembly
- nacelles/pylon attachment fittings
- indicating/warning devices
- static dischargers
- closure panels
- other specific components

1.11 carry out three of the following types of test/check on the aircraft wings:

- checking incidence rig
- inspecting primary structure/spar
- inspecting integral fuel tank
- checking skins for cracking and distortion
- checking control surface for range and freedom of movement
- primary structural element (PSE) fastener inspection and replacement
- checking wing skins for dents and scratches against manufacturer's tolerances
- checking surface protection (such as paint finish, polish)
- checking critical fastenings for security
- checking for lightning strikes
- heavy landing check
- stress jacking
- checking for dents
- carrying out 'special-to-type' tests

using two of the following:

- mechanical measuring equipment
- electrical measuring equipment
- incidence boards
- ground support equipment
- use of safety locks
- 'special-to-type' test equipment

1.12 carry out maintenance on aircraft wings in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)

- Extended Range Twin-Engine Operations Procedures (ETOPS) (where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/structural repair manual/approved change documentation (service bulletin)

1.13 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.14 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:

- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.15 dispose of waste materials in accordance with safe working practices and approved procedures

| **Learning outcome** |
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| The learner will:<br>2. Know how to maintain wings on aircraft |
| **Assessment criteria** |
| The learner can:<br>2.1 2explain the specific safety practices and procedures that they need to observe when working on aircraft wings<br>2.2 explain the requirements for working on wing fuel tanks to maintain safe conditions; the provision of adequate and safe lighting and avoidance of sources of ignition<br>2.3 explain the importance of maintenance on aircraft wings, and impact upon ETOPS systems, legislation and local procedures<br>2.4 describe the hazards associated with removing, fitting and testing aircraft wing components, and with the tools and equipment used, and explain how to minimise them and reduce any risk<br>2.5 explain what protective equipment they need to use for both personal protection and protection of the aircraft<br>2.6 explain the importance of good aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft<br>2.7 explain how to extract and use information from aircraft maintenance manuals, log books, flight logs, and other documents needed in the maintenance process<br>2.8 explain how to carry out currency/issue checks on the specifications they are working with<br>2.9 explain the terminology used in aircraft wings, and the use of system diagrams and associated symbols<br>2.10 describe the basic principles of operation of the aircraft wing components being worked on, and the function of the various units/components<br>2.11 explain what preparations need to be undertaken on the wing |

structure, prior to repair

2.12 explain the repair methods and procedures to be used, and the importance of adhering to these procedures

2.13 explain the application of sealants and adhesives within the repair activities, and the precautions that must be taken when working with them

2.14 explain how to conduct any necessary checks to ensure the accuracy and quality of the repair

2.15 explain how to recognising defects

2.16 explain the techniques used to remove components from aircraft wings without damage to the components or surrounding structure

2.17 describe the various mechanical fasteners to be removed and replaced, and explain their methods of removal and replacement

2.18 describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections

2.19 explain the methods of lifting, handling and supporting the components/equipment during the removal and fitting activities

2.20 explain the methods of checking that components are fit for purpose, and how to identify defects and wear characteristics

2.21 explain the need to replace items such as seals and gaskets

2.22 explain the need to label and store correctly components that require repair or overhaul, and to check that replacement components have the correct part/identification markings and accompanying release documentation

2.23 explain how to replace and reconnect components onto the wing

2.24 explain how to make adjustments to components/assemblies to ensure that they function correctly

2.25 explain why electrical bonding is critical, and why it must be both mechanically and electrically secure

2.26 explain the purpose of symmetry and rigging checks; how they are carried out; how to locate the rigging points and faces; and the use of incidence boards

2.27 explain how to carry out routine checks and servicing of the aircraft wings

2.28 explain the need to check that cabin/cockpit switches, selectors and circuit breakers are in the correct position before removing wing components

2.29 explain what types of test need to be carried out on the aircraft wing, and the test equipment to be used

2.30 explain the methods and procedures to be used to carry out the various tests

2.31 explain the importance of carrying out the tests in the specified sequence, checking all readings/movements at each stage

2.32 explain how to record the results of each individual test, and the documentation that must be used

2.33 explain how to analyse the test results and make valid decisions about the acceptability of the wing components

2.34 explain the procedures to be followed if the equipment or system fails to meet the test specification

2.35 explain why tool/equipment control is critical, and what to do if a tool or piece of equipment is unaccounted for on completion of the activities

2.36 describe the problems that can occur with the aircraft wing

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| | maintenance operations, and explain how these can be overcome |
| 2.37 | explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation |
| 2.38 | describe the procedure for the safe disposal of waste materials and scrap components |
| 2.39 | describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve |

## Guidance

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

2.2 (such as fuel tank training), and the importance of emergency procedures and safe systems of work (including permits to work, required air quantities (RAQs) and local exhaust ventilation (LEV))

2.15 (such as skin blemishes, poor skin lines, ineffective fasteners, foreign object damage)

2.16 (such as release of pressures/force, proof marking, extraction of components) and the need to protect the system integrity by fitting blanking plugs and ensuring exposed components are correctly covered/protected)

2.17 (such as threaded fasteners, special securing devices)

2.23 (such as ensuring correct orientation, position and alignment; tightening securing devices to the required torque; replacing locking and securing devices; eliminating stress on pipework/connections; ensuring that pipework and cables are correctly supported at suitable intervals; carrying out visual checks of all components)

2.24 (such as setting working clearance, setting travel)

# Unit 731 Maintaining propeller/propulsor systems on aircraft

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| **UAN:** | **F/601/6275** |
| **Level:** | 3 |
| **Credit value:** | 86 |
| **GLH:** | 168 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 331: Maintaining Propeller/ Propulsor Systems on Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft propeller/propulsor systems, in accordance with the approved aircraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It covers both fixed and variable pitch mechanical or electrical propellers, pumps, motors, governor, alternators, and those units and components external to or integral with the engine that are used to control the propeller blade angle. It includes propeller spinner synchronizers. It also covers propulsor duct assemblies, including aerodynamic fairing of mechanical components, stators, vectoring systems, etc. The maintenance activities will include the removal, fitting and testing of a range of propeller/propulsor system components. The learner will remove the required components and fit approved replacements, as appropriate. The learner will then need to test and adjust the completed system to meet the aircraft maintenance manual, change documentation (service bulletin) and airworthiness requirements.<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the aircraft manual, change/service bulletin documentation and airworthiness requirements for the maintenance activities undertaken, and to report any problems with these requirements 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 are correctly accounted for on completion of the activities, and that all necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to aircraft propeller/propulsor systems. The learner will understand the component removal, fitting and testing methods and procedures, and their application, along with the propeller/propulsor system maintenance requirements. The learner will know how the equipment functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the propeller/propulsor system is maintained to the required standard.

The learner will understand the safety precautions required when working on the propeller/propulsor system, especially those for ensuring that the power system, and its fuel supply, is safely and correctly isolated. 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.

**Notes:** 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 61 Propellers/Propulsors. 2. To display competence in this unit, it is necessary to both remove and fit propeller/propulsor system components. The learner must remove components; however, they may fit a replacement component where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| **Learning outcome** |
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| The learner will:<br>1. Be able to maintain propeller/propulsor systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the maintenance of the aircraft propeller/propulsor system:<br>• ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures<br>• obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)<br>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates<br>• 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<br>• ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)<br>• use approved removal, fitting and testing techniques and procedures at all times<br>• leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from fluid spillages, damage and foreign object debris<br>• return tools and equipment to the correct storage location on completion of the activities<br>• ensure that work carried out is correctly documented and recorded<br>• ensure that any outstanding tests are correctly documented<br>1.3 follow the relevant maintenance schedules to carry out the required work<br>1.4 carry out the maintenance activities within the limits of their personal authority<br>1.5 carry out maintenance on three of the following parts of the aircraft propeller/propulsor system:<br>• propeller assembly<br>• braking<br>• controls<br>• indicating<br>• feathering/reversing<br>• propulsor duct<br>1.6 carry out the maintenance activities in the specified sequence and in an agreed timescale |

1.7 carry out fifteen of the following maintenance activities:

- removing covers to expose components to be removed
- carrying out fault diagnosis and system checks
- preparing the system for maintenance (such as isolating, draining fluids)
- disconnecting electrical connections
- disconnect/removing hoses and pipes
- removing securing devices and mechanical fasteners
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing damaged/defective components
- replacing single use items such as seals, filters, gaskets
- refitting components in the correct position, orientation and alignment
- setting and adjusting replaced components (such as travel, working clearance)
- making mechanical connections
- making electrical connections
- torque loading as required
- replenishing fluid systems
- carrying out rigging checks
- carrying out system functional checks
- ensuring that replacement components have the correct part numbers
- fitting blanks, labelling (and storing in the correct location) components that require repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)
- carrying out area inspections prior to task close down

1.8 remove and fit six different propeller/propulsor system components (at least two must be from group A):

group a:

- propeller/blades
- dome
- hub
- spinner
- slip ring
- de-icer devices
- distributor valve
- stators
- spinner/governor synchronizers
- drive shafts
- synchronizing shafts
- pumps

- motors
- governor
- alternators
- gearboxes
- brake mechanisms
- brush block assembly
- counter weights
- propulsor duct assemblies
- vector drive attachments

group b:

- levers/linkages
- pulleys
- bearings
- seals/gaskets
- pipes and hoses
- fairings
- covers
- prop pitch control
- anti-ice heater mats
- de-ice tank
- cables/harness/wiring
- switches/plugs
- indicators and warning devices
- other specific components

1.9 service/check aircraft propeller/propulsor systems, to include carrying out five of the following:

- visually checking the system for damage and leaks
- lubricating the propeller
- adjusting the governor
- performing static function checks
- checking the track
- performing a propeller runout check
- examining the propeller for damage and corrosion
- dressing out blade damage
- examining the brush block assembly
- measuring and adjusting synchro-phaser magnetic pickup gap
- checking and adjusting dome and unfeathering accumulators
- checking propeller pitch control mechanisms and adjusting to establish blade angles
- checking propeller hub for cracks and/or debonding of blade leading edge cap
- dynamically balancing the propeller
- checking indicating and warning systems
- checking attachment of propeller and spinner for security

1.10 carry out three of the following tests on the aircraft propeller/propulsor system:

- checking that ground start mechanisms operate correctly
- checking accuracy of propeller RPM
- verifying that low/high RPM is achieved
- verifying take-off RPM
- testing electric anti-icing system
- built in test equipment (BITE) test
- 'special-to-type' tests

using two of the following:

- stroboscope
- tachometer
- ground test rig
- built in test equipment (BITE)
- 'special-to-type' test equipment

1.11 carry out maintenance on aircraft propeller/propulsor systems in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Extended Range Twin-Engine Operations Procedures (ETOPS) (where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/approved change documentation (service bulletin)

1.12 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.13 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:

- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.14 dispose of waste materials in accordance with safe working practices and approved procedures

| **Learning outcome** |
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| The learner will:<br>2. Know how to maintain propeller/propulsor systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>2.1 explain the specific safety practices and procedures that they need to observe when working on aircraft propeller/propulsor systems<br>2.2 explain the need to check that cabin/cockpit switches, selectors and circuit breakers are in the correct position before applying any form of external power<br>2.3 explain the importance of maintenance on aircraft propeller systems, and impact upon ETOPS systems, Electrical Wiring |

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| | Interconnect Systems (EWIS), legislation and local procedures |
| 2.4 | describe the hazards associated with carrying out maintenance activities on aircraft propeller/propulsor systems, and with the tools and equipment used, and how to minimise them and reduce any risk |
| 2.5 | explain what protective equipment they need to use for both personal protection and protection of the aircraft |
| 2.6 | explain the importance of aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft |
| 2.7 | explain how to extract and use information from aircraft manuals, log books, flight logs, charts, system and physical layouts, specifications, symbols used in aircraft propeller/propulsor systems, and other documents needed in the maintenance activities |
| 2.8 | explain how to carry out currency/issue checks on the specifications they are working with |
| 2.9 | explain the terminology used in aircraft propeller/propulsor systems, and the use of system diagrams and associated symbols |
| 2.10 | explain the basic principles of operation of the propeller/propulsor system being worked on, and the function of the units that make up the system |
| 2.11 | explain the techniques used to remove components from aircraft propeller/propulsor system without damage to the components or surrounding structure |
| 2.12 | describe the various mechanical fasteners to be removed and replaced, and explain their methods of removal and replacement |
| 2.13 | describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections |
| 2.14 | explain the importance of ensuring that any exposed components or pipe ends are correctly covered/protected |
| 2.15 | explain the need to label and store correctly components that require repair or overhaul, and to check that replacement components have the correct part/identification markings and accompanying release documentation |
| 2.16 | explain how to fit propeller/propulsor components safely and correctly |
| 2.17 | explain how to make adjustments to components/assemblies to ensure that they function correctly |
| 2.18 | explain why securing devices need to be tightened to the correct torque, locked and labelled, and the different methods that are used |
| 2.19 | describe the tools and equipment used in the maintenance activities, and explain their calibration/care and control procedures |
| 2.20 | explain why tool/equipment control is critical, and what to do if a tool or piece of equipment is unaccounted for on completion of the activities |
| 2.21 | explain how to carry out routine checks and servicing of the aircraft propeller/propulsor system |
| 2.22 | explain what types of test need to be carried out on the aircraft propeller/propulsor system, and the test equipment to be used |
| 2.23 | explain the methods and procedures to be used to carry out the |

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| | various tests on the propeller/propulsor system |
| 2.24 | explain the importance of carrying out the tests in the specified sequence, checking all readings and movements at each stage |
| 2.25 | explain how to record the results of each individual test, and the documentation that must be used |
| 2.26 | explain how to analyse the test results, and make valid decisions about the acceptability of the propeller/propulsor system |
| 2.27 | explain the procedures to be followed if the equipment or system fails to meet the test specification |
| 2.28 | explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation |
| 2.29 | describe the procedure for the safe disposal of waste materials, scrap components and fuel/fluids |
| 2.30 | describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve |

# Unit 731 Maintaining propeller/propulsor systems on aircraft

Supporting information

## Guidance

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

2.2 (such as electrical, hydraulic, air or vacuum)

2.4 (such as handling oils, greases, traps from moving parts, hot parts of engines, misuse of tools)

2.10 (such as propeller assembly, blade, de-ice boot, spinner, hub, synchronizer section, braking and feathering, and propeller control and indicating)

2.11 (such as release of pressures/force, draining of fluids, removal of components and the need to protect the system integrity by fitting blanking plugs and ensuring that exposed components are correctly covered/protected)

2.12 (such as threaded fasteners, special securing devices)

2.16 (such as use of lifting and handling equipment; ensuring the correct tightness of connections; eliminating stress on pipework/connections; carrying out visual checks of all components)

2.17 (such as travel and working clearance)

# Unit 732 Maintaining rotor systems on rotorcraft

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| **UAN:** | **H/601/6284** |
| **Level:** | 3 |
| **Credit value:** | 86 |
| **GLH:** | 168 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 332: Maintaining Rotor Systems on Rotorcraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on rotorcraft main and/or tail rotors, in accordance with the approved rotorcraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It covers the main and tail rotor head assembly, rotor blades and blade folding system, swashplate assemblies, and the rotor shaft units if not an integral part of the gearbox. It also includes indicating systems which show operation or activation of the rotor systems. The maintenance activities will include the removal, fitting and testing of a range of main and/or tail rotor system components. The learner will remove the required components and fit approved replacements, as appropriate. The learner will then need to test and adjust the completed system to meet the rotorcraft maintenance manual, change documentation (service bulletin) and airworthiness requirements.<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the rotorcraft manual, change/service bulletin documentation and airworthiness requirements for the maintenance activities undertaken, and to report any problems with these requirements 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 are correctly |

accounted for on completion of the activities, and that all necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to rotorcraft main and/or tail rotor systems. The learner will understand the component removal, fitting and testing methods and procedures, and their application, along with the rotor system maintenance requirements. The learner will know how the equipment functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the main and tail rotor system is maintained to the required standard.

The learner will understand the safety precautions required when working on the rotor system, especially those for ensuring that the power system is safely and correctly isolated. 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.

**Notes:** 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 62 Main Rotors and ATA Chapter 64 Tail Rotor. 2. To display competence in this unit, it is necessary to both remove and fit rotor system components. The learner must remove components; however, they may fit a replacement component where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| **Learning outcome** |
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| The learner will:<br>1. Be able to maintain rotor systems on rotorcraft |
| **Assessment criteria** |
| The learner can:<br>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 maintenance of the rotorcraft main and/or tail rotor system:

- ensure that appropriate authorisation to work on the rotorcraft is obtained, and observe all relevant isolation and safety procedures
- obtain and use the correct documentation (such as job instructions, technical instructions, rotorcraft manuals and maintenance documentation)
- obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates
- adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
- ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)
- use approved removal, fitting and testing techniques and procedures at all times
- leave the rotorcraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from fluid spillages, damage and foreign object debris
- return tools and equipment to the correct storage location on completion of the activities
- ensure that work carried out is correctly documented and recorded
- ensure that any outstanding tests are correctly documented

1.3 follow the relevant maintenance schedules to carry out the required work

1.4 carry out the maintenance activities within the limits of their personal authority

1.5 carry out maintenance on three of the following parts of the rotorcraft rotor system:

- main rotor blades
- tail rotor blades
- rotor heads
- trim actuators
- rotor servos
- blade folding system
- rotor shafts
- swash plate assembly
- indicating system
- pivoting and swivelling actuators

1.6 carry out the maintenance activities in the specified sequence and in an agreed timescale

1.7 carry out fifteen of the following maintenance activities:

- removing fairings to expose components to be removed
- carrying out fault diagnosis and system checks

- preparing the system for maintenance (such as isolating, draining fluids)
- disconnecting electrical connections
- disconnecting/removing hoses and pipes
- removing securing devices and mechanical fasteners
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing damaged/defective components
- replacing single use items such as seals, filters, gaskets
- refitting components in the correct position, orientation and alignment
- setting and adjusting replaced components (such as travel, working clearance)
- making mechanical connections
- making electrical connections
- torque loading as required
- replenishing fluid systems
- carrying out system functional checks
- ensuring that replacement components have the correct part numbers
- fitting blanks, labelling (and storing in the correct location) components that require repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)
- carrying out area inspections prior to task close down

1.8 remove and fit six different rotor system components (at least two must be from group A):

group a:

- rotor blades
- mast assembly
- clutch assembly
- bumper/damper
- coupling
- rotor/rudder hub assembly
- rotor head
- swash plate
- azimuth star assembly (collective pitch)
- blade governor synchronizes
- pitch change linkage
- rotor/drive shafts
- speed governor
- rudder blade plate
- trunnion
- main drive actuator

- wobble ring
- pitch control beam
- brake mechanisms
- wear/grip pads
- cams
- housings
- scupper assembly
- lead/lag damper

group b:

- levers/linkages
- pulleys
- bearings
- seals/gaskets
- bolt assemblies
- support brackets
- lubrication tank
- folding hinge pin
- blade lock pin
- control lock pin
- springs
- pipes and hoses
- rotor head fairings
- covers
- anti-ice heater mats
- fairing assemblies
- balance weights
- de-icer boot
- cable harness/wiring/switches/plugs
- indicators and warning devices
- other specific components

1.9 service/check rotorcraft main and tail rotor systems, to include carrying out five of the following:

- visually checking the system for damage and leaks
- adjusting the governor
- performing static function checks
- examining main and tail rotor blades for damage and corrosion
- carrying out blend repair to rotor blades
- replacing main rotor blade erosion tape
- performing main rotor blade debonding check
- checking main/tail rotor pitch change mechanism
- tracking/balancing the main rotor
- adjusting main rotor trim tab
- adjusting main/tail rotor pitch change linkage
- fitting and removing rigging pins
- checking and adjusting main rotor control rigging

- checking and adjusting tail rotor control rigging
- checking indicating and warning systems
- lubricating rotor mechanism
- checking spar integrity system
- servicing lead/lag damper
- examining flapping hinge and droop stop

1.10 carry out two of the following tests on the rotorcraft rotor system:

- checking that ground start mechanisms operate correctly
- testing electric anti-icing system
- testing rotor braking system
- built in test equipment (BITE) test
- 'special-to-type' tests
- blade tracking

using two of the following:

- stroboscope
- tachometer
- ground test rig
- built in test equipment (BITE)
- 'special-to-type' test equipment

1.11 carry out maintenance on rotorcraft main and tail rotor systems in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- rotorcraft maintenance manual/approved change documentation (service bulletin)

1.12 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.13 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:

- job cards/work sheets
- computer records
- rotorcraft technical log
- rotorcraft cabin log
- rotorcraft log book

1.14 dispose of waste materials in accordance with safe working practices and approved procedures

| **Learning outcome** |
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| The learner will:<br>2. Know how to maintain rotor systems on rotorcraft |
| **Assessment criteria** |
| The learner can:<br>2.1 explain the specific safety practices and procedures that they need to observe when working on rotorcraft main and tail rotor systems |

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| 2.2 | explain the importance of maintenance on rotorcraft rotor systems, and impact upon legislation and local procedures |
| 2.3 | explain the need to check that cabin/cockpit switches, selectors and circuit breakers are in the correct position before applying any form of external power |
| 2.4 | describe the hazards associated with carrying out maintenance activities on rotorcraft main and tail rotor systems, and with the tools and equipment used, and explain how to minimise them and reduce any risk |
| 2.5 | explain what protective equipment they need to use for both personal protection and protection of the rotorcraft |
| 2.6 | explain the importance of good aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft |
| 2.7 | explain how to extract and use information from rotorcraft manuals, log books, flight logs, charts, system and physical layouts, specifications, symbols used in rotorcraft main and tail rotor systems, and other documents needed in the maintenance activities |
| 2.8 | explain how to carry out currency/issue checks on the specifications they are working with |
| 2.9 | explain terminology used in rotorcraft main rotor systems, and the use of system diagrams and associated symbols |
| 2.10 | describe the basic principles of operation of the main and/or tail rotor system being worked on, and the function of the units that make up the system |
| 2.11 | explain the techniques used to remove components from rotorcraft main and/or tail rotor systems without damage to the components or surrounding structure |
| 2.12 | describe the various mechanical fasteners that will need to be removed and replaced, and explain their methods of removal and replacement |
| 2.13 | describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections |
| 2.14 | explain the importance of ensuring that any exposed components or pipe ends are correctly covered/protected |
| 2.15 | explain the need to label and store correctly components that require repair or overhaul, and to check that replacement components have the correct part/identification markings and accompanying release documentation |
| 2.16 | explain how to fit main rotor components safely and correctly |
| 2.17 | explain how to make adjustments to components/assemblies to ensure that they function correctly |
| 2.18 | explain why securing devices need to be tightened to the correct torque, locked and labelled, and the different methods that are used |
| 2.19 | describe the tools and equipment used in the maintenance activities, and explain their calibration/care and control procedures |
| 2.20 | explain why tool/equipment control is critical, and what to do if a tool or piece of equipment is unaccounted for on completion of the activities |
| 2.21 | explain how to carry out routine checks and servicing of the rotorcraft main and/or tail rotor system |

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| 2.22 | explain what types of test need to be carried out on the rotorcraft main and/or tail rotor system, and the test equipment to be used |
| 2.23 | explain the methods and procedures to be used to carry out the various tests on the rotor systems |
| 2.24 | explain the importance of carrying out the tests in the specified sequence, checking all readings and movements at each stage |
| 2.25 | explain how to record the results of each individual test, and the documentation that must be used |
| 2.26 | explain how to analyse the test results, and how to make valid decisions about the acceptability of the rotor system |
| 2.27 | explain the procedures to be followed if the equipment or system fails to meet the test specification |
| 2.28 | explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation |
| 2.29 | describe the procedure for the safe disposal of waste materials, scrap components and fuel/fluids |
| 2.30 | describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve |

# Unit 732 Maintaining rotor systems on rotorcraft

Supporting information

## Guidance

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

2.2 (such as electrical, hydraulic, air or vacuum)

2.4 (such as handling oils, greases, traps from moving parts, hot parts of engines, misuse of tools)

2.10 (such as rotor blade, rotor heads, swash plate assemblies, blade folding mechanisms, de-ice boot, blade braking and blade control and indicating)

2.11 (such as release of pressures/force, draining of fluids, removal of components and the need to protect the system integrity by fitting blanking plugs and ensuring that exposed components are correctly covered/protected)

2.12 (such as threaded fasteners, special securing devices)

2.16 (such as use of lifting and handling equipment; ensuring the correct tightness of connections; eliminating stress on pipework/connections; carrying out visual checks of all components)

2.17 (such as travel and working clearance)

# Unit 733 Maintaining rotor drive systems on rotorcraft

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| **UAN:** | **A/601/6288** |
| **Level:** | 3 |
| **Credit value:** | 86 |
| **GLH:** | 168 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 333: Maintaining Rotor Drive Systems on Rotorcraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on rotorcraft main and/or tail drive systems, in accordance with the approved rotorcraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It covers the main and tail rotor drive, and includes all components transmitting power to the rotors, such as engine coupling components, drive shafts and bearings, drive supports, clutch and freewheel units, gearboxes and their components, accelerometers, vibration monitoring equipment and indicating systems which show operation or activation of the rotor systems. The maintenance activities will include the removal, fitting and testing of a range of main and/or tail rotor drive system components. The learner will remove the required components and fit approved replacements, as appropriate. The learner will then need to test and adjust the completed system to meet the rotorcraft maintenance manual, change documentation (service bulletin) and airworthiness requirements.<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the rotorcraft manual, change/service bulletin documentation and airworthiness requirements for the maintenance activities undertaken, and to report any problems with these requirements 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 are correctly accounted for on completion of the activities, and that all necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to rotorcraft main and/or tail rotor drive systems. The learner will understand the component removal, fitting and testing methods and procedures, and their application, along with the rotor drive systems maintenance requirements. The learner will know how the equipment functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the main and tail rotor drive systems are maintained to the required standard.

The learner will understand the safety precautions required when working on the rotor drive systems, especially those for ensuring that the power system is safely and correctly isolated. 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.

**Notes:** 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 63 Main Rotor Drives and ATA Chapter 65 Tail Rotor Drive. 2. To display competence in this unit, it is necessary to both remove and fit rotor drive system components. The learner must remove components; however, they may fit a replacement component where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| Learning outcome |
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| The learner will:<br>1. Be able to maintain rotor drive systems on rotorcraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the maintenance of the rotorcraft main and/or tail rotor drive system:<br>• ensure that appropriate authorisation to work on the rotorcraft is obtained, and observe all relevant isolation and safety procedures<br>• obtain and use the correct documentation (such as job instructions, technical instructions, rotorcraft manuals and maintenance documentation)<br>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates<br>• 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<br>• ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)<br>• use approved removal, fitting and testing techniques and procedures at all times<br>• leave the rotorcraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from fluid spillages, damage and foreign object debris<br>• return tools and equipment to the correct storage location on completion of the activities<br>• ensure that work carried out is correctly documented and recorded<br>• ensure that any outstanding tests are correctly documented<br>1.3 follow the relevant maintenance schedules to carry out the required work<br>1.4 carry out the maintenance activities within the limits of their personal authority<br>1.5 carry out maintenance on three of the following parts of the rotorcraft rotor drive system:<br>• main rotor gearbox/transmission<br>• intermediate gearbox/transmission<br>• combining gearbox/transmission<br>• nose gearbox/transmission<br>• tail rotor gearbox<br>• AFT vertical shaft<br>• drive shaft/high speed shaft<br>• engine/gearbox couplings |

- clutch/freewheel units
- rotor braking system
- rotorcraft cooling fan
- accelerometer
- indicating system
- any other gearbox/transmission in the drive train

1.6 carry out the maintenance activities in the specified sequence and in an agreed timescale

1.7 carry out fifteen of the following maintenance activities:

- removing fairings and covers to expose components to be removed
- carrying out fault diagnosis and system checks
- preparing the system for maintenance (such as isolating, draining fluids)
- disconnecting electrical connections
- disconnecting/removing hoses and pipes
- removing securing devices and mechanical fasteners
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing damaged/defective components
- replacing single use items such as seals, filters, gaskets
- refitting components in the correct position, orientation and alignment
- setting and adjusting replaced components (such as travel, working clearance)
- making mechanical connections
- making electrical connections
- torque loading as required
- replenishing fluid systems
- carrying out system functional checks
- ensuring that replacement components have the correct part numbers
- fitting blanks, labelling (and storing in the correct location) components that require repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)
- carrying out area inspections prior to task close down

1.8 remove and fit six different rotor drive system components (at least two must be from group A):

group a:

- clutch assembly
- freewheel units
- clutch operating mechanisms
- flexible couplings
- drive shaft support

- drive shafts
- bearings
- dynamic seals
- housings
- lubricating pumps
- brake mechanisms
- control valves
- vibration bars
- suspension units
- mounts/attachments
- accessory drive casing

group b:

- levers/linkages
- static seals/gaskets
- bolt assemblies
- support brackets
- chip detectors
- control units
- sensors
- accelerometers
- drive belts and pulleys
- pipes and hoses
- rotor drive fairings
- gearbox covers
- locks and stops
- mechanical controls (plungers, springs, rollers)
- anti-ice heater mats
- cable harness/wiring/switches/plugs
- electrical controls (solenoids, motors, switches)
- indicators and warning devices
- other specific components

1.9 service/check rotorcraft main and tail rotor drive systems, to include carrying out three of the following:

- visually checking gearboxes and drive system for damage and leaks
- checking and adjusting clutch mechanisms
- checking and adjusting braking mechanisms
- checking gearbox chip detectors
- carrying out oil drain rotor tune adjustments
- checking indicating and warning systems

1.10 carry out three of the following tests on the rotorcraft rotor drive system:

- visual inspection
- gearbox alignment (main, tail, intermediate)
- drive shaft/high speed shaft alignment
- 'special-to-type' tests

- visually checking gearboxes and drive systems for correct oil levels
- built in test equipment (BITE) test
- timings
- tension adjuster check
- freedom and range of movement
- safety interlock test
- static or dynamic balancing of drive shafts
- ground run tests
- leak test
- vibration analysis
- phasing check

using three of the following:

- built in test equipment (BITE)
- dial test indicator
- laser alignment
- clinometers
- lay straight wires
- use of safety locks
- plumb and bob
- feeler/slip gauges
- 'go/no go' gauge
- vibration analysis equipment
- 'special-to-type' test equipment
- optical sight instruments
- jigs/fixture
- wrenches/'special-to-type' appliances

1.11 carry out maintenance on rotorcraft main and tail rotor systems in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- rotorcraft maintenance manual/approved change documentation (service bulletin)

1.12 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.13 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:

- job cards/work sheets
- computer records
- rotorcraft technical log
- rotorcraft cabin log
- rotorcraft log book

1.14 dispose of waste materials in accordance with safe working practices and approved procedures

| Learning outcome |
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| The learner will:<br>2. Know how to maintain rotor drive systems on rotorcraft |
| **Assessment criteria** |
| The learner can:<br>2.1 explain the specific safety practices and procedures that they need to observe when working on rotorcraft main and tail rotor systems<br>2.2 explain the importance of maintenance on rotorcraft rotor drive systems, and impact upon legislation and local procedures<br>2.3 explain the need to check that cabin/cockpit switches, selectors and circuit breakers are in the correct position before applying any form of external power<br>2.4 describe the hazards associated with carrying out maintenance activities on rotorcraft main and tail rotor systems, and with the tools and equipment used, and explain how to minimise them and reduce any risk<br>2.5 explain what protective equipment they need to use for both personal protection and protection of the rotorcraft<br>2.6 explain the importance of good aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft<br>2.7 explain how to extract and use information from rotorcraft manuals, log books, flight logs, charts, system and physical layouts, specifications, symbols used in rotorcraft main and tail rotor systems, and other documents needed in the maintenance activities<br>2.8 explain how to carry out currency/issue checks on the specifications they are working with<br>2.9 explain the terminology used in rotorcraft power transmission systems, and the use of system diagrams and associated symbols<br>2.10 describe the basic principles of operation of the main and/or tail rotor drive system being worked on, and the function of the units that make up the system<br>2.11 explain the techniques used to remove components from rotorcraft main and/or tail rotor systems without damage to the components or surrounding structure<br>2.12 describe the various mechanical fasteners that will need to be removed and replaced, and explain their methods of removal and replacement<br>2.13 describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections<br>2.14 explain the methods of lifting, handling and supporting the components/equipment during the maintenance activities<br>2.15 explain the importance of ensuring that any exposed components or pipe ends are correctly covered/protected<br>2.16 explain the need to label and store correctly components that require repair or overhaul, and to check that replacement components have the correct part/identification markings and accompanying release documentation<br>2.17 explain how to replace and reconnect components into the rotor |

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| | power transmission system |
| 2.18 | explain how to make adjustments to components to ensure that they function correctly |
| 2.19 | explain why securing devices need to be correctly torqued, locked and labelled, and the different methods that are used |
| 2.20 | describe the tools and equipment used in the maintenance activities, and explain their calibration/care and control procedures |
| 2.21 | explain why tool/equipment control is critical, and what to do if a tool or piece of equipment is unaccounted for on completion of the activities |
| 2.22 | explain how to carry out routine checks and servicing of the rotorcraft main and/or tail rotor system |
| 2.23 | explain what tests need to be carried out on the rotorcraft power transmission system, and the test equipment to be used |
| 2.24 | explain the methods and procedures to be used to carry out the various tests on the rotor power transmission systems |
| 2.25 | explain the importance of carrying out the tests in the specified sequence, checking all readings and movements at each stage |
| 2.26 | explain how to record the results of each individual test, and the documentation that must be used |
| 2.27 | explain how to analyse the test results, and how to make valid decisions about the acceptability of the rotor power transmission system |
| 2.28 | explain the procedures to be followed if the equipment or system fails to meet the test specification |
| 2.29 | explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation |
| 2.30 | describe the procedure for the safe disposal of waste materials, scrap components and fuel/fluids |
| 2.31 | describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve |

# Unit 733 Maintaining rotor drive systems on rotorcraft

Supporting information

## Guidance

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

2.3 (such as electrical, hydraulic, air or vacuum)

2.4 (such as handling oils, greases, traps from moving parts, lifting and moving heavy and bulky components, hot parts of engines, misuse of tools)

2.10 (such as main, intermediate, tail and nose gearboxes, clutch/freewheel mechanisms, braking equipment, couplings and drive shafts and indicating systems)

2.11 (such as release of pressures/force, draining of fluids, removal of components and the need to protect the system integrity by fitting blanking plugs and ensuring that exposed components are correctly covered/protected)

2.12 (such as threaded fasteners, special securing devices)

2.17 (such as the use of gaskets/seals and jointing/sealing compounds; ensuring correct orientation, position and alignment; tightening securing devices to the required torque; replacing locking and securing devices; eliminating stress on pipework/connections; ensuring that pipework and cables are correctly supported at suitable intervals; carrying out visual checks of all components)

2.18 (such as travel, working clearance)

# Unit 734 Maintaining rotor blade and tail pylon folding systems on rotorcraft

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| **UAN:** | **F/601/6292** |
| **Level:** | 3 |
| **Credit value:** | 86 |
| **GLH:** | 168 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 334: Maintaining Rotor Blade and Tail Pylon Folding Systems on Rotorcraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on rotor blade and tail pylon folding systems, in accordance with the approved rotorcraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It covers the whole of the system for ensuring automatic or manual folding and spreading of the rotor blades and/or tail pylon, and includes the mechanical, hydraulic, electrical and indicating equipment and systems permanently fitted to the rotorcraft. The maintenance activities will include the removal, fitting and testing of a range of rotor blade and tail pylon folding system components. The learner will remove the required components and fit approved replacements, as appropriate. The learner will then need to test and adjust the completed system to meet the rotorcraft maintenance manual, change documentation (service bulletin) and airworthiness requirements.<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the rotorcraft manual, change/service bulletin documentation and airworthiness requirements for the maintenance activities undertaken, and to report any problems with these requirements 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 are correctly accounted for on completion of the activities, and that all necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to rotor blade and tail pylon folding systems. The learner will understand the component removal, fitting and testing methods and procedures, and their application, along with the rotor blade and tail pylon folding systems maintenance requirements. The learner will know how the equipment functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the rotor blade and tail pylon folding systems are maintained to the required standard.

The learner will understand the safety precautions required when working on the rotor blade and tail pylon folding systems, especially those for ensuring that the power system is safely and correctly isolated. 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.

**Notes:** 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 66 Rotor Blade and Tail Pylon Folding Systems. 2. To display competence in this unit, it is necessary to both remove and fit rotor blade and tail pylon folding system components. The learner must remove components; however, they may fit a replacement component where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation

| Learning outcome |
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| The learner will:<br>1. Be able to maintain rotor blade and tail pylon folding systems on rotorcraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the maintenance of the rotor blade and tail pylon folding system:<br>• ensure that appropriate authorisation to work on the rotorcraft is obtained, and observe all relevant isolation and safety procedures<br>• obtain and use the correct documentation (such as job instructions, technical instructions, rotorcraft manuals and maintenance documentation)<br>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates<br>• 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<br>• ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)<br>• use approved removal, fitting and testing techniques and procedures at all times<br>• leave the rotorcraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from fluid spillages, damage and foreign object debris<br>• return tools and equipment to the correct storage location on completion of the activities<br>• ensure that work carried out is correctly documented and recorded<br>• ensure that any outstanding tests are correctly documented<br>• follow the relevant maintenance schedules to carry out the required work<br>1.3 carry out the maintenance activities within the limits of their personal authority<br>1.4 carry out maintenance on two of the following parts of the rotorcraft rotor blade and tail pylon folding system:<br>• rotor blades<br>• tail pylon<br>• controls and indicating<br>1.5 carry out the maintenance activities in the specified sequence and in an agreed timescale<br>1.6 carry out fifteen of the following maintenance activities:<br>• removing fairings and covers to expose components to be removed |

- carrying out fault diagnosis and system checks
- preparing the system for maintenance (such as isolating, releasing pressure, draining fluids)
- disconnecting electrical connections
- disconnecting/removing hoses and pipes
- removing securing devices and mechanical fasteners
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- refitting components in the correct position, orientation and alignment
- setting and adjusting replaced components (such as travel, working clearance)
- making mechanical connections
- making electrical connections
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing all damaged/defective components
- replacing single use items such as seals, filters, gaskets
- torque loading as required
- replenishing fluid systems
- carrying out system functional checks
- ensuring that replacement components have the correct part numbers
- fitting blanks, labelling (and storing in the correct location) components that require repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)
- carrying out area inspections prior to task close down
- remove and fit six different rotor blade and tail pylon folding system components from the following:
- actuators
- control valves
- hinge mechanisms
- flexible couplings
- levers/linkages
- bolt assemblies
- support brackets
- locks and stops
- mechanical controls (plungers, springs, rollers)
- pipes and hoses
- fairings
- bearings
- static seals/gaskets
- dynamic seals
- control units
- sensors

- electrical controls (solenoids, motors, switches)
- indicators and warning devices
- cable/harness/wiring
- switches/plugs
- other specific components

1.7 service/check and test rotor blade and tail pylon folding systems, to include carrying out three of the following:

- visually checking folding system for damage and leaks
- checking critical fastenings for security
- checking for freedom and range of movement
- checking and adjusting folding mechanisms
- checking and adjusting locking mechanisms
- checking for vibration
- checking tracking/balance
- carrying out a safety interlock test
- checking indicating and warning systems
- built in test equipment (BITE) test
- 'special-to-type' test

1.8 carry out maintenance on rotorcraft rotor blade and tail pylon folding systems in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/approved change documentation (service bulletin)

1.9 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.10 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:

- job cards/work sheets
- computer records
- rotorcraft technical log
- rotorcraft cabin log
- rotorcraft log book

1.11 dispose of waste materials in accordance with safe working practices and approved procedures

| **Learning outcome** |
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| The learner will:<br>2. Know how to maintain rotor blade and tail pylon folding systems on rotorcraft |
| **Assessment criteria** |
| The learner can:<br>2.1 explain the specific safety practices and procedures that they need to observe when working on rotorcraft rotor blade and tail pylon folding systems |

2.2 explain the importance of maintenance on rotorcraft rotor blade and tail pylon folding systems, and impact upon legislation and local procedures

2.3 explain the need to check that cabin/cockpit switches, selectors and circuit breakers are in the correct position before applying any form of external power

2.4 describe the hazards associated with carrying out maintenance activities on rotorcraft rotor blade and tail pylon folding systems, and with the tools and equipment used, and explain how to minimise them and reduce any risk

2.5 explain what protective equipment they need to use for both personal protection and protection of the rotorcraft

2.6 explain the importance of good aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft

2.7 explain how to extract and use information from rotorcraft manuals, log books, flight logs, charts, system and physical layouts, specifications, symbols used in rotorcraft rotor blade and tail pylon folding systems, and other documents needed in the maintenance activities

2.8 explain how to carry out currency/issue checks on the specifications they are working with

2.9 explain the terminology used in rotorcraft rotor blade and tail pylon folding systems, and the use of system diagrams and associated symbols

2.10 describe the basic principles of operation of the rotor blade and tail pylon folding system being worked on, and the function of the units that make up the system

2.11 explain the techniques used to remove components from rotor blade and tail pylon folding systems without damage to the components or surrounding structure

2.12 describe the various mechanical fasteners to be removed and replaced, and their methods of removal and replacement

2.13 describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections

2.14 explain the methods of lifting, handling and supporting the components/equipment during the maintenance activities

2.15 explain the need to label and store correctly components that require repair or overhaul, and to check that replacement components have the correct part/identification markings and accompanying release documentation

2.16 explain how to replace and reconnect components into the rotor blade and tail pylon folding system

2.17 explain how to make adjustments to components to ensure that they function correctly

2.18 explain why securing devices need to be correctly torqued, locked and labelled, and the different methods that are used

2.19 describe the tools and equipment used in the maintenance activities, and explain their calibration/care and control procedures

2.20 explain why tool/equipment control is critical, and what to do if a tool or piece of equipment is unaccounted for on completion of the activities

2.21 explain how to carry out routine checks and servicing of the

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| | rotorcraft rotor blade and tail pylon folding system |
| 2.22 | explain what tests need to be carried out on the rotor blade and tail pylon folding system, and the test equipment to be used |
| 2.23 | explain the methods and procedures to be used to carry out the various tests on the rotor blade/tail pylon folding systems |
| 2.24 | explain the importance of carrying out the tests in the specified sequence, checking readings/movements at each stage |
| 2.25 | explain how to record the results of each individual test, and the documentation that must be used |
| 2.26 | explain how to analyse the test results, and how to make valid decisions about the acceptability of the rotor blade and tail pylon folding system |
| 2.27 | explain the procedures to be followed if the equipment or system fails to meet the test specification |
| 2.28 | explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation |
| 2.29 | describe the procedure for the safe disposal of waste materials, scrap components and fuel/fluids |
| 2.30 | describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve |

# Unit 734 Maintaining rotor blade and tail pylon folding systems on rotorcraft

Supporting information

## Guidance

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

2.3 (such as electrical, hydraulic)

2.4 (such as handling oils, greases, traps from moving parts, lifting and moving heavy and bulky components, hot parts of engines, misuse of tools)

2.10 (such as mechanisms, hydraulic actuators, electrical equipment and indicating systems)

2.11(such as release of pressures/force, draining of fluids, removal of components and the need to protect the system integrity by ensuring that exposed components and pipe ends are correctly covered/protected)

2.12 (such as threaded fasteners, special securing devices)

2.16 (such as the use of gaskets/seals; ensuring the correct orientation, position and alignment; tightening securing devices to the required torque; replacing locking and securing devices; eliminating stress on pipework/connections; ensuring that pipework and cables are correctly supported at suitable intervals; carrying out visual checks of all components)

2.17 (such as travel, freedom of movement and working clearance)

# Unit 735 Maintaining flight control systems on rotorcraft

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| **UAN:** | **L/601/6294** |
| **Level:** | 3 |
| **Credit value:** | 86 |
| **GLH:** | 168 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 335: Maintaining Flight Control Systems on Rotorcraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on rotorcraft flight control systems, in accordance with the approved rotorcraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It includes units and components which manually control the flight attitude and characteristics of the rotorcraft. The maintenance activities will include the removal, fitting and testing of a range of rotorcraft flight control components. The learner will be required to select the correct tools and equipment to use, based on the operations to be performed and the components to be removed, fitted and tested. The rotorcraft flight control components will include items such as control linkage and control cables for collective pitch, cyclic pitch, directional control, servo controls and corresponding systems. The learner will remove the required components and fit approved replacements, as appropriate. The learner will then need to test and adjust the completed system to meet the rotorcraft maintenance manual, change documentation (service bulletin) and airworthiness requirements.<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the rotorcraft manual, change/service bulletin documentation and airworthiness requirements for the maintenance activities undertaken, and to report any problems with these requirements 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 are correctly accounted for on completion of the activities, and that all necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to rotorcraft flight control systems. The learner will understand the removal, fitting and testing methods and procedures, and their application, along with the rotorcraft flight control system maintenance requirements. The learner will know how the rotorcraft flight controls functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the equipment is maintained to the required standard.

The learner will understand the safety precautions required when working on rotorcraft flight control systems, especially those for isolating the equipment, lifting and handling control components. 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.

**Notes:** 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 67 Rotors Flight Controls. 2. To display competence in this unit, it is necessary to both remove and fit rotorcraft flight control system components. The learner must remove components; however, they may fit a replacement component where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| **Learning outcome** |
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| The learner will:<br>1. Be able to maintain flight control systems on rotorcraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the maintenance of the rotorcraft flight control system:<br>• ensure that appropriate authorisation to work on the rotorcraft is obtained, and observe all relevant isolation and safety procedures<br>• obtain and use the correct documentation (such as job instructions, technical instructions, rotorcraft manuals and maintenance documentation)<br>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates<br>• 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<br>• ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)<br>• ensure the safe isolation of the control system before commencing work on the equipment<br>• where appropriate, apply electrostatic discharge (ESD) avoidance procedures<br>• use approved removal, fitting and testing techniques and procedures at all times<br>• leave the rotorcraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from damage and foreign object debris<br>• return tools and equipment to the correct storage location on completion of the activities<br>• ensure that work carried out is correctly documented and recorded<br>• ensure that any outstanding tests are correctly documented<br>1.3 follow the relevant maintenance schedules to carry out the required work<br>1.4 carry out the maintenance activities within the limits of their personal authority<br>1.5 carry out maintenance on two of the following rotorcraft flight control systems:<br>• main rotor control<br>• tail rotor control<br>• tilt rotor flight control<br>• anti-torque rotor control (yaw control)<br>• servo control |

- rotor flight control system wiring

1.6 carry out the maintenance activities in the specified sequence and in an agreed timescale

1.7 carry out fifteen of the following maintenance activities:

- removing access panels and covers to expose components to be removed
- carrying out fault diagnosis and system checks
- preparing the system for maintenance (such as isolating, releasing stored pressure)
- disconnecting electrical connections
- removing securing devices and mechanical fasteners
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing damaged/defective components
- refitting components in the correct position, orientation and alignment
- setting and adjusting replaced components
- making mechanical connections
- making electrical connections
- torque loading as required
- carrying out functional checks of the system
- ensuring that replacement components have the correct part numbers
- labelling (and storing in the correct location) components that require repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)
- carrying out area inspections prior to task close down

1.8 remove and fit four different rotorcraft flight control system components (at least three must be from group A):

group a:

- collective pitch lever
- cyclic pitch stick
- rudder pedals
- swash plate
- torque tubes
- magnetic brakes
- actuators
- blade pitch change rods
- mixer box/units
- artificial feel units
- elevator
- gradient boxes
- auxiliary servo equipment (ASE)

- primary servo jack
- primary flight computers
- stability augmentation system (SAS)

group b:

- cables and pulleys
- control rods
- position transmitters
- levers and linkages
- actuators/motors/servos
- bell cranks/quadrants
- turnbuckles
- locks and stops
- sensors
- position transmitters
- return springs
- other specific components

1.9 carry out five of the following types of test/check on the rotorcraft flight control systems:

- check collective system rigging
- check cyclic system rigging
- check anti-torque system rigging
- static friction check
- adjust blade trim tab
- check blade track/balance
- built in test equipment (BITE) test
- timings
- cable tension check
- safety interlock test
- adjust pitch links
- pre flight tests
- check controls for operation and sense
- leak test
- 'special-to-type' tests

using two of the following:

- built in test equipment (BITE)
- aircraft power supply/displays and gauges
- ground support equipment
- use of safety locks
- 'special-to-type' test equipment
- measuring equipment

1.10 carry out maintenance on rotorcraft flight control systems in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)

- rotorcraft maintenance manual/approved change documentation (service bulletin)

1.11 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.12 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:

- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.13 dispose of waste materials in accordance with safe working practices and approved procedures

**Learning outcome**

The learner will:

2. Know how to maintain flight control systems on rotorcraft

**Assessment criteria**

The learner can:

2.1 explain the specific safety practices and procedures that they need to observe when working on rotorcraft flight control systems

2.2 explain the importance of maintenance on rotorcraft flight control systems, and impact upon legislation and local procedures

2.3 describe the hazards associated with removing, fitting and testing rotorcraft flight control system components, and with the tools and equipment used, and explain how to minimise them and reduce any risk

2.4 explain what protective equipment they need to use for both personal protection and protection of the rotorcraft

2.5 explain the importance of good aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft

2.6 explain how to extract and use information from rotorcraft maintenance manuals, log books, flight logs, and other documents needed in the maintenance process

2.7 explain how to carry out currency/issue checks on the specifications they are working with

2.8 explain the terminology used in rotorcraft flight control systems, and the use of system diagrams and associated symbols

2.9 describe the basic principles of operation of the rotorcraft flight control system being worked on, and the function of the various units/components within the system

2.10 explain the techniques used to remove components from rotorcraft flight control systems without damage to the components or surrounding structure

2.11 describe the various mechanical fasteners to be removed and replaced, and explain their methods of removal and replacement

2.12 describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections

2.13 explain the importance of applying electrostatic discharge (ESD) avoidance procedures when working on sensitive equipment or devices

2.14 explain the methods of lifting, handling and supporting the components/equipment during the maintenance activities

2.15 explain the methods of checking that components are fit for purpose, and how to identify defects and wear characteristics

2.16 explain the need to label and store correctly components that require repair or overhaul, and to check that replacement components have the correct part/identification markings and accompanying release documentation

2.17 explain how to replace and reconnect components into the system

2.18 explain how to make adjustments to components/assemblies to ensure that they function correctly

2.19 explain why electrical bonding is critical, and why it must be both mechanically and electrically secure

2.20 explain the purpose of symmetry and rigging checks; how they are carried out; how to locate the rigging points and faces; and the use of incidence boards

2.21 explain how to carry out routine checks and servicing of the rotorcraft flight control system

2.22 explain the need to check that cabin/cockpit switches, selectors and circuit breakers are in the correct position before applying any form of external power

2.23 explain what types of test need to be carried out on the rotorcraft flight control system, and the test equipment to be used

2.24 explain the methods and procedures to be used to carry out the various tests on the rotorcraft flight control system

2.25 explain the importance of carrying out the tests in the specified sequence, checking all readings and movements at each stage

2.26 explain how to record the results of each individual test, and the documentation that must be used

2.27 explain how to analyse the test results, and make valid decisions about the acceptability of the flight control systems

2.28 explain the procedures to be followed if the equipment or system fails to meet the test specification

2.29 explain why tool/equipment control is critical, and what to do if a tool or piece of equipment is unaccounted for on completion of the activities

2.30 describe the problems that can occur with the flight control system maintenance operations, and explain how these can be overcome

2.31 explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation

2.32 describe the procedure for the safe disposal of waste materials and scrap components

2.33 describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve

# Unit 735 Maintaining flight control systems on rotorcraft

Supporting information

## Guidance

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

2.10 (such as release of pressures/force, proof marking, extraction of components, and the need to protect the system integrity by fitting blanking plugs and ensuring that exposed components are correctly covered/protected)

2.11 (such as threaded fasteners, special securing devices)

2.17 (such as ensuring the correct orientation, position and alignment; tightening securing devices to the required torque; replacing locking and securing devices; eliminating stress on pipework/connections; ensuring that pipework and cables are correctly supported at suitable intervals; carrying out visual checks of all components)

2.22 (such as electrical, hydraulic, air or vacuum)

# Unit 736 Maintaining power plant on aircraft

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| **UAN:** | **H/601/6298** |
| **Level:** | 3 |
| **Credit value:** | 86 |
| **GLH:** | 168 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 336: Maintaining Power Plant on Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft power plant, in accordance with the approved aircraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It covers both fixed wing and rotary winged aircraft, and covers the overall power package/engine dressing, inclusive of engine air intakes, engine mounts, cowling, scoops and cowl flaps. It does not cover engine strip down and maintenance activities, which are covered in other units/ATA chapters. The maintenance activities will include carrying out a complete engine change, and the removal, fitting and testing of a range of power plant components. The learner will remove the required components and fit approved replacements, as appropriate. The learner will then need to test and adjust the completed system to meet the aircraft maintenance manual, change documentation (service bulletin) and airworthiness requirements.<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the aircraft manual, change/service bulletin documentation and airworthiness requirements for the maintenance activities undertaken, and to report any problems with these requirements 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 are correctly |

accounted for on completion of the activities, and that all necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to aircraft power plant. The learner will understand the component removal, fitting and testing methods and procedures, and their application, along with the power plant maintenance requirements. The learner will know how the equipment functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the aircraft power plant is maintained to the required standard.

The learner will understand the safety precautions required when working on the aircraft power plant, especially those for ensuring that the power plant, and its fuel supply, is safely and correctly isolated. 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.

**Notes:** 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 71 Aircraft Power Plant. 2. To display competence in this unit, it is necessary to both remove and fit aircraft power plant components. The learner must remove components; however, they may fit a replacement component where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| Learning outcome |
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| The learner will:<br>1. Be able to maintain power plant on aircraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the maintenance of the aircraft power plant system:<br>• ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures<br>• obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)<br>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates<br>• 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<br>• ensure the safe isolation and draining of fuel and oil pipes/lines before breaking into the system<br>• ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)<br>• use approved removal, fitting and testing techniques and procedures at all times<br>• leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from fluid spillages, damage and foreign object debris<br>• return tools and equipment to the correct storage location on completion of the activities<br>• ensure that work carried out is correctly documented and recorded<br>• ensure that any outstanding tests are correctly documented<br>1.3 follow the relevant maintenance schedules to carry out the required work<br>1.4 carry out the maintenance activities within the limits of their personal authority<br>1.5 carry out both of the following activities:<br>• contribute significantly to an engine removal<br>• contribute significantly to an engine installation<br>plus: carry out maintenance on three of the following parts of the aircraft power plant:<br>• cowling/containment<br>• engine mounts<br>• attached fittings |

- exhaust components
- fireseals and shrouds
- electrical harness
- nozzles and jet pipes
- engine air intakes
- engine drains
- reverse thrust

1.6 carry out the maintenance activities in the specified sequence and in an agreed timescale

1.7 carry out fifteen of the following maintenance activities:

- removing cowling and containment covers to expose components to be removed
- carrying out fault diagnosis and system checks
- preparing the system for maintenance (such as isolating, draining fluids)
- disconnecting electrical connections
- removal of bonding
- disconnecting/removing hoses and pipes
- removing securing devices and mechanical fasteners
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing damaged/defective components
- replacing single use items such as seals, filters, gaskets
- refitting components in the correct position, orientation and alignment
- setting and adjusting replaced components (such as travel, working clearance)
- making mechanical connections
- making electrical connections
- carrying out bonding
- torque loading as required
- replenishing fluid systems
- carrying out system functional checks
- ensuring that replacement components have the correct part numbers
- fitting blanks, labelling (and storing in the correct location) components that require repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)
- carrying out area inspections prior to task close down

1.8 remove and fit four different aircraft power plant components (at least two must be from group A):

group a:

- accessory section cowls
- nose ring cowls

- compressor fan cowls
- buried engine ducts
- vortex generators
- cowl flaps
- cowling supports
- hydraulic pump
- nozzle exhaust
- fan blades
- scoops
- actuators
- engine mounts
- vibration dampers
- drain lines
- manifolds
- tanks
- integrated drive generator (IDG)
- fuel control/metering unit (FCU/FMU)
- flame arrestors vents
- fire wire
- fire detection units
- fire bottle
- electrical plugs/sockets
- conduits
- position indicators
- starter
- air intake

group b:

- attachment and locking mechanisms
- rod assemblies/levers and linkages
- support links
- fittings and brackets
- cables
- engine mounting bolts
- seals
- cable harness/wiring/switches/plugs
- indicators and warning devices
- other specific components

1.9 service/check aircraft power plant, to include carrying out five of the following:

- visually checking power plant for damage and leaks
- checking fastenings/security of all power plant access panels/cowls
- examining engine mounting bolt assemblies
- checking the starting system
- checking cowl flap rigging
- checking indicating and warning systems

- carrying out nozzle rigging

1.10 assist in carrying out an engine ground run test, to include carrying out all of the following:

- checking that the aircraft is correctly parked in authorised position for a ground run
- positioning all required safety equipment prior to ground run
- carrying out prescribed pre-start and start procedures
- ground running an engine in accordance with maintenance manual and local authority requirements/regulations
- checking and recording all specified parameters
- shutting down the engine in accordance with specified procedures

1.11 carry out maintenance on aircraft power plant in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Extended Range Twin-Engine Operations Procedures (ETOPS) (where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/approved change documentation (service bulletin)

1.12 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.13 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:

- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.14 dispose of waste materials in accordance with safe working practices and approved procedures

| **Learning outcome** |
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| The learner will:<br>2. Know how to maintain power plant on aircraft |
| **Assessment criteria** |
| The learner can:<br>2.1 explain the specific safety practices and procedures that they need to observe when working on aircraft power plant<br>2.2 explain the need to check that cabin/cockpit switches, selectors and circuit breakers are in the correct position before applying any form of external power<br>2.3 explain the importance of maintenance on aircraft power plant, and impact upon ETOPS systems, Electrical Wiring Interconnect systems (EWIS), legislation and local procedures<br>2.4 describe the hazards associated with carrying out maintenance activities on aircraft power plant, and with the tools and equipment |

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| | used, and explain how to minimise them and reduce any risk |
| 2.5 | explain what protective equipment they need to use for both personal protection and protection of the aircraft |
| 2.6 | explain the importance of aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft |
| 2.7 | explain how to extract and use information from aircraft manuals, log books, flight logs, charts, system and physical layouts, specifications, symbols used in aircraft power plant, and other documents in the maintenance activities |
| 2.8 | explain how to carry out currency/issue checks on the specifications they are working with |
| 2.9 | explain the terminology used in aircraft power plant, and the use of system diagrams and associated symbols |
| 2.10 | describe the basic principles of operation of the power plant being worked on, and the function of the units that make up the system |
| 2.11 | explain the techniques used to remove power plant and power plant components without damage to the components or surrounding structure |
| 2.12 | describe the various mechanical fasteners to be removed and replaced, and their methods of removal and replacement |
| 2.13 | describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections |
| 2.14 | explain the need to label and store correctly components that require repair or overhaul, and to check that replacement components have the correct part/identification markings and accompanying release documentation |
| 2.15 | explain how to remove and refit aircraft power plant components safely and correctly |
| 2.16 | explain how to make adjustments to components/assemblies to ensure that they function correctly |
| 2.17 | explain why securing devices need to be tightened to the correct torque, locked and labelled, and the different methods that are used |
| 2.18 | describe the tools and equipment used in the maintenance activities, and explain their calibration/care and control procedures |
| 2.19 | explain why tool/equipment control is critical, and what to do if a tool or piece of equipment is unaccounted for on completion of the activities |
| 2.20 | explain what routine checks and tests need to be carried out on the aircraft power plant |
| 2.21 | explain how to conduct engine ground runs, and the engine data/parameters to be recorded |
| 2.22 | explain the importance of carrying out the engine ground run in accordance with the aircraft manual and regulations |
| 2.23 | explain how to record the results of the engine ground run, and the documentation that must be used |
| 2.24 | explain how to analyse the ground run results, and how to make valid decisions about the acceptability of the aircraft power unit under test |
| 2.25 | explain the procedures to be followed if the power plant fails to meet the ground run specification |

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| 2.26 | describe the procedure for the safe disposal of waste materials, scrap components and fuel/fluids |
| 2.27 | describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve |

# Unit 736 Maintaining power plant on aircraft

Supporting information

## Guidance

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

2.2 (such as electrical, hydraulic, air or vacuum)

2.4 (such as handling oils, greases, aviation fuel, the safe release of fuel and other fluids, traps from moving parts, hot parts of engines, misuse of tools)

2.11 (such as release of pressures/force, draining of fuel/fluids, removal of components and the need to protect the system integrity by ensuring that exposed components and pipe ends are correctly covered/protected)

2.12 (such as threaded fasteners, special securing devices)

2.15 (such as use of lifting and handling equipment; ensuring the correct tightness of connections; eliminating stress on pipework/connections; carrying out visual checks of all components)

2.16 (such as travel and working clearance)

# Unit 737 Maintaining turbine engines on aircraft

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| **UAN:** | **K/601/6299** |
| **Level:** | 3 |
| **Credit value:** | 86 |
| **GLH:** | 168 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 337: Maintaining Turbine Engines on Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft turbine engines, in accordance with the approved aircraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It covers both fixed wing and rotary winged aircraft, and covers the general maintenance requirements. It does not cover complete engine overhaul, for which other units are available. The maintenance activities will include carrying out the removal, fitting and testing of a range of turbine engine components. The learner will remove the required components and fit approved replacements, as appropriate. The learner will then need to test and adjust the completed system to meet the aircraft maintenance manual, change documentation (service bulletin) and airworthiness requirements.<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the aircraft manual, change/service bulletin documentation and airworthiness requirements for the maintenance activities undertaken, and to report any problems with these requirements 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 are correctly accounted for on completion of the activities, and that all necessary job/task documentation is |

completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to aircraft turbine engines. The learner will understand the component removal, fitting and testing methods and procedures, and their application, along with the turbine engine maintenance requirements. The learner will know how the equipment functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the aircraft turbine engine is maintained to the required standard.

The learner will understand the safety precautions required when working on the aircraft turbine engines, especially those for ensuring that the engine, and its fuel supply, is safely and correctly isolated. 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.

**Notes:** 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 72 Aircraft Turbine Engines. 2. To display competence in this unit, it is necessary to both remove and fit aircraft turbine engine components. The learner must remove components; however, they may fit a replacement component where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| **Learning outcome** |
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| The learner will:<br>1. Be able to maintain turbine engines on aircraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the maintenance of the aircraft |

turbine engine:

- ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures
- obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)
- obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates
- adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
- ensure the safe isolation and draining of fluid lines before breaking into the system
- ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)
- use approved removal, fitting and testing techniques and procedures at all times
- leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from fluid spillages, damage and foreign object debris
- return tools and equipment to the correct storage location on completion of the activities
- ensure that work carried out is correctly documented and recorded
- ensure that any outstanding tests are correctly documented

1.3 follow the relevant maintenance schedules to carry out the required work

1.4 carry out the maintenance activities within the limits of their personal authority

1.5 carry out maintenance on one of the following types of aircraft turbine engine:

- turbo prop
- ducted fan
- un-ducted fan
- turbo jet
- turbo-shaft
- turbo-fan

1.6 carry out maintenance on two of the following parts of the aircraft turbine engine:

- air intake section
- air inlet section
- compressor section
- combustion section
- turbine section
- fan section
- accessory drives

- by-pass section
- reverse thrust
- propulsor section (rear mounted)
- nozzles and jet pipes
- reduction gear and shaft section (turboprop or front-mounted driven propulsor)

1.7 carry out the maintenance activities in the specified sequence and in an agreed timescale

1.8 carry out fifteen of the following maintenance activities:

- removing cowling and fairings to expose components to be removed
- carrying out inspections, fault diagnosis and system checks
- preparing the system for maintenance (such as isolating, draining fluids)
- disconnecting electrical connections
- disconnecting/removing hoses and pipes
- removing securing devices and mechanical fasteners
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing damaged/defective components
- replacing single use items such as seals, filters, gaskets
- refitting components in the correct position, orientation and alignment
- setting and adjusting replaced components
- making mechanical connections
- making electrical connections
- torque loading as required
- replenishing fluid systems
- carrying out system functional checks
- ensuring that replacement components have the correct part numbers
- fitting blanks, labelling (and storing in the correct location) components that require repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)
- carrying out area inspections prior to task close down

1.9 remove and fit six different aircraft turbine engine components (at least two must be from group A):

group a:

- drive shafts
- reduction gears
- propulsor blades
- guide vanes
- shrouds
- rotor/stator fan blades

- burner cans
- turbine nozzles
- hydraulic pump
- nozzle exhaust
- gearboxes/gearbox housing
- drive tubs/shafts
- oil pump assembly
- compressor spinners
- curvic couplings
- nose cone support rings
- front and rear blade root chocking pads
- bearing support assembly
- integrated drive generator (IDG)
- fuel control/meter unit (FCU/FMU)
- annulus fillers/sealing strips
- attrition linings
- compressor support structural fairings
- bearing housing end cover
- bearings
- cooling air manifold
- valves (such as oil tank check)
- starter
- air intake

group b:

- attachment and locking mechanisms
- rod assemblies/levers and linkages
- support links
- mounting bolts
- fittings and brackets
- cables
- nose cowl
- seals
- fairings
- cable harness/wiring/switches/plugs
- indicators and warning devices
- other specific components

1.10 service/check aircraft turbine engines, to include carrying out four of the following:

- visually checking the system for damage and leaks
- checking fastenings/security of all engine access panels/cowls
- checking and cleaning rotor and compressor blades (compressor washing)
- oil replenishment
- carrying out vibration checks
- carrying out blade tip clearance checks
- carrying out transient acoustic propagation (TAP) test of

rotor/compressor blades

1.11 carry out maintenance on aircraft turbine engines in compliance with one of the following:
- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Extended Range Twin-Engine Operations Procedures (ETOPS) (where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/approved change documentation (service bulletin)

1.12 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.13 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:
- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.14 dispose of waste materials in accordance with safe working practices and approved procedures

| **Learning outcome** |
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| The learner will:<br>2. Know how to maintain turbine engines on aircraft |
| **Assessment criteria** |
| The learner can:<br>2.1 explain the specific safety practices and procedures that they need to observe when working on aircraft turbine engines<br>2.2 explain the need to check that cabin/cockpit switches, selectors and circuit breakers are in the correct position before applying any form of external power<br>2.3 explain the importance of maintenance on aircraft turbine engines, and impact upon ETOPS systems, Electrical Wiring Interconnect Systems (EWIS), legislation and local procedures<br>2.4 describe the hazards associated with carrying out maintenance activities on aircraft turbine engines, and with the tools and equipment used, and explain how to minimise them and reduce any risk<br>2.5 explain what protective equipment they need to use for both personal protection and protection of the aircraft<br>2.6 explain the importance of good aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft<br>2.7 explain how to extract and use information from aircraft manuals, log books, flight logs, charts, system and physical layouts, specifications, symbols used in aircraft turbine engines, and other documents in the maintenance activities |

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| 2.8 | explain how to carry out currency/issue checks on the specifications they are working with |
| 2.9 | explain the terminology used in aircraft turbine engines, and the use of system diagrams and associated symbols |
| 2.10 | describe the basic principles of operation of the turbine engine being worked on, and the function of the units that make up the system |
| 2.11 | explain the techniques used to remove turbine engine components without damage to the components or surrounding structure |
| 2.12 | describe the various mechanical fasteners to be removed and replaced, and explain their methods of removal and replacement |
| 2.13 | describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections |
| 2.14 | explain the need to label and store correctly components that require repair or overhaul, and to check that replacement components have the correct part/identification markings and accompanying release documentation |
| 2.15 | explain how to remove and refit aircraft turbine engine components safely and correctly |
| 2.16 | explain how to make adjustments to components/assemblies to ensure that they function correctly |
| 2.17 | explain why securing devices need to be tightened to the correct torque, locked and labelled, and the different methods that are used |
| 2.18 | describe the tools and equipment used in the maintenance activities, and explain their calibration/care and control procedures |
| 2.19 | explain why tool/equipment control is critical, and what to do if a tool or piece of equipment is unaccounted for on completion of the activities |
| 2.20 | explain what routine checks and tests need to be carried out on the aircraft turbine engine |
| 2.21 | explain how to record the results of the checks and tests, and the documentation that must be used |
| 2.22 | explain how to analyse the checks and tests, and make valid decisions about the acceptability of the aircraft turbine engine |
| 2.23 | describe the procedure for the safe disposal of waste materials, scrap components and fuel/fluids |
| 2.24 | describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve |

# Unit 737 Maintaining turbine engines on aircraft

Supporting information

## Guidance

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

2.2 (such as electrical, hydraulic, air or vacuum)

2.4 (such as handling oils, greases, the safe release of fuel and other fluids, traps from moving parts, hot parts of engines, misuse of tools)

2.11 (such as release of pressures/force, draining of fuel/fluids, removal of components and the need to protect the system integrity by ensuring that exposed components and pipe ends are correctly covered/protected)

2.12 (such as threaded fasteners, special securing devices)

2.15 (such as use of lifting and handling equipment; ensuring the correct tightness of connections; eliminating stress on pipework/connections; carrying out visual checks of all components)

2.16 (such as blade tip clearance)

# Unit 738 Maintaining reciprocating engines on aircraft

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| **UAN:** | **M/601/6336** |
| **Level:** | 3 |
| **Credit value:** | 86 |
| **GLH:** | 168 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 338: Maintaining Reciprocating Engines on Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft reciprocating engines, both spark and compression ignition, in accordance with the approved aircraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It covers both fixed wing and rotary winged aircraft, and covers the general maintenance requirements. It does not cover complete engine overhaul, for which other units are available. The maintenance activities will include carrying out the removal, fitting and testing of a range of reciprocating engine components. The learner will remove the required components and fit approved replacements, as appropriate. The learner will then need to test and adjust the completed system to meet the aircraft maintenance manual, change documentation (service bulletin) and airworthiness requirements.<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the aircraft manual, change/service bulletin documentation and airworthiness requirements for the maintenance activities undertaken, and to report any problems with these requirements 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 are correctly accounted for on completion of the |

activities, and that all necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to aircraft reciprocating engines. The learner will understand the component removal, fitting and testing methods and procedures, and their application, along with the reciprocating engines maintenance requirements. The learner will know how the equipment functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the aircraft reciprocating engine is maintained to the required standard.

The learner will understand the safety precautions required when working on the aircraft reciprocating engines, especially those for ensuring that the engine, and its fuel supply, is safely and correctly isolated. 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.

**Notes:** 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 72 Aircraft Reciprocating Engines. 2. To display competence in this unit, it is necessary to both remove and fit aircraft reciprocating engine components. The learner must remove components; however, they may fit a replacement component where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| **Learning outcome** |
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| The learner will:<br>1. Be able to maintain reciprocating engines on aircraft |
| **Assessment criteria** |
| The learner can:<br>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 maintenance of the aircraft reciprocating engine:

- ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures
- obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)
- obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates
- adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
- ensure the safe isolation and draining of fluid lines before breaking into the system
- ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)
- use approved removal, fitting and testing techniques and procedures at all times
- leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from fluid spillages, damage and foreign object debris
- return tools and equipment to the correct storage location on completion of the activities
- ensure that work carried out is correctly documented and recorded
- ensure that any outstanding tests are correctly documented

1.3 follow the relevant maintenance schedules to carry out the required work

1.4 carry out the maintenance activities within the limits of their personal authority

1.5 carry out maintenance on one of the following types of aircraft reciprocating engine:

- in-line engine
- horizontally-opposed engine
- vee engine
- rotary engine

1.6 carry out maintenance on three of the following parts of the aircraft reciprocating engine:

- front section (drive)
- power section
- cylinder section
- supercharger section
- lubrication system
- power recovery section

1.7 carry out the maintenance activities in the specified sequence and in an agreed timescale

1.8 carry out fifteen of the following maintenance activities:

- removing cowling and fairings to expose components to be removed
- carrying out inspections, fault diagnosis and system checks
- preparing the system for maintenance (such as isolating, draining fluids)
- disconnecting electrical connections
- disconnecting/removing hoses and pipes
- removing securing devices and mechanical fasteners
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing damaged/defective components
- replacing single use items such as seals, filters, gaskets
- refitting components in the correct position, orientation and alignment
- setting and adjusting replaced components (such as valve clearance, bearing end float)
- making mechanical connections
- making electrical connections
- torque loading as required
- replenishing fluid systems
- carrying out system functional checks
- ensuring that replacement components have the correct part numbers
- fitting blanks, labelling (and storing in the correct location) components that require repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)
- carrying out area inspections prior to task close down

1.9 remove and fit six different aircraft reciprocating engine components (at least three must be from group A):

group a:

- cylinder heads
- cylinder liners
- fly wheel
- torque converter
- gearbox
- oil pump assembly
- reduction gear
- piston assemblies
- camshaft assemblies
- crank shafts
- pushrods
- timing mechanisms

- shell bearings
- injector mechanisms
- turbo/supercharger
- carburettor systems
- valve mechanisms
- bearing housing end cover
- ball/roller bearings
- manifolds

group b:

- attachment and locking mechanisms
- rod assemblies/levers and linkages
- fittings and brackets
- pulleys and sprockets
- belts and chains
- cables
- springs
- sump pans
- seals and gaskets
- fairings
- pipes and unions
- filters/strainers

1.10 service/check aircraft reciprocating engines, to include carrying out five of the following:

- visually checking the system for damage and leaks
- checking fastenings/security of all engine access panels/cowls
- testing and, where appropriate, changing plugs
- carrying out compression checks
- checking and adjusting fuel and ignition timing
- checking and adjusting valve clearance
- checking reference RPM
- checking magnetic chip detectors/filters, and examining foreign matter
- checking and, where appropriate, changing high tension leads
- checking and replenishing oil levels

1.11 carry out maintenance on aircraft reciprocating engines in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Extended Range Twin-Engine Operations Procedures (ETOPS) (where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/approved change documentation (service bulletin)

1.12 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.13 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:
- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.14 dispose of waste materials in accordance with safe working practices and approved procedures

**Learning outcome**

The learner will:

2. Know how to maintain reciprocating engines on aircraft

**Assessment criteria**

The learner can:

2.1 explain the specific safety practices and procedures that they need to observe when working on aircraft reciprocating engines

2.2 explain the need to check that cabin/cockpit switches, selectors and circuit breakers are in the correct position before applying any form of external power

2.3 explain the importance of maintenance on aircraft reciprocating engines and impact upon ETOPS systems, Electrical Wiring Interconnect Systems (EWIS), legislation and local procedures

2.4 describe the hazards associated with carrying out maintenance activities on aircraft reciprocating engines, and with the tools and equipment used, and explain how to minimise them and reduce any risk

2.5 explain what protective equipment they need to use for both personal protection and protection of the aircraft

2.6 explain the importance of good aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft

2.7 explain how to extract and use information from aircraft manuals, log books, flight logs, charts, system and physical layouts, specifications, symbols used in aircraft reciprocating engines, and other documents needed in the maintenance activities

2.8 explain how to carry out currency/issue checks on the specifications they are working with

2.9 explain the terminology used in aircraft reciprocating engines, and the use of system diagrams and associated symbols

2.10 describe the basic principles of operation of the reciprocating engine being worked on, and the function of the units that make up the system

2.11 explain the techniques used to remove reciprocating engine components without damage to the components or surrounding structure

2.12 describe the various mechanical fasteners to be removed and replaced, and their methods of removal and replacement

2.13 describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections

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| 2.14 | explain the need to label and store correctly components that require repair or overhaul, and to check that replacement components have the correct part/identification markings and accompanying release documentation |
| 2.15 | explain how to remove and refit aircraft reciprocating engine components safely and correctly |
| 2.16 | explain how to make adjustments to components/assemblies to ensure that they function correctly |
| 2.17 | explain why securing devices need to be tightened to the correct torque, locked and labelled, and the different methods that are used |
| 2.18 | describe the tools and equipment used in the maintenance activities, and explain their calibration/care and control procedures |
| 2.19 | explain why tool/equipment control is critical, and what to do if a tool or piece of equipment is unaccounted for on completion of the activities |
| 2.20 | explain what routine checks and tests need to be carried out on the aircraft reciprocating engine |
| 2.21 | explain how to record the results of the checks and tests, and the documentation that must be used |
| 2.22 | explain how to analyse the checks and tests, and how to make valid decisions about the acceptability of the aircraft reciprocating engine |
| 2.23 | describe the procedure for the safe disposal of waste materials, scrap components and fuel/fluids |
| 2.24 | describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve |

# Unit 738 Maintaining reciprocating engines on aircraft

Supporting information

## Guidance

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

2.2 (such as electrical, hydraulic, air or vacuum)

2.4 (such as handling oils, greases, the safe release of fuel and other fluids, traps from moving parts, hot parts of engines, misuse of tools)

2.11 (such as release of pressures/force, draining of fuel/fluids, removal of components and the need to protect the system integrity by ensuring that exposed components and pipe ends are correctly covered/protected)

2.12 (such as threaded fasteners, special securing devices)

2.15 (such as use of lifting and handling equipment; ensuring the correct tightness of connections; eliminating stress on pipework/connections; carrying out visual checks of all components)

2.16 (such as valve clearance, ignition timing, belt/chain tension)

# Unit 739 Maintaining engine fuel and control systems on aircraft

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| **UAN:** | **F/601/6339** |
| **Level:** | 3 |
| **Credit value:** | 55 |
| **GLH:** | 133 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 339: Maintaining Engine Fuel and Control Systems on Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft engine fuel and control systems, in accordance with the approved aircraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It covers fixed wing and rotary winged aircraft, and includes both turbine and reciprocating engines. For turbine engines, it covers those units and components and associated mechanical systems or electrical circuits which deliver or control fuel to the engine beyond the main fuel quick disconnect. This includes engine driven fuel pumps and filter assembly, main and thrust augmention fuel controls, electronic temperature datum control, temperature datum valve, fuel manifold, fuel nozzles, fuel enrichment system, speed sensitivity switch, relay box assembly, solenoid drip valves, etc. For reciprocating engines, it covers those units and components which deliver metered fuel and air to the engine, and includes the carburettor master control from the inlet side to the discharge nozzles, injection pumps, carburettor, injection nozzles and fuel primer. The air portion includes units and components from the scoop inlet to the vapour return and impeller chamber. The maintenance activities will include the removal, fitting and testing of a range of engine fuel system components. The learner will be expected to use the approved procedure for correctly isolating the fuel supply and the system before breaking into the system circuit. |

The learner will remove the required components and fit approved replacements, as appropriate. The learner will then need to test and adjust the completed system to meet the aircraft maintenance manual, change documentation (service bulletin) and airworthiness requirements.

The learner's responsibilities will require them to comply with the specific practices and procedures identified in the aircraft manual, change/service bulletin documentation and airworthiness requirements for the maintenance activities undertaken, and to report any problems with these requirements 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 are correctly accounted for on completion of the activities, and that all necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to aircraft engine fuel and control systems. The learner will understand the removal, fitting and testing methods and procedures, and their application, along with the engine fuel and control system maintenance requirements. The learner will know how the equipment functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the equipment is maintained to the required standard.

The learner will understand the safety precautions required when working on aircraft engine fuel and control systems, especially those for ensuring the system cleanliness and the avoidance of spillage, fire and explosion. 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.

**Notes:** 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 73 Engine Fuel and Control. 2. To display competence in

this unit, it is necessary to both remove and fit aircraft engine fuel and control system components. The learner must remove components; however, they may fit a replacement component where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| **Learning outcome** |
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| The learner will:<br>1. Be able to maintain engine fuel and control systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the maintenance of the aircraft engine fuel and control system:<br>• ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures<br>• obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)<br>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates<br>• adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment, breathing apparatus and other relevant safety regulations and procedures to realise a safe system of work<br>• ensure the safe isolation and ventilation of the fuel equipment before breaking into the system<br>• ensure that the relevant safety devices, mechanical/physical locks and external signage are in place (where appropriate)<br>• use approved removal, fitting and testing techniques and procedures at all times<br>• leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from damage and foreign object debris<br>• return tools and equipment to the correct storage location on completion of the activities<br>• ensure that work carried out is correctly documented and recorded<br>• ensure that any outstanding tests are correctly documented<br>1.3 follow the relevant maintenance schedules to carry out the required work<br>1.4 carry out the maintenance activities within the limits of their personal authority |

1.5 carry out maintenance on two of the following parts of the aircraft engine fuel and control system:

- distribution
- controlling and governing
- indicating

1.6 carry out the maintenance activities in the specified sequence and in an agreed timescale

1.7 carry out fifteen of the following maintenance activities:

- removing access panels and covers to expose components to be removed
- carrying out fault diagnosis and system checks
- preparing the system for maintenance (such as isolating, draining and removing fuel)
- disconnecting electrical connections
- disconnecting/removing hoses and pipes
- removing securing devices and mechanical fasteners
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing damaged/defective components
- replacing single use items such as seals, filters, gaskets
- refitting components in the correct position, orientation and alignment
- making mechanical connections
- making electrical connections
- torque loading as required
- charging and bleeding the fuel system
- carrying out system functional checks
- ensuring that replacement components have the correct part numbers
- fitting blanks, labelling (and storing in the correct location) components that require repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)
- carrying out area inspections prior to task close down

1.8 remove and fit six different aircraft engine fuel and control system components (at least two must be from group A):

group a:

- control valves (such as fuel return, temperature datum, solenoid drip, burner staging)
- engine driven pump
- fuel nozzles
- injector nozzles
- turbine governor
- fuel flow divider
- stator alternator

- engine control unit
- rotor alternator
- fuel manifold
- fuel primer
- carburettor
- injector pump
- engine fuel/oil cooler
- engine interface unit
- hydro-mechanical units
- servo fuel heater
- relay box assembly
- valves
- solenoids
- electronic control unit

group b:

- pipes/hose assemblies
- levers and linkages
- cables and pulleys
- actuators
- safety devices
- fuel filters
- fuel flow sensor/transmitter
- temperature regulator
- gaskets and seals
- fuel pressure indicating devices
- differential fuel switch
- fuel flow indicating devices
- other specific components

1.9 service/check the aircraft engine fuel and control system, to include carrying out three of the following:

- checking the system for leaks
- checking and cleaning/replacing filters
- cleaning injector nozzles
- checking carburettor float setting
- checking fuel/meter control unit (FCU/FMU)
- adjust/rigging throttle box
- cleaning/testing fuel nozzles
- adjusting AMC
- adjusting ABC
- checking indicating systems (such as fuel flow, fuel pressure and temperature warning)

1.10 carry out two of the following tests on the aircraft engine fuel and control system:

- leak test
- fuel pressure test
- fuel flow test

- built in test equipment (BITE) test
- 'special-to-type' tests
- engine run

using one of the following:

- aircraft power source/system
- ground test rig
- 'special to type' test equipment

1.11 carry out maintenance on aircraft engine fuel and control systems in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Extended Range Twin-Engine Operations Procedures (ETOPS) (where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/approved change documentation (service bulletin)

1.12 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.13 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:

- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.14 dispose of waste materials in accordance with safe working practices and approved procedures

| **Learning outcome** |
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| The learner will:<br>2. Know how to maintain engine fuel and control systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>2.1 explain the specific safety practices and procedures that they need to observe when carrying out maintenance activities on aircraft engine fuel and control systems<br>2.2 explain the importance of maintenance on aircraft engine fuel and control systems, and impact upon ETOPS systems, Electrical Wiring Interconnect Systems (EWIS), legislation and local procedures<br>2.3 explain the safety procedures that must be carried out before work is started on removing the engine fuel and control system components<br>2.4 describe the hazards associated with removing aircraft engine fuel and control system components, and with the tools and equipment used, and explain how to minimise them and reduce any risk<br>2.5 explain what protective equipment that they need to use for both personal protection and protection of the aircraft<br>2.6 explain the importance of aircraft husbandry and of ensuring that, |

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| | throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft |
| 2.7 | explain how to extract and use information from aircraft manuals, log books, flight logs, charts, circuit and physical layouts, specifications, symbols used in aircraft engine fuel and control systems, and other documents needed in the maintenance process |
| 2.8 | explain how to carry out currency/issue checks on the specifications they are working with |
| 2.9 | explain the terminology used in aircraft engine fuel and control systems |
| 2.10 | describe the various types of pipe and components that make up the aircraft engine fuel and control system |
| 2.11 | describe the basic principles of operation of the aircraft engine fuel and control system being worked on, and the function of the various units/components within the system |
| 2.12 | explain the techniques used to remove components from aircraft engine fuel and control systems without damage to the components or surrounding structure |
| 2.13 | describe the various mechanical fasteners to be removed and replaced, and explain their methods of removal and replacement |
| 2.14 | describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections |
| 2.15 | explain the methods of lifting, and supporting the components/equipment during the maintenance activities |
| 2.16 | explain how to recognise contaminants, and the problems they can create; the effects and likely symptoms of contamination in the engine fuel system |
| 2.17 | explain the need to label and store correctly components that require repair or overhaul, and to check that replacement components have the correct part/identification markings and accompanying release documentation |
| 2.18 | explain how to fit components into the circuit |
| 2.19 | explain how to make adjustments to components/assemblies to ensure that they function correctly |
| 2.20 | explain why electrical bonding is critical, and why it must be both mechanically and electrically secure |
| 2.21 | explain why securing devices need to be correctly torqued, locked and labelled, and the different methods used |
| 2.22 | explain how to carry out routine checks and servicing of the aircraft engine fuel and control system |
| 2.23 | explain what types of test need to be carried out on the aircraft engine fuel system, and the test equipment to be used |
| 2.24 | explain the methods and procedures to be used to carry out the various tests on the engine fuel and control system |
| 2.25 | explain the importance of carrying out tests in the specified sequence and checking/recording the results at each stage |
| 2.26 | explain how to record the results of each individual test, and the documentation that must be used |
| 2.27 | explain how to analyse the test results, and how to make valid decisions about the acceptability of the aircraft engine fuel and control system |
| 2.28 | explain the procedures to be followed if the equipment or system |

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| | fails to meet the test specification |
| 2.29 | explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation |
| 2.30 | describe the procedure for the safe disposal of waste materials, scrap components and waste fuel |
| 2.31 | describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve |

# Unit 739 Maintaining engine fuel and control systems on aircraft

Supporting information

## Guidance

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

2.3 (such as displaying warning notices, ensuring adequate fire fighting equipment)

2.4 (such as handling fluids, flammable fluids, fire and explosion, misuse of tools)

2.10 (such as rigid pipes; flexible hoses; valves, pumps, injector nozzles, governor, fuel heater, fuel and oil cooler, mechanical and electrical control and indicating devices)

2.12 (such as release of pressures/force, draining of fluids, proof marking, and the protecting circuit integrity by ensuring that exposed components and pipe ends are correctly covered/protected)

2.13 (such as threaded fasteners, special securing devices)

2.18 (such as the use of gaskets/seals; ensuring the correct tightness of pipe fittings and connections; eliminating stress on pipework/connections; carrying out visual checks of all components; checking the security of joints and that the system is safe to refuel)

2.19 (such as flow and pressure settings and their effect on the engine fuel system)

2.22 (including checking for leaks, checking and changing filters, checking and cleaning injectors and fuel nozzles)

# Unit 740 Maintaining ignition systems on aircraft

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| **UAN:** | **T/601/6340** |
| **Level:** | 3 |
| **Credit value:** | 71 |
| **GLH:** | 147 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 340: Maintaining Ignition Systems on Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft ignition systems, in accordance with the approved aircraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It covers both fixed wing and rotary winged aircraft, and includes units and components which generate the electrical power, control and provide or distribute high and low voltage electrical current to ignite the fuel air mixture in the cylinders of reciprocating engines or in the combustion chambers or thrust augmentation of turbine engines. The maintenance activities will include the removal, fitting and testing of a range of ignition system components. The learner will be required to select the correct tools and equipment to use, based on the operations to be performed and the components to be removed or replaced. The aircraft ignition components will include items such as induction vibrators, magnetos, distributors, exciters, booster coils, transformers, storage capacitors, spark plugs, igniters, ignition harness and other associated wiring and switches. The learner will remove the required components and fit approved replacements, as appropriate. The learner will then need to test and adjust the completed system to meet the aircraft maintenance manual, change documentation (service bulletin) and airworthiness requirements.<br>The learner's responsibilities will require them to comply with the specific practices and |

procedures identified in the aircraft manual, change/service bulletin documentation and airworthiness requirements for the maintenance activities undertaken, and to report any problems with these requirements 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 are correctly accounted for on completion of the activities, and that all necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to aircraft ignition systems. The learner will understand the removal, fitting and testing methods and procedures, and their application, along with the system maintenance requirements. The learner will know how the equipment functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the ignition system is maintained to the required standard

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

**Notes:** 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 74 Ignition. 2. To display competence in this unit, it is necessary to both remove and fit aircraft ignition system components. The learner must remove components; however, they may fit a replacement component where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| Learning outcome |
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| The learner will:<br>1. Be able to maintain ignition systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the maintenance of the aircraft ignition system:<br>• ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures<br>• obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)<br>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates<br>• 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<br>• ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)<br>• where appropriate, apply electrostatic discharge (ESD) avoidance procedures<br>• use approved removal, fitting and testing techniques and procedures at all times<br>• leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from damage and foreign object debris<br>• return tools and equipment to the correct storage location on completion of the activities<br>• ensure that work carried out is correctly documented and recorded<br>• ensure that any outstanding tests are correctly documented<br>1.3 follow the relevant maintenance schedules to carry out the required work<br>1.4 carry out the maintenance activities within the limits of their personal authority<br>1.5 carry out maintenance on two of the following parts of the aircraft ignition system:<br>• generation of high and low voltage electrical power supply<br>• distribution of the power supply (ignition harness)<br>• ignition switching/isolation<br>1.6 carry out the maintenance activities in the specified sequence and in an agreed timescale<br>1.7 carry out fifteen of the following maintenance activities:<br>• removing access panels and covers to expose components to |

be removed
- carrying out fault diagnosis and system checks
- preparing the system for maintenance (such as isolating)
- disconnecting electrical connections
- removal of bonding
- removing cable securing devices
- making mechanical connections
- making electrical connections
- carrying out bonding
- removing securing devices and mechanical fasteners
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing all damaged/defective components
- refitting components in the correct position, orientation and alignment
- installing cable securing devices
- torque loading as required
- setting and adjusting replaced components (such as spark plug gap, distributor settings, ignition timing, igniter plug immersion depth)
- carrying out functional checks of the system
- ensuring that replacement components have the correct part numbers
- labelling (and storing in the correct location) components that require repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)
- carrying out area inspections prior to task close down

1.8 remove and fit six different ignition system components (at least two must be from group A):

group a:
- magneto
- distributor
- ignition/induction vibrator
- high energy ignition units
- low tension coil
- ignition relays
- exciters
- transformers
- ignition harness
- ignition switches
- capacitors
- booster coils

group b:

- spark plugs
- glow plugs
- high tension leads
- low tension leads
- electrical plugs/sockets
- igniters
- transducers/sensors
- wires/cables

1.9 carry out two of the following types of check/test on the aircraft ignition system:

- test spark plugs
- test glow plugs
- check ignition unit
- check HT leads
- ignition timing
- test igniters
- BITE test
- 'special-to-type' tests

using one of the following:

- stroboscope
- aircraft power source
- 'special-to-type' test sets
- measuring equipment (such as gap gauges)

1.10 carry out maintenance on aircraft ignition systems in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Extended Range Twin-Engine Operations Procedures (ETOPS) (where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/approved change documentation (service bulletin)

1.11 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.12 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:

- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.13 dispose of waste materials in accordance with safe working practices and approved procedures

| Learning outcome |
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| The learner will:<br>2. Know how to maintain ignition systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>2.1 explain the specific safety practices and procedures that they need to observe when working with aircraft ignition systems<br>2.2 explain the importance of maintenance on aircraft ignition systems, and impact upon ETOPS systems, Electrical Wiring Interconnect Systems (EWIS), legislation and local procedures<br>2.3 describe the hazards associated with removing, fitting and testing aircraft ignition system components, and with the tools and equipment used, and explain how to minimise them and reduce any risk<br>2.4 explain what protective equipment that they need to use for both personal protection and protection of the aircraft<br>2.5 explain the importance of good aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft<br>2.6 explain how to extract and use information from aircraft manuals, log books, flight logs, charts, circuit and physical layouts, specifications, symbols used in aircraft ignition systems, and other documents needed in the maintenance process<br>2.7 explain how to carry out currency/issue checks on the specifications they are working with<br>2.8 explain the terminology used in aircraft ignition systems, and the use of system diagrams and associated symbols<br>2.9 describe the basic principles of operation of the ignition system being worked on, and the function of the various units within the system<br>2.10 describe the various mechanical fasteners that are used, and explain their methods of removal and replacement<br>2.11 explain the importance of using the specified fasteners for the installation, and why they must not substitute others<br>2.12 explain why securing devices need to be locked and labelled, and the different methods that are used to remove and install them<br>2.13 explain the torque loading requirements on the fasteners, and what to do if these loadings are exceeded or not achieved<br>2.14 describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections<br>2.15 explain the techniques used to remove components from aircraft ignition systems without damage to the components or surrounding structure<br>2.16 explain the importance of applying electrostatic discharge (ESD) avoidance procedures when working on sensitive equipment or devices<br>2.17 explain the need to label and store correctly components that require repair or overhaul, and to check that replaced components have the correct part/identification markings and accompanying release documentation |

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| 2.18 | explain the techniques used to position, align, adjust and secure the replaced components without damage to the components or surrounding structure |
| 2.19 | explain the procedures for ensuring that they have the correct tools, equipment, components and fasteners for the activities |
| 2.20 | explain the methods of lifting, handling and supporting the components/equipment during the maintenance activities |
| 2.21 | explain why electrical bonding is critical, and why it must be both mechanically and electrically secure |
| 2.22 | describe the tools and equipment used in the maintenance activities, and explain their calibration/care and control procedures |
| 2.23 | explain why tool/equipment control is critical, and what to do if a tool or piece of equipment is unaccounted for on completion of the activities |
| 2.24 | describe the problems that can occur with the maintenance operations, and explain how these can be overcome |
| 2.25 | explain how to recognise defects |
| 2.26 | explain how to carry out routine checks and servicing of the aircraft ignition system |
| 2.27 | explain the need to check that cabin/cockpit switches, selectors and circuit breakers are in the correct position before working on the ignition system |
| 2.28 | explain what types of test need to be carried out on the aircraft ignition system, and the test equipment to be used |
| 2.29 | explain the methods and procedures to be used to carry out the various tests on the ignition system |
| 2.30 | explain how to record the results of each individual test, and the documentation that must be used |
| 2.31 | explain how to analyse the test results, and how to make valid decisions about the acceptability of the ignition system |
| 2.32 | explain the procedures to be followed if the equipment or system fails to meet the test specification |
| 2.33 | explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation |
| 2.34 | describe the procedure for the safe disposal of waste materials and scrap components |
| 2.35 | describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve |

# Unit 740 Maintaining ignition systems on aircraft

Supporting information

## Guidance

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

2.10 (such as threaded fasteners, special securing devices)

2.25 (such as incorrectly seated plugs and sockets, ineffective fasteners, foreign object damage or contamination)

2.26 (including adjusting plug gaps and checking ignition timing)

# Unit 741 Maintaining bleed air systems on aircraft

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| **UAN:** | **F/601/6342** |
| **Level:** | 3 |
| **Credit value:** | 77 |
| **GLH:** | 154 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 341: Maintaining Bleed Air Systems on Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft engine bleed air systems, in accordance with the approved aircraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It covers both fixed wing and rotary winged aircraft, and covers the units and components which go together to conduct air to the extension shaft and torquemeter assembly. It includes compressor bleed systems used to control flow of air through the engine, cooling air systems and heated air systems for engine anti-icing. It does not include aircraft anti-icing, engine starting systems, or exhaust supplementary air systems, which are covered in other units/ATA chapters. The maintenance activities will include the removal, fitting and testing of a range of engine bleed air system components. The learner will remove the required components and fit approved replacements, as appropriate. The learner will then need to test and adjust the completed system to meet the aircraft maintenance manual, change documentation (service bulletin) and airworthiness requirements.<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the aircraft manual, change/service bulletin documentation and airworthiness requirements for the maintenance activities undertaken, and to report any problems with these requirements 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 are correctly accounted for on completion of the activities, and that all necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to aircraft engine bleed air systems. The learner will understand the removal, fitting and testing methods and procedures, and their application, along with the bleed air systems maintenance requirements. The learner will know how the equipment functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the equipment is maintained to the required standard.

The learner will understand the safety precautions required when working on aircraft bleed air systems, especially those for isolating the equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

**Notes:** 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 75 Bleed Air. 2. To display competence in this unit, it is necessary to both remove and fit aircraft engine bleed air system components. The learner must remove components; however, they may fit a replacement component where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| Learning outcome |
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| The learner will:<br>1. Be able to maintain bleed air systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the maintenance of the aircraft engine bleed air system:<br>• ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures<br>• obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)<br>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates<br>• 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<br>• ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)<br>• use approved removal, fitting and testing techniques and procedures at all times<br>• leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from damage and foreign object debris<br>• return tools and equipment to the correct storage location on completion of the activities<br>• ensure that work carried out is correctly documented and recorded<br>• ensure that any outstanding tests are correctly documented<br>1.3 follow the relevant maintenance schedules to carry out the required work<br>1.4 carry out the maintenance activities within the limits of their personal authority<br>1.5 carry out maintenance on two of the following parts of the aircraft engine bleed air system:<br>• engine anti-icing<br>• engine cooling<br>• compressor bleed control<br>• compressor bleed governor<br>• compressor bleed valve<br>• bleed air indicating<br>• bleed air system wiring<br>• nozzle control system |

1.6 carry out the maintenance activities in the specified sequence and in an agreed timescale

1.7 carry out fifteen of the following maintenance activities:

- removing access panels and covers to expose components to be removed
- carrying out fault diagnosis and system checks
- preparing the system for maintenance (such as isolating)
- disconnecting electrical connections (where applicable)
- disconnect/removing hoses and pipes
- removing securing devices and mechanical fasteners
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing all damaged/defective components
- replacing single use items such as seals, filters, gaskets
- refitting components in the correct position, orientation and alignment
- setting and adjusting replaced components (such as travel, working clearance)
- making mechanical connections
- making electrical connections
- torque loading as required
- carrying out system functional checks
- ensuring that replacement components have the correct part numbers
- fitting blanks, labelling (and storing in the correct location) components that require repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)
- carrying out area inspections prior to task close down

1.8 remove and fit four different aircraft engine bleed air system components (at least one must be from group A):

group a:

- jet pump
- compressor
- governor
- valves
- actuators
- regulator
- vortex spoiler
- air motor servo units (AMSU)

group b:

- levers and linkages
- control mechanisms
- ducting
- pipes and hoses

- air filters
- sensors/transmitters
- warning devices (temperature, pressure)
- cables/harness/wiring
- plugs/sockets/switches
- other specific components

1.9 service/check the aircraft bleed air system, to include carrying out four of the following:

- inspecting engine anti-icing system
- inspecting variable stator blades
- checking and adjusting compressor bleed governor
- checking and adjusting pressure regulator
- checking bleed air indicating systems (such as pressure, temperature, control positions)
- checking blow-off valve (BOV)
- checking compressor control bleed valves/mechanisms

1.10 carry out two of the following tests on the aircraft bleed air system:

- leak test
- pressure test
- 'special-to-type' tests
- reduced system test
- movement tests (such as range, timing, sequencing)
- built in test equipment (BITE) test

using one of the following:

- aircraft power source/system
- ground test rig

1.11 carry out maintenance on aircraft engine bleed air systems in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Extended Range Twin-Engine Operations Procedures (ETOPS) (where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/approved change documentation (service bulletin)

1.12 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.13 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:

- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.14 dispose of waste materials in accordance with safe working practices and approved procedures

| Learning outcome |
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| The learner will:<br>2. Know how to maintain bleed air systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>2.1 explain the specific safety practices and procedures that they need to observe when working on aircraft bleed air systems<br>2.2 explain the need to check that cabin/cockpit switches, selectors and circuit breakers are in the correct position before applying any form of external power<br>2.3 explain the importance of maintenance on aircraft bleed air systems, and impact upon ETOPS systems, Electrical Wiring Interconnect Systems (EWIS), legislation and local procedures<br>2.4 describe the hazards associated with carrying out maintenance activities on aircraft bleed air systems, and with the tools and equipment used, and explain how to minimise them and reduce any risk<br>2.5 explain what protective equipment they need to use for both personal protection and protection of the aircraft<br>2.6 explain the importance of good aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft<br>2.7 explain how to extract and use information from aircraft manuals, log books, flight logs, charts, circuit and physical layouts, specifications, symbols used in aircraft pneumatic systems, and other documents needed in the maintenance activities<br>2.8 explain how to carry out currency/issue checks on the specifications they are working with<br>2.9 explain the terminology used in aircraft bleed air systems, and the use of system diagrams and associated symbols<br>2.10 describe the basic principles of operation of the aircraft bleed air system being worked on<br>2.11 explain the techniques used to remove components from aircraft bleed air systems without damage to the components or surrounding structure<br>2.12 describe the various mechanical fasteners to be removed and replaced, and explain their methods of removal and replacement<br>2.13 describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections<br>2.14 explain the need to label and store correctly components that require repair or overhaul, and to check that replacement components have the correct part/identification markings and accompanying release documentation<br>2.15 explain how to fit components into the circuit<br>2.16 describe the tools and equipment used in the maintenance activities, and their calibration/care and control procedures<br>2.17 explain why tool/equipment control is critical, and what to do if a tool or piece of equipment is unaccounted for on completion of the activities<br>2.18 explain how to make adjustments to components/assemblies to |

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| | ensure that they function correctly |
| 2.19 | explain why securing devices need to be tightened to the correct torque, locked and labelled, and the different methods that are used |
| 2.20 | explain how to carry out routine checks and servicing of the aircraft bleed air system |
| 2.21 | explain what types of test need to be carried out on the aircraft bleed air system, and the test equipment to be used |
| 2.22 | explain the methods and procedures to be used to carry out the various tests on the bleed air system |
| 2.23 | explain how to record the results of the tests, and the documentation that must be used |
| 2.24 | explain how to analyse the test results, and how to make valid decisions about the acceptability of the aircraft bleed air system |
| 2.25 | explain the procedures to be followed if the equipment or system fails to meet the test specification |
| 2.26 | explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation |
| 2.27 | describe the procedure for the safe disposal of waste materials and scrap components |
| 2.28 | describe the extent of their own authority, and to whom they should report if they have problems that they cannot resolve |

# Unit 741 Maintaining bleed air systems on aircraft

Supporting information

## Guidance

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

2.2 (such as electrical, hydraulic, air or vacuum)

2.4, (such as hot parts of engines, traps from moving parts, misuse of tools)

2.10 (such as system layout, engine cooling, engine anti-icing, compressor control and indication and warning)

2.11 (such as release of pressures/force, removal of components and the need to protect the circuit integrity by ensuring that exposed components and pipe ends are correctly covered/protected)

2.12 (such as threaded fasteners, special securing devices)

2.15 (such as ensuring correct position and orientation; correct the tightness of fittings and connections; eliminating stress on pipework, cables and connections; carrying out visual checks of all components)

2.18 (such as setting travel and freedom of movement; governor settings and their effect on the bleed air system)

2.20 (including checking the engine anti-icing system, the compressor bleed governor and the variable stator blades)

# Unit 742 Maintaining engine controls on aircraft

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| **UAN:** | **R/601/6345** |
| **Level:** | 3 |
| **Credit value:** | 86 |
| **GLH:** | 168 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 342: Maintaining Engine Controls on Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft engine control systems, in accordance with the approved aircraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It includes units and components which govern operation of the engine, and includes units and components that are interconnected for emergency shutdown. The maintenance activities will include the removal, fitting and testing of a range of engine control components. The learner will be required to select the correct tools and equipment to use, based on the operations to be performed and the components to be removed, fitted and tested. The aircraft engine control components will include items such as linkages, cables, levers, pulleys, switches and wiring. The learner will remove the required components and fit approved replacements, as appropriate. The learner will then need to test and adjust the completed system to meet the aircraft maintenance manual, change documentation (service bulletin) and airworthiness requirements.<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the aircraft manual, change/service bulletin documentation and airworthiness requirements for the maintenance activities undertaken, and to report any problems with these requirements 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 are correctly accounted for on completion of the activities, and that all necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to aircraft engine control systems. The learner will understand the removal, fitting and testing methods and procedures, and their application, along with the aircraft engine control system maintenance requirements. The learner will know how the aircraft engine controls function, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the equipment is maintained to the required standard.

The learner will understand the safety precautions required when working on aircraft engine control systems, especially those for isolating the equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

**Notes:** 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 76 Engine Controls. 2. To display competence in this unit, it is necessary to both remove and fit aircraft engine control system components. The learner must remove components; however, they may fit a replacement component where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation

| Learning outcome |
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| The learner will:<br>1. Be able to maintain engine controls on aircraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the maintenance of the aircraft engine control system:<br>• ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures<br>• obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)<br>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates<br>• 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<br>• ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)<br>• ensure the safe isolation of the engine control system before commencing work on the equipment<br>• where appropriate, apply electrostatic discharge (ESD) avoidance procedures<br>• use approved removal, fitting and testing techniques and procedures at all times<br>• leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from damage and foreign object debris<br>• return tools and equipment to the correct storage location on completion of the activities<br>• ensure that work carried out is correctly documented and recorded<br>• ensure that any outstanding tests are correctly documented<br>1.3 follow the relevant maintenance schedules to carry out the required work<br>1.4 carry out the maintenance activities within the limits of their personal authority<br>1.5 carry out maintenance on two of the following parts of the aircraft engine control systems:<br>• engine synchronizing<br>• mixture control<br>• power control<br>• throttles<br>• start system |

- reverse thrust
- emergency shutdown
- engine control system wiring
- variable air intake
- nozzle control system
- fuel/air control
- engine bypass

1.6 carry out the maintenance activities in the specified sequence and in an agreed timescale

1.7 carry out fifteen of the following maintenance activities:

- removing access panels and covers to expose components to be removed
- carrying out fault diagnosis and system checks
- preparing the system for maintenance (such as isolating)
- disconnecting electrical connections
- removing securing devices and mechanical fasteners
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing damaged/defective components
- refitting components in the correct position, orientation and alignment
- setting and adjusting replaced components (such as freedom of movement, cable tension)
- making mechanical connections
- making electrical connections
- torque loading as required
- carrying out functional checks of the system
- ensuring that replacement components have the correct part numbers
- labelling (and storing in the correct location) components that require repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)
- carrying out area inspections prior to task close down

1.8 remove and fit four different aircraft engine control system components from the following:

- cables and pulleys
- connecting rods
- position transmitters
- start valve
- fuel control/meter unit (FCU/FMU)
- levers and linkages
- actuators
- motors

- servos
- turnbuckles
- jack screws
- locks and stops
- bell cranks
- sensors
- cables/harness/wiring
- plugs/sockets/switches
- other specific components

1.9 carry out three of the following types of test/check on the aircraft engine control systems:

- rig thrust lever
- rig RPM control
- rig mixture high pressure cock lever
- rig power lever
- check control synchronization (multi-engine)
- engine run
- rig/check variable intake
- rig/check reverse thrust
- rig/check bypass
- check cable tension
- adjust pedestal microswitches
- check range and sense of operation of controls
- 'special-to-type' tests
- built in test equipment (BITE) test

using two of the following:

- built in test equipment (BITE)
- aircraft power supply/displays and gauges
- ground support equipment
- use of safety locks
- 'special-to-type' test equipment
- measuring equipment

1.10 carry out maintenance on aircraft engine control systems in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Extended Range Twin-Engine Operations Procedures (ETOPS) (where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/approved change documentation (service bulletin)

1.11 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.12 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:

- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.13 dispose of waste materials in accordance with safe working practices and approved procedures

| **Learning outcome** |
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| The learner will:<br>2. Know how to maintain engine controls on aircraft |
| **Assessment criteria** |
| The learner can:<br>2.1 explain the specific safety practices and procedures that they need to observe when working on aircraft engine control systems<br>2.2 explain the importance of maintenance on aircraft engine controls, and impact upon ETOPS systems, Electrical Wiring Interconnect Systems (EWIS), legislation and local procedures<br>2.3 describe the hazards associated with removing, fitting and testing aircraft engine control system components, and with the tools and equipment used, and explain how to minimise them and reduce any risk<br>2.4 explain what protective equipment that they need to use for both personal protection and protection of the aircraft<br>2.5 explain the importance of good aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft<br>2.6 explain how to extract and use information from aircraft maintenance manuals, log books, flight logs, and other documents needed in the maintenance process<br>2.7 explain how to carry out currency/issue checks on the specifications they are working with<br>2.8 explain the terminology used in aircraft engine control systems, and the use of system diagrams and associated symbols<br>2.9 describe the basic principles of operation of the aircraft engine control system being worked on, and the function of the various units/components within the system<br>2.10 explain the techniques used to remove components from aircraft engine control systems without damage to the components or surrounding structure<br>2.11 describe the various mechanical fasteners to be removed and replaced, and their methods of removal and replacement<br>2.12 explain the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections<br>2.13 explain the importance of applying electrostatic discharge (ESD) avoidance procedures when working on sensitive equipment or devices<br>2.14 explain the methods of lifting, handling and supporting the components/equipment during the maintenance activities<br>2.15 explain the methods of checking that components are fit for |

purpose, and how to identify defects and wear characteristics

2.16 explain the need to replace items such as seals and gaskets

2.17 explain the need to label and store correctly components that require repair or overhaul, and to check that replacement components have the correct part/identification markings and accompanying release documentation

2.18 explain how to replace and reconnect components into the system

2.19 explain how to make adjustments to components/assemblies to ensure that they function correctly

2.20 explain why electrical bonding is critical, and why it must be both mechanically and electrically secure

2.21 explain how to carry out routine checks and servicing of the aircraft engine control system

2.22 explain the need to check that cabin/cockpit switches, selectors and circuit breakers are in the correct position before applying any form of external power

2.23 explain what types of test need to be carried out on the aircraft engine control system, and the test equipment to be used

2.24 explain the methods and procedures to be used to carry out the various tests on the engine control system

2.25 explain the importance of carrying out the tests in the specified sequence, checking all readings and movements at each stage

2.26 explain how to record the results of the checks and tests, and the documentation that must be used

2.27 explain how to analyse the test results, and make valid decisions about the acceptability of the engine control systems

2.28 explain the procedures to be followed if the equipment or system fails to meet the test specification

2.29 explain why tool/equipment control is critical, and what to do if a tool or piece of equipment is unaccounted for on completion of the activities

2.30 describe the problems that can occur with the aircraft engine control system maintenance operations, and explain how these can be overcome

2.31 explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation

2.32 describe the procedure for the safe disposal of waste materials and scrap components

2.33 describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve

# Unit 742 Maintaining engine controls on aircraft

Supporting information

## Guidance

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

2.10 (such as proof marking, extraction of components and the need to protect the system integrity by ensuring that exposed components and pipe ends are correctly covered/protected)

2.11 (such as threaded fasteners, special securing devices)

2.18 (such as ensuring the correct orientation, position and alignment; tightening securing devices to the required torque; replacing locking and securing devices; eliminating stress on pipework/connections; ensuring that pipework and cables are correctly supported at suitable intervals; carrying out visual checks of all components)

2.19 (such as setting working clearance, setting travel)

2.22 (such as electrical, hydraulic, air or vacuum)

# Unit 743 Maintaining engine indicating systems on aircraft

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| **UAN:** | **H/601/6348** |
| **Level:** | 3 |
| **Credit value:** | 86 |
| **GLH:** | 168 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 343: Maintaining Engine Indicating Systems on Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft engine indicating systems, in accordance with the approved aircraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It covers both fixed wing and rotary winged aircraft, and includes units, components and associated systems which indicate engine operation. The units and components will include indicators, transmitters, analyzers, phase detectors, instruments/gauges, amplifiers, generators, display units, transmitters, receivers and computers. The maintenance activities will include the removal, fitting and testing of a range of aircraft engine indicating system components. The learner will be expected to use the approved procedure for correctly isolating the circuit/system, and to remove the required components and fit approved replacements, as appropriate. The learner will then need to test and adjust the completed system to meet the aircraft maintenance manual, change documentation (service bulletin) and airworthiness requirements.<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the aircraft manual, change/service bulletin documentation and airworthiness requirements for the maintenance activities undertaken, and to report any problems with these requirements 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 are correctly accounted for on completion of the activities, and that all necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to aircraft engine indicating systems. The learner will understand the removal, fitting and testing methods and procedures, and their application, along with the engine indicating systems maintenance requirements. The learner will know how the equipment functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the equipment is maintained to the required standard.

The learner will understand the safety precautions required when working on aircraft engine indicating systems. 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.

**Notes:** 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 77 Engine Indicating Systems. 2. To display competence in this unit, it is necessary to both remove and fit aircraft engine indicating system components. The learner must remove components; however, they may fit a replacement component where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| Learning outcome |
| --- |
| The learner will:<br>1. Be able to maintain engine indicating systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the maintenance of the aircraft engine indicating systems:<br>• ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures<br>• obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)<br>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates<br>• 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<br>• ensure the safe isolation of the engine indicating systems before breaking into the system circuit<br>• ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)<br>• where appropriate, apply electrostatic discharge (ESD) avoidance procedures<br>• use approved removal, fitting and testing techniques and procedures at all times<br>• leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from damage and foreign object debris<br>• return tools and equipment to the correct storage location on completion of the activities<br>• ensure that work carried out is correctly documented and recorded<br>• ensure that any outstanding tests are correctly documented<br>1.3 follow the relevant maintenance schedules to carry out the required work<br>1.4 carry out the maintenance activities within the limits of their personal authority<br>1.5 carry out maintenance on four of the following parts of the aircraft engine indicating systems:<br>• power indicating system<br>• engine pressure ratio (EPR)<br>• engine brake mean effective pressure/torque<br>• manifold pressure (MP)<br>• oil pressure indication |

- fuel flow indication
- engine temperature
- engine revs per minute (RPM)
- cylinder head temperature
- engine exhaust gas temperature
- turbine inlet temperature
- turbine blade temperature
- Nf tacho
- Ng tacho
- engine oil pressure/ temperature/quantity
- inter turbine temperature
- chip detection
- bleed air
- ignition analyzer
- vibration analyzer
- integrated instrument systems
- system wiring

1.6 carry out the maintenance activities in the specified sequence and in an agreed timescale

1.7 carry out fifteen of the following maintenance activities:

- removing access panels and covers to expose components to be removed
- carrying out fault diagnosis and system checks
- preparing the system for maintenance (such as isolating)
- disconnecting electrical connections
- removal of bonding
- removing cable securing devices
- removing securing devices and mechanical fasteners
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing damaged/defective components
- refitting components in the correct position, orientation and alignment
- setting and adjusting replaced components (such as zero, range, travel, clearance)
- making mechanical connections
- making electrical connections
- carrying out bonding
- torque loading
- installing cable securing devices
- carrying out functional checks of the system
- ensuring that replacement components have the correct part numbers
- labelling (and storing in the correct location) components that

require repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)
- carrying out area inspections prior to task close down

1.8 remove and fit four different aircraft indicating/recording system components (at least two must be from group A.)

group a:
- display units
- computers
- instruments/gauges
- amplifiers
- generators (such as pulse, speed/tacho, tone)
- thermocouples
- analysers
- phase detectors

group b:
- transmitters (such as temperature, flow, pressure, vibration)
- receivers
- switches (such as micro, proximity)
- input and follow-up devices
- relays
- capacitance units
- transducers/sensors
- circuit breakers
- wires/cables
- plugs/sockets
- other specific components

1.9 carry out two of the following tests on the aircraft engine indicating systems:
- continuity check
- voltage check
- comparison check
- vibration analysis
- functional test
- leak test
- engine run
- BITE test
- 'special-to-type' tests

using two of the following:
- measuring equipment
- external power source (such as electrical/hydraulic)
- pitot/static pump/digital air data test equipment
- 'special-to-type' test sets
- aircraft power source (such as electrical/hydraulic)

1.10 carry out maintenance on aircraft engine indicating systems in compliance with one of the following:
- Civil Aviation Authority (CAA)/European Aviation Safety

Agency (EASA)
- Extended Range Twin-Engine Operations Procedures (ETOPS) (where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/approved change documentation (service bulletin)

1.11 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.12 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:
- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.13 dispose of waste materials in accordance with safe working practices and approved procedures

**Learning outcome**

The learner will:

2. Know how to maintain engine indicating systems on aircraft

**Assessment criteria**

The learner can:

2.1 explain the specific safety practices and procedures that they need to observe when working on aircraft indication and recording systems

2.2 explain the need to check that cabin/cockpit switches, selectors and circuit breakers are in the correct position before applying any form of external power

2.3 explain the importance of maintenance on aircraft engine indicating systems, and impact upon ETOPS systems, Electrical Wiring Interconnect Systems (EWIS), legislation and local procedures

2.4 describe the hazards associated with carrying out maintenance activities on aircraft engine indication systems, and with the tools and equipment used, and explain how to minimise them and reduce any risk

2.5 explain what protective equipment that they need to use for both personal protection and protection of the aircraft

2.6 explain the importance of aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft

2.7 explain how to extract and use information from aircraft manuals, log books, flight logs, charts, circuit and physical layouts, specifications, symbols used in aircraft indication and recording systems, and other documents needed in the maintenance activities

2.8 explain how to carry out currency/issue checks on the specifications they are working with

2.9 explain the terminology used in aircraft engine indication systems,

and the use of system diagrams and associated symbols

2.10 describe the basic principles of operation of the engine indicating system being worked on, and the function of the various units that make up the system

2.11 explain the techniques used to remove components from the aircraft engine indicating systems without damage to the components or surrounding structure

2.12 describe the various mechanical fasteners to be removed and replaced, and their methods of removal and replacement

2.13 describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections

2.14 explain the importance of applying electrostatic discharge (ESD) avoidance procedures when working on sensitive equipment or devices

2.15 explain the need to label and store correctly components that require repair or overhaul, and to check that replacement components have the correct part/identification markings and accompanying release documentation

2.16 explain how to fit equipment and components into the system

2.17 explain how to make adjustments to components/assemblies to ensure that they function correctly

2.18 explain why securing devices need to be tightened to the correct torque, locked and labelled, and the different methods that are used

2.19 describe the tools and equipment used in the maintenance activities, and explain their calibration/care and control procedures

2.20 explain why tool/equipment control is critical, and what to do if a tool or piece of equipment is unaccounted for on completion of the activities

2.21 explain why electrical bonding is critical, and why it must be both mechanically and electrically secure

2.22 explain how to carry out routine checks and servicing of the aircraft engine indicating system

2.23 explain what types of test need to be carried out on the aircraft engine indicating system, and the test equipment to be used

2.24 explain the methods and procedures to be used to carry out the various tests on the engine indicating system

2.25 explain how to record the results of each individual test, and the documentation that must be used

2.26 explain how to analyse the test results, and how to make valid decisions about the acceptability of the aircraft engine indicating systems

2.27 explain the procedures to be followed if the equipment or system fails to meet the test specification

2.28 explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation

2.29 describe the procedure for the safe disposal of waste materials and scrap components

2.30 describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve

# Unit 743 Maintaining engine indicating systems on aircraft

Supporting information

## Guidance

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

2.2 (such as electrical, hydraulic, air or vacuum)

2.11 (such as removal of components and the need to protect the circuit integrity by labelling and covering exposed circuits)

2.12 (such as threaded fasteners, special securing devices)

2.16 (such as ensuring the correct position and orientation; ensuring the correct tightness of fastenings; eliminating stress on cables; correctly making electrical connections; carrying out visual checks of all components)

2.17 (such as zero, range, travel and working clearance)

2.22 (including checking for security of equipment)

2.23 (such as continuity, voltage)

# Unit 744 Maintaining engine exhaust systems on aircraft

| | |
|---|---|
| **UAN:** | **D/601/6350** |
| **Level:** | 3 |
| **Credit value:** | 77 |
| **GLH:** | 154 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 344: Maintaining Engine Exhaust Systems on Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft engine exhaust systems, in accordance with the approved aircraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It covers both fixed wing and rotary winged aircraft, and covers the portion of the system which directs the engine exhaust gases overboard. For turbine engines, it includes units external to the basic engine, such as thrust reverser and noise suppressor. For reciprocating engines, it includes augmentation, stacks, clamps, etc. It does not include exhaust driven turbines which are covered in other units/ATA chapters. The maintenance activities will include the removal, fitting and testing of a range of engine exhaust system components. The learner will remove the required components and fit approved replacements, as appropriate. The learner will then need to test and adjust the completed system to meet the aircraft maintenance manual, change documentation (service bulletin) and airworthiness requirements.<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the aircraft manual, change/service bulletin documentation and airworthiness requirements for the maintenance activities undertaken, and to report any problems with these requirements 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 are correctly accounted for on completion of the activities, and that all necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to aircraft engine exhaust systems. The learner will understand the removal, fitting and testing methods and procedures, and their application, along with the exhaust systems maintenance requirements. The learner will know how the equipment functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the equipment is maintained to the required standard.

The learner will understand the safety precautions required when working on aircraft engine exhaust systems, especially those for isolating the equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

**Notes:** 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 78 Engine Exhaust. 2. To display competence in this unit, it is necessary to both remove and fit aircraft engine exhaust system components. The learner must remove components; however, they may fit a replacement component where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| Learning outcome |
| --- |
| The learner will:<br>1. Be able to maintain engine exhaust systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the maintenance of the aircraft engine exhaust system:<br>• ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures<br>• obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)<br>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates<br>• 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<br>• ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)<br>• use approved removal, fitting and testing techniques and procedures at all times<br>• leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from damage and foreign object debris<br>• return tools and equipment to the correct storage location on completion of the activities<br>• ensure that work carried out is correctly documented and recorded<br>• ensure that any outstanding tests are correctly documented<br>1.3 follow the relevant maintenance schedules to carry out the required work<br>1.4 carry out the maintenance activities within the limits of their personal authority<br>1.5 carry out maintenance on two of the following parts of the aircraft engine exhaust system:<br>• collector/tailpipe/nozzle<br>• noise suppressor<br>• thrust reverser<br>• supplementary air<br>• engine exhaust system wiring<br>1.6 carry out the maintenance activities in the specified sequence and in an agreed timescale<br>1.7 carry out fifteen of the following maintenance activities:<br>• removing access panels and covers to expose components to |

be removed
- carrying out fault diagnosis and system checks
- preparing the system for maintenance (such as isolating)
- disconnecting electrical connections (where applicable)
- disconnect/removing hoses and pipes
- removing securing devices and mechanical fasteners
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing damaged/defective components
- replacing single use items such as seals, filters, gaskets
- refitting components in the correct position, orientation and alignment
- setting and adjusting replaced components (such as travel, working clearance)
- making mechanical connections
- making electrical connections
- torque loading as required
- carrying out system functional checks
- ensuring that replacement components have the correct part numbers
- fitting blanks, labelling (and storing in the correct location) components that require repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)
- carrying out area inspections prior to task close down

1.8 remove and fit four different aircraft engine exhaust system components (at least one must be from group A):

group a:
- collector rings
- exhaust mixer ducts
- thrust augmention ducts
- variable nozzles
- integrated nozzle assembly
- actuators
- clamshells
- tertiary air doors
- service panels/fairings
- jet pipe
- exhaust cone
- shroud assembly
- trimmers

group b:
- levers and linkages
- control mechanisms

- ducting
- baffles
- seals
- pipes and hoses
- air filters
- springs
- shields
- cables/harness/wiring
- plugs/sockets/switches
- position indicators/warning devices
- other specific components

1.9 service/check the aircraft engine exhaust system, to include carrying out three of the following:

- inspecting the integrated nozzle assembly (INA) (such as for cracks, distortion, dents/damage to acoustical lining)
- inspecting the collector nozzle system
- inspecting the exhaust cone (such as cracks, dents, nicks or scores, distortion)
- inspecting the exhaust gasket
- checking and adjusting trimmers
- carrying out a pressure check of the cabin heater muff
- checking exhaust indicating systems (such as control positions)

1.10 carry out two of the following tests on the aircraft engine exhaust system:

- leak test
- pressure test
- movement tests (such as range, timing, sequencing)
- built in test equipment (BITE) test
- 'special-to-type' tests

using one of the following:

- aircraft power supply/systems
- ground test rig

1.11 carry out maintenance on aircraft engine exhaust systems in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Extended Range Twin-Engine Operations Procedures (ETOPS) (where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/approved change documentation (service bulletin)

1.12 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.13 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:

- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.14 dispose of waste materials in accordance with safe working practices and approved procedures

| **Learning outcome** |
| --- |
| The learner will:<br>2. Know how to maintain engine exhaust systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>2.1 explain the specific safety practices and procedures that they need to observe when working on aircraft engine exhaust systems<br>2.2 explain the need to check that cabin/cockpit switches, selectors and circuit breakers are in the correct position before applying any form of external power<br>2.3 explain the importance of maintenance on aircraft engine exhaust systems, and impact upon ETOPS systems, Electrical Wiring Interconnect Systems (EWIS), legislation and local procedures<br>2.4 describe the hazards associated with carrying out maintenance activities on aircraft engine exhaust systems, and with the tools and equipment used, and explain how to minimise them and reduce any risk<br>2.5 explain what protective equipment they need to use for both personal protection and protection of the aircraft<br>2.6 explain the importance of good aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft<br>2.7 explain how to extract and use information from aircraft manuals, log books, flight logs, charts, circuit and physical layouts, specifications, symbols used in aircraft engine exhaust systems, and other documents needed in the maintenance activities<br>2.8 explain how to carry out currency/issue checks on the specifications they are working with<br>2.9 explain the terminology used in aircraft engine exhaust systems, and the use of system diagrams and associated symbols<br>2.10 describe the basic principles of operation of the aircraft engine exhaust system being worked on<br>2.11 explain the techniques used to remove components from aircraft engine exhaust systems without damage to the components or surrounding structure<br>2.12 describe the various mechanical fasteners to be removed and replaced, and explain their methods of removal and replacement<br>2.13 describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections<br>2.14 explain the need to label and store correctly components that require repair or overhaul, and to check that replacement components have the correct part/identification markings and |

accompanying release documentation

2.15 explain how to fit components into the system

2.16 describe the tools and equipment used in the maintenance activities, and explain their calibration/care and control procedures

2.17 explain why tool/equipment control is critical, and what to do if a tool or piece of equipment is unaccounted for on completion of the activities

2.18 explain how to make adjustments to components/assemblies to ensure that they function correctly

2.19 explain why securing devices need to be tightened to the correct torque, locked and labelled, and the different methods that are used

2.20 explain how to carry out routine checks and servicing of the aircraft engine exhaust system

2.21 explain what types of test need to be carried out on the aircraft engine exhaust system, and the test equipment to be used

2.22 explain the methods and procedures to be used to carry out the various tests on the exhaust system

2.23 explain how to record the results of the tests, and the documentation that must be used

2.24 explain how to analyse the test results, and how to make valid decisions about the acceptability of the aircraft exhaust system

2.25 explain the procedures to be followed if the equipment or system fails to meet the test specification

2.26 explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation

2.27 describe the procedure for the safe disposal of waste materials and scrap components

2.28 describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve

# Unit 744 Maintaining engine exhaust systems on aircraft

Supporting information

## Guidance

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

2.2 (such as electrical, hydraulic, air or vacuum)

2.4 (such as hot parts of engines, traps from moving parts, misuse of tools)

2.10 (such as system layout, noise suppression, thrust reverser, supplementary air control, and indication and warning)

2.11 (such as release of pressures/force, removal of components and the need to protect the circuit integrity by ensuring that exposed components and pipe ends are correctly covered/protected)

2.12 (such as threaded fasteners, special securing devices)

2.15 (such as ensuring the correct position and orientation; correct tightness of fittings and connections; eliminating stress on pipework, cables and connections; carrying out visual checks of all components)

2.18 (such as setting travel and freedom of movement)

2.20 (including checking the security of critical fasteners, checking the condition of the exhaust gasket, pressure checking the cabin heater muff)

# Unit 745 Maintaining lubricating oil systems on aircraft

| | |
|---|---|
| **UAN:** | **T/601/6354** |
| **Level:** | 3 |
| **Credit value:** | 77 |
| **GLH:** | 154 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 345: Maintaining Lubricating Oil Systems on Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft lubricating oil systems, in accordance with the aircraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It covers both fixed wing and rotary winged aircraft, and covers the units and components external to the engine, which store and deliver lubricating oil to and from the engine. It includes units and components from the lubricating oil engine outlet to the inlet, including the inlet and outlet fittings, tanks, radiators, valves, and the auxiliary oil systems. The maintenance activities will include the removal, fitting and testing of a range of lubricating oil system components. The learner will be expected to use the approved procedure for correctly isolating the system before breaking into the system circuit. The learner will remove the required components and fit approved replacements, as appropriate. The learner will then need to test and adjust the completed system to meet the aircraft maintenance manual, change documentation (service bulletin) and airworthiness requirements.<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the aircraft manual, change/service bulletin documentation and airworthiness requirements for the maintenance activities undertaken, and to report any problems with these requirements 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 are correctly accounted for on completion of the activities, and that all necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to aircraft lubricating oil systems. The learner will understand the removal, fitting and testing methods and procedures, and their application, along with the lubricating oil system maintenance requirements. The learner will know how the equipment functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the equipment is maintained to the required standard.

The learner will understand the safety precautions required when working on aircraft lubricating oil systems, especially those for ensuring system cleanliness and the avoidance of oil spillage. 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.

**Notes:** 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 79 Lubricating Oil. 2. To display competence in this unit, it is necessary to both remove and fit aircraft lubricating oil system components. The learner must remove components; however, they may fit a replacement component where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| Learning outcome |
| --- |
| The learner will:<br>1. Be able to maintain lubricating oil systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the maintenance of the aircraft lubricating oil system:<br>• ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures<br>• obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)<br>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates<br>• 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<br>• ensure the safe isolation of the lubricating oil equipment before breaking into the system<br>• ensure that the relevant safety devices, mechanical/physical locks and external signage are in place (where appropriate)<br>• use approved removal, fitting and testing techniques and procedures at all times<br>• leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from oil spillage, damage and foreign object debris<br>• return tools and equipment to the correct storage location on completion of the activities<br>• ensure that work carried out is correctly documented and recorded<br>• ensure that any outstanding tests are correctly documented<br>1.3 follow the relevant maintenance schedules to carry out the required work<br>1.4 carry out the maintenance activities within the limits of their personal authority<br>1.5 carry out maintenance on two of the following parts of the aircraft lubricating oil system:<br>• oil storage<br>• distribution<br>• oil cooling<br>• oil pressure/regulation |

- oil indicating
- system wiring

1.6 carry out the maintenance activities in the specified sequence and in an agreed timescale

1.7 carry out fifteen of the following maintenance activities:

- removing access panels and covers to expose components to be removed
- carrying out fault diagnosis and system checks
- preparing the system for maintenance (such as isolating, draining and removing oil)
- disconnecting electrical connections
- disconnecting/removing hoses and pipes
- removing securing devices and mechanical fasteners
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing damaged/defective components
- replacing single use items such as seals, filters, gaskets
- refitting components in the correct position, orientation and alignment
- making mechanical connections
- making electrical connections
- torque loading as required
- charging and bleeding the system
- carrying out system functional checks
- ensuring that replacement components have the correct part numbers
- fitting blanks, labelling (and storing in the correct location) components that require repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)
- carrying out area inspections prior to task close down

1.8 remove and fit four different aircraft lubricating oil system components (at least one must be from group A):

group a:

- control valves (such as drain, bleed, change over, fire wall, dump)
- main oil tanks
- auxiliary oil tank
- primary or secondary pressure pump
- valves (such as oil pressure relief, shut-off)
- scavenge pump
- oil cooling units
- radiator
- oil distribution block/manifold
- oil tubes and connectors

- regulators (temperature, flow)
- tank interconnectors
- oil transmitter units (such as pressure, temperature, quantity)

group b:

- pipes/hoses
- safety devices
- solenoids
- oil filters
- pressure switches
- sensors
- gaskets and seals
- MCD housings
- ventilating components
- magnetic chip detectors (MCD)
- strainer (pressure pump)
- oil filler necks and caps
- wires/cables
- plugs/sockets
- other specific components

1.9 service/check the aircraft lubricating oil system, to include carrying out three of the following:

- checking the system for leaks
- checking and cleaning/replacing filters/strainers
- flushing out the oil system
- checking and replenishing the oil system
- examining engine oil tubes for damage or leaks
- checking calibration of oil quantity gauges (labelling or other methods)
- checking, and where applicable, adjusting pressure relief valve
- checking indicating systems (such as temperature warning, oil level, oil pressure)

1.10 carry out three of the following tests on the aircraft lubricating oil system:

- leak test
- oil level/contents check
- oil sampling/check
- built in test equipment (BITE) test
- checking contents of magnetic chip indicators against specification
- 'special-to-type' tests

using one of the following:

- oil sampling devices
- MCD particle analysis equipment
- aircraft power source/system
- ground test rig (such as air flow)
- 'special to type' test equipment

1.11 carry out maintenance on aircraft lubricating oil systems in

compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Extended Range Twin-Engine Operations Procedures (ETOPS) (where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/approved change documentation (service bulletin)

1.12 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.13 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:

- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.14 dispose of waste materials in accordance with safe working practices and approved procedures

| **Learning outcome** |
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| The learner will:<br>2. Know how to maintain lubricating oil systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>2.1 explain the specific safety practices and procedures that they need to observe when carrying out maintenance activities on aircraft lubricating oil systems<br>2.2 explain the importance of maintenance on aircraft lubricating oil systems, and impact upon ETOPS systems, Electrical Wiring Interconnect Systems (EWIS), legislation and local procedures<br>2.3 explain the need to check that cabin/cockpit switches, selectors and circuit breakers are in the correct position before applying any form of external power<br>2.4 describe the hazards associated with removing aircraft engine lubrication system components, and with the tools and equipment used, and explain how to minimise them and reduce any risk<br>2.5 explain what protective equipment they need to use for both personal protection and protection of the aircraft<br>2.6 explain the importance of good aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft<br>2.7 explain how to extract and use information from aircraft manuals, log books, flight logs, charts, circuit and physical layouts, specifications, symbols used in aircraft lubricating oil systems, and other documents in the maintenance process<br>2.8 explain how to carry out currency/issue checks on the specifications they are working with |

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| 2.9 | explain the terminology used in aircraft lubricating oil systems, and the use of system diagrams and associated symbols |
| 2.10 | describe the various types of pipe and components that make up the aircraft lubricating oil system |
| 2.11 | describe the basic principles of operation of the aircraft lubricating oil system being worked on, and the function of the various units/components within the system |
| 2.12 | explain the techniques used to remove components from aircraft lubricating oil systems without damage to the components or surrounding structure |
| 2.13 | describe the various mechanical fasteners to be removed and replaced, and explain their methods of removal and replacement |
| 2.14 | describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections |
| 2.15 | explain the methods of lifting, and supporting the components/equipment during the removal and replacement activities |
| 2.16 | explain how to recognise contaminants, and the problems they can create; the effects and likely symptoms of contamination in the lubricating oil system |
| 2.17 | explain the need to label and store correctly components that require repair or overhaul, and to check that replacement components have the correct part/identification markings and accompanying release documentation |
| 2.18 | explain how to fit components into the circuit |
| 2.19 | explain how to make adjustments to components/assemblies to ensure that they function correctly |
| 2.20 | explain why bonding is critical, and why it must be both mechanically and electrically secure |
| 2.21 | explain why securing devices need to be tightened to the correct torque, locked and labelled, and the methods to be used |
| 2.22 | explain how to carry out routine checks and servicing of the aircraft lubricating oil system |
| 2.23 | explain what types of test need to be carried out on the aircraft lubricating oil system, and the test equipment to be used |
| 2.24 | explain the methods and procedures to be used to carry out the various tests on the lubricating oil system |
| 2.25 | explain the importance of carrying out the tests in the specified sequence, checking readings/movements at each stage |
| 2.26 | explain how to record the results of each individual test, and the documentation that must be used |
| 2.27 | explain how to analyse the test results, and how to make valid decisions about the acceptability of the aircraft lubricating oil system |
| 2.28 | explain the procedures to be followed if the equipment or system fails to meet the test specification |
| 2.29 | explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation |
| 2.30 | describe the procedure for the safe disposal of waste materials, scrap components and waste oil |
| 2.31 | describe the extent of their own authority, and explain to whom |

they should report if they have problems that they cannot resolve

# Unit 745 Maintaining lubricating oil systems on aircraft

Supporting information

## Guidance

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

2.3 (such as electrical, hydraulic, air or vacuum)

2.4 (such as handling oils and fluids, misuse of tools)

2.10 (such as rigid pipes; flexible hoses; pipe connectors; pipe sealing and supporting devices; valves used for flow, pressure control and bypass; oil pumps (such as main pressure, secondary and scavenger); oil coolers and radiators; mechanical and electrical control devices)

2.12 (such as release of pressures, draining of fluids, proof marking, extraction of components and the need to protect the circuit integrity by fitting blanking plugs and labelling exposed circuits)

2.13 (such as threaded fasteners, special securing devices)

2.18 (such as the use of gaskets/seals and jointing/sealing compounds; ensuring the correct tightness of pipe fittings and connections; eliminating stress on pipework/connections; carrying out visual checks of all components; checking the security of joints and that the system is safe to refill)

2.19 (such as flow and pressure settings, and their effect on the system, travel and working clearance)

2.22 (including checking for leaks, checking and changing filters, checking the calibration of oil quantity gauges)

# Unit 746 Maintaining engine starting systems on aircraft

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| **UAN:** | **L/601/6358** |
| **Level:** | 3 |
| **Credit value:** | 77 |
| **GLH:** | 154 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 346: Maintaining Engine Starting Systems on Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft engine starting systems, in accordance with the approved aircraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It covers both fixed wing and rotary winged aircraft, and covers units and components used for starting the engine, including electrical, inertia air or other starter systems. It does not include ignition systems, which are covered in other units/ATA chapters. The maintenance activities will include the removal, fitting and testing of a range of starter system components. The learner will be required to select the correct tools and equipment to use, based on the operations to be performed and the components to be removed or replaced. The aircraft starting system components will include items such as starters, actuators, valves, solenoids, clutch assembly, ring gear, electrical modules and controls and other associated wiring and switches. The learner will remove the required components and fit approved replacements, as appropriate. The learner will then need to test and adjust the completed system to meet the aircraft maintenance manual, change documentation (service bulletin) and airworthiness requirements.<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the aircraft manual, change/service bulletin documentation and airworthiness requirements for the maintenance |

activities undertaken, and to report any problems with these requirements 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 are correctly accounted for on completion of the activities, and that all necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to aircraft starting systems. The learner will understand the removal, fitting and testing methods and procedures, and their application, along with the system maintenance requirements. The learner will know how the equipment functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the starting system is maintained to the required standard.

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

**Notes:** 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 80 Starting. 2. To display competence in this unit, it is necessary to both remove and fit aircraft starter system components. The learner must remove components; however, they may fit a replacement component where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| Learning outcome |
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| The learner will:<br>1. Be able to maintain engine starting systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the maintenance of the aircraft engine starting system:<br>• ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures<br>• obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)<br>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates<br>• 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<br>• ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)<br>• where appropriate, apply electrostatic discharge (ESD) avoidance procedures<br>• use approved removal, fitting and testing techniques and procedures at all times<br>• leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from damage and foreign object debris<br>• return tools and equipment to the correct storage location on completion of the activities<br>• ensure that work carried out is correctly documented and recorded<br>• ensure that any outstanding tests are correctly documented<br>1.3 follow the relevant maintenance schedules to carry out the required work<br>1.4 carry out the maintenance activities within the limits of their personal authority<br>1.5 carry out maintenance on three of the following parts of the aircraft starting system:<br>• engine cranking<br>• engine starter<br>• start valves/controls<br>• starter system wiring<br>1.6 carry out the maintenance activities in the specified sequence and in an agreed timescale<br>1.7 carry out fifteen of the following maintenance activities: |

- removing access panels and covers to expose components to be removed
- carrying out fault diagnosis and system checks
- preparing the system for maintenance (such as isolating)
- disconnecting electrical connections
- removal of bonding
- removing cable securing devices
- making mechanical connections
- making electrical connections
- carrying out bonding
- removing securing devices and mechanical fasteners
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing all damaged/defective components
- refitting components in the correct position, orientation and alignment
- installing cable securing devices
- torque loading as required
- setting and adjusting replaced components
- carrying out functional checks of the system
- ensuring that replacement components have the correct part numbers
- labelling (and storing in the correct location) components that require repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)
- carrying out area inspections prior to task close down

1.8 remove and fit four different starter system components (at least two must be from group A):

group a:

- starter
- starter quick attach-detach adapter (QAD)
- starter control valve
- butterfly valve
- pistons
- cartridge start
- actuator
- solenoid valve
- cluster gear assembly
- clutch mechanism
- ring gear
- starter relay
- solenoid
- electrical/electronic modules

- air/hydraulic modules
- starter harness
- starter switch

group b:

- static or dynamic seals
- coupling clamps
- electrical plugs/sockets
- springs
- start valve filter
- transducers/sensors
- wires/cables
- other specific components

1.9 carry out three of the following types of check/test on the aircraft starter system:

- visually check the starter system for leaks/damage
- operational test of the pneumatic starter
- check cranking speed
- check operation of starter indication
- carry out BITE test
- carry out 'special-to-type' tests

using one of the following:

- ground test rig
- aircraft power source/system
- 'special-to-type' test sets

1.10 carry out maintenance on aircraft starting systems in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Extended Range Twin-Engine Operations Procedures (ETOPS) (where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/approved change documentation (service bulletin)

1.11 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.12 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:

- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.13 dispose of waste materials in accordance with safe working practices and approved procedures

| Learning outcome |
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| The learner will:<br>2. Know how to maintain engine starting systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>2.1 explain the specific safety practices and procedures that they need to observe when working with aircraft starting systems<br>2.2 explain the importance of maintenance on aircraft engine starting systems, and impact upon ETOPS systems, Electrical Wiring Interconnect Systems (EWIS), legislation and local procedures<br>2.3 describe the hazards associated with removing, fitting and testing aircraft starting system components, and with the tools and equipment used, and explain how to minimise them and reduce any risk<br>2.4 explain what protective equipment they need to use for both personal protection and protection of the aircraft<br>2.5 explain the importance of good aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft<br>2.6 explain how to extract and use information from aircraft manuals, log books, flight logs, charts, circuit and physical layouts, specifications, symbols used in aircraft starting systems, and other documents needed in the maintenance process<br>2.7 explain how to carry out currency/issue checks on the specifications they are working with<br>2.8 explain the terminology used in aircraft starting systems, and the use of system diagrams and associated symbols<br>2.9 describe the basic principles of operation of the starting system being worked on, and the function of the various units within the system<br>2.10 describe the various mechanical fasteners that are used, and explain their methods of removal and replacement<br>2.11 explain the importance of using the specified fasteners for the particular installation, and why they must not substitute others<br>2.12 explain why securing devices need to be locked and labelled, and the different methods that are used to remove and install them<br>2.13 explain the torque loading requirements on the fasteners, and what to do if these loadings are exceeded or not achieved<br>2.14 describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections<br>2.15 explain the techniques used to remove components from aircraft starting systems without damage to the components or surrounding structure<br>2.16 explain the importance of applying electrostatic discharge (ESD) avoidance procedures when working on sensitive equipment or devices<br>2.17 explain the need to label and store correctly components that require repair or overhaul, and to check that replaced components have the correct part/identification markings and accompanying release documentation |

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| 2.18 | explain the techniques used to position, align, adjust and secure the replaced components without damage to the components or surrounding structure |
| 2.19 | explain the procedures for ensuring that they have the correct tools, equipment, components and fasteners for the activities |
| 2.20 | explain the methods of lifting, handling and supporting the components/equipment during the maintenance activities |
| 2.21 | explain why electrical bonding is critical, and why it must be both mechanically and electrically secure |
| 2.22 | describe the tools and equipment used in the maintenance activities, and explain their calibration/care and control procedures |
| 2.23 | explain why tool/equipment control is critical, and what to do if a tool or piece of equipment is unaccounted for on completion of the activities |
| 2.24 | describe the problems that can occur with the maintenance operations, and explain how these can be overcome |
| 2.25 | explain how to recognise defects |
| 2.26 | explain how to carry out routine checks and servicing of the aircraft starting system |
| 2.27 | explain the need to check that cabin/cockpit switches, selectors and circuit breakers are in the correct position before working on the starter system |
| 2.28 | explain what types of test need to be carried out on the aircraft starter system, and the test equipment to be used |
| 2.29 | explain the methods and procedures to be used to carry out the various tests on the starter system |
| 2.30 | explain how to record the results of each individual test, and the documentation that must be used |
| 2.31 | explain how to analyse the test results, and how to make valid decisions about the acceptability of the starter system |
| 2.32 | explain the procedures to be followed if the equipment or system fails to meet the test specification |
| 2.33 | explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation |
| 2.34 | describe the procedure for the safe disposal of waste materials and scrap components |
| 2.35 | describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve |

# Unit 746 Maintaining engine starting systems on aircraft

Supporting information

## Guidance

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

2.10 (such as threaded fasteners, special securing devices)

2.25 (such as incorrectly seated plugs and sockets, ineffective fasteners, foreign object damage or contamination)

2.26 (including checking operation of the starters)

# Unit 747 Maintaining reciprocating engine turbo-supercharging systems on aircraft

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| **UAN:** | **Y/601/6363** |
| **Level:** | 3 |
| **Credit value:** | 77 |
| **GLH:** | 154 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 347: Maintaining Reciprocating Engine Turbo-Supercharging Systems on Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft reciprocating engine turbo-supercharging systems, in accordance with the approved aircraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It covers both fixed wing and rotary winged aircraft, and includes power recovery turbine assemblies and turbo-supercharging units when external to the engine. The maintenance activities will include the removal, fitting and testing of a range of engine turbo-supercharging system components. The learner will remove the required components and fit approved replacements, as appropriate. The learner will then need to test and adjust the completed system to meet the aircraft maintenance manual, change documentation (service bulletin) and airworthiness requirements.<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the aircraft manual, change/service bulletin documentation and airworthiness requirements for the maintenance activities undertaken, and to report any problems with these requirements 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 are correctly accounted for on completion of the activities, and that all necessary job/task documentation is completed thoroughly, |

accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to aircraft engine turbo-supercharging systems. The learner will understand the removal, fitting and testing methods and procedures, and their application, along with the turbo-supercharging systems maintenance requirements. The learner will know how the equipment functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the equipment is maintained to the required standard.

The learner will understand the safety precautions required when working on aircraft engine turbo-supercharging systems, especially those for isolating the equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

**Notes:** 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 81 Reciprocating Engine Turbines. 2. To display competence in this unit, it is necessary to both remove and fit aircraft engine turbo-supercharging system components. The learner must remove components; however, they may fit a replacement component where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| **Learning outcome** |
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| The learner will:<br>1. Be able to maintain reciprocating engine turbo-supercharging systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the maintenance of the aircraft |

engine turbo-supercharging system:

- ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures
- obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)
- obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates
- adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
- ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)
- use approved removal, fitting and testing techniques and procedures at all times
- leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from damage and foreign object debris
- return tools and equipment to the correct storage location on completion of the activities
- ensure that work carried out is correctly documented and recorded
- ensure that any outstanding tests are correctly documented

1.3 follow the relevant maintenance schedules to carry out the required work

1.4 carry out the maintenance activities within the limits of their personal authority

1.5 carry out maintenance on two of the following parts of the aircraft engine turbo-supercharging system:

- power recovery turbine
- exhaust turbocharger
- supercharger
- turbo-supercharger system wiring

1.6 carry out the maintenance activities in the specified sequence and in an agreed timescale

1.7 carry out fifteen of the following maintenance activities:

- removing access panels and covers to expose components to be removed
- carrying out fault diagnosis and system checks
- preparing the system for maintenance (such as isolating)
- disconnecting electrical connections (where applicable)
- disconnect/removing hoses and pipes
- removing securing devices and mechanical fasteners
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework

or vents
- checking components for serviceability
- replacing damaged/defective components
- replacing single use items such as seals, filters, gaskets
- refitting components in the correct position, orientation and alignment
- setting and adjusting replaced components (such as travel, working clearance)
- making mechanical connections
- making electrical connections
- torque loading as required
- carrying out system functional checks
- ensuring that replacement components have the correct part numbers
- fitting blanks, labelling (and storing in the correct location) components that require repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)
- carrying out area inspections prior to task close down

1.8 remove and fit four different aircraft engine turbo-supercharger system components (at least one must be from group A):

group a:
- turbo blower
- supercharger unit
- waste gate
- density controller
- actuators
- cables/harness/wiring

group b:
- levers and linkages
- control mechanisms
- seals
- pipes and hoses
- service panels/fairings
- air filters
- springs
- heat shields
- plugs/sockets/switches
- position indicators/warning devices
- other specific components

1.9 service/check the aircraft engine turbo-supercharging system, to include carrying out three of the following:
- inspecting the turbo-supercharger units (such as for cracks, signs of leakage or damage)
- inspecting heat shields for damage/deterioration
- checking and adjusting density controller
- checking turbo-supercharging indicating systems

1.10 carry out three of the following tests on the aircraft engine turbo-

supercharging system:

- leak test
- pressure test
- 'special-to-type' tests
- movement tests (such as range, timing, sequencing)
- built in test equipment (BITE) test

using one of the following:

- aircraft power source/systems
- ground test rig

1.11 carry out maintenance on aircraft engine turbo-supercharging systems in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Extended Range Twin-Engine Operations Procedures (ETOPS) (where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/approved change documentation (service bulletin)

1.12 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.13 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:

- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.14 dispose of waste materials in accordance with safe working practices and approved procedures

| **Learning outcome** |
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| The learner will:<br>2. Know how to maintain reciprocating engine turbo-supercharging systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>2.1 explain the specific safety practices and procedures that they need to observe when working on aircraft engine turbo-supercharging systems<br>2.2 explain the need to check that cabin/cockpit switches, selectors and circuit breakers are in the correct position before applying any form of external power<br>2.3 explain the importance of maintenance on aircraft engine turbo-supercharging systems, and impact upon ETOPS systems, Electrical Wiring Interconnect Systems (EWIS), legislation and local procedures<br>2.4 describe the hazards associated with carrying out maintenance activities on aircraft engine turbo-supercharging systems, and with |

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| | the tools and equipment used, and explain how to minimise them and reduce any risk |
| 2.5 | explain what protective equipment they need to use for both personal protection and protection of the aircraft |
| 2.6 | explain the importance of good aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft |
| 2.7 | explain how to extract and use information from aircraft manuals, log books, flight logs, charts, circuit and physical layouts, specifications, symbols used in aircraft engine turbo-supercharging systems, and other documents needed in the maintenance activities |
| 2.8 | explain how to carry out currency/issue checks on the specifications they are working with |
| 2.9 | explain the terminology used in aircraft engine turbo-supercharging systems, and the use of system diagrams and associated symbols |
| 2.10 | describe the basic principles of operation of the aircraft engine turbo-supercharging system being worked on |
| 2.11 | explain the techniques used to remove components from aircraft engine turbo-supercharging systems without damage to the components or surrounding structure |
| 2.12 | describe the various mechanical fasteners to be removed and replaced, and explain their methods of removal and replacement |
| 2.13 | describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections |
| 2.14 | explain the need to label and store correctly components that require repair or overhaul, and to check that replacement components have the correct part/identification markings and accompanying release documentation |
| 2.15 | explain how to fit components into the system |
| 2.16 | describe the tools and equipment used in the maintenance activities, and explain their calibration/care and control procedures |
| 2.17 | explain why tool/equipment control is critical, and what to do if a tool or piece of equipment is unaccounted for on completion of the activities |
| 2.18 | explain how to make adjustments to components/assemblies to ensure that they function correctly |
| 2.19 | explain why securing devices need to be tightened to the correct torque, locked and labelled, and the different methods that are used |
| 2.20 | explain how to carry out routine checks and servicing of the aircraft engine turbo-supercharging system |
| 2.21 | explain what types of test need to be carried out on the aircraft engine turbo-supercharging system, and the test equipment to be used |
| 2.22 | explain the methods and procedures to be used to carry out the various tests on the turbo-supercharging system |
| 2.23 | explain how to record the results of the tests, and the documentation that must be used |
| 2.24 | explain how to analyse the test results, and how to make valid decisions about the acceptability of the aircraft turbo-supercharging system |

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| 2.25 | explain the procedures to be followed if the equipment or system fails to meet the test specification |
| 2.26 | explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation |
| 2.27 | describe the procedure for the safe disposal of waste materials and scrap components |
| 2.28 | describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve |

# Unit 747 Maintaining reciprocating engine turbo-supercharging systems on aircraft

Supporting information

## Guidance

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

2.2 (such as electrical, hydraulic, air or vacuum)

2.4, (such as hot parts of engines, traps from moving parts, misuse of tools)

2.10 (such as system layout, and indication and warning)

2.11 (such as release of pressures/force, removal of components and the need to protect the circuit integrity by ensuring that exposed components and pipe ends are correctly covered/protected)

2.12 (such as threaded fasteners, special securing devices)

2.15 (such as ensuring the correct position and orientation; correct tightness of fittings and connections; eliminating stress on pipework, cables and connections; carrying out visual checks of all components)

2.18 (such as adjusting density controller)

2.20 (including checking the security of critical fasteners, checking condition of gaskets)

# Unit 748 Maintaining engine water injection systems on aircraft

| | |
|---|---|
| **UAN:** | **M/601/6370** |
| **Level:** | 3 |
| **Credit value:** | 77 |
| **GLH:** | 154 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 348: Maintaining Engine Water Injection Systems on Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft engine water injection systems, in accordance with the approved aircraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It covers both fixed wing and rotary winged aircraft, and covers the units and components which provide, deliver and inject water or water mixtures into the induction system. The maintenance activities will include the removal, fitting and testing of a range of engine water injection system components, such as water tanks/bladder cells, interconnectors, pumps, valves, controls, pipes, transmitters and indicators. The learner will be expected to use the approved procedure for correctly isolating the system before breaking into the system circuit. The learner will remove the required components and fit approved replacements, as appropriate. The learner will then need to test and adjust the completed system to meet the aircraft maintenance manual, change documentation (service bulletin) and airworthiness requirements.<br>The learner's responsibilities will require them to comply with the specific practices and procedures identified in the aircraft manual, change/service bulletin documentation and airworthiness requirements for the maintenance activities undertaken, and to report any problems with these requirements 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 are correctly |

accounted for on completion of the activities, and that all necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to aircraft engine water injection systems. The learner will understand the removal, fitting and testing methods and procedures, and their application, along with the engine water injection system maintenance requirements. The learner will know how the equipment functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the equipment is maintained to the required standard.

The learner will understand the safety precautions required when working on aircraft engine water injection systems, especially those involved with working on pressurised systems. 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.

**Notes:** 1. This unit is designed to cover the practical experience requirements of the Airline Transport Association (ATA) Chapter 82 Water Injection. 2. To display competence in this unit, it is necessary to both remove and fit aircraft engine water injection system components. The learner must remove components; however, they may fit a replacement component where the original was previously removed by another person. The learner should also be aware of how to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| **Learning outcome** |
| --- |
| The learner will:<br>1. Be able to maintain engine water injection systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the maintenance of the aircraft engine water injection system:<br>• ensure that appropriate authorisation to work on the aircraft is |

obtained, and observe all relevant isolation and safety procedures
- obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)
- obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates
- adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
- ensure that the system is safely isolated and depressurised and (where appropriate) drain off fluid before breaking into the system
- ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)
- use approved removal, fitting and testing techniques and procedures at all times
- leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from damage and foreign object debris
- return tools and equipment to the correct storage location on completion of the activities
- ensure that work carried out is correctly documented and recorded
- ensure that any outstanding tests are correctly documented

1.3 follow the relevant maintenance schedules to carry out the required work

1.4 carry out the maintenance activities within the limits of their personal authority

1.5 carry out maintenance on two of the following parts of the aircraft engine water injection system:
- water storage
- distribution
- dumping and purging
- indicating

1.6 carry out the maintenance activities in the specified sequence and in an agreed timescale

1.7 carry out fifteen of the following maintenance activities:
- removing access panels and covers to expose components to be removed
- carrying out fault diagnosis and system checks
- preparing the system for maintenance (such as isolating, draining)
- disconnecting electrical connections
- disconnect/removing hoses and pipes
- removing mechanical fasteners and securing devices
- supporting equipment to be removed
- dismantling equipment to an appropriate level

- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing damaged/defective components
- replacing single use items such as seals, gaskets
- refitting components in the correct position, orientation and alignment
- setting and adjusting replaced components
- making mechanical connections
- making electrical connections
- torque loading
- carrying out system functional checks
- ensuring that replacement components have the correct part numbers
- fitting blanks, labelling (and storing in the correct location) components that require repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)
- carrying out area inspections prior to task close down

1.8 remove and fit four different engine water injection system components (at least two must be from group A):

group a:

- water pump
- valves
- water pressure regulator
- control unit
- water tanks/bladder cells
- interconnectors
- solenoids
- filling system components
- ventilating components

group b:

- sensors/transmitters
- temperature probes
- water pipes and hoses
- wiring/switches/plugs
- other specific components

1.9 service/check the aircraft engine water injection system, to include carrying out four of the following:

- checking the system for leaks
- checking and adjusting the water/methanol control unit
- checking fluid for quality/correct mixture
- checking tank content indicating systems
- checking jettison systems

1.10 carry out three of the following tests on the aircraft engine water injection system:

- leak test

- pressure test
- system charging
- flow test
- built in test equipment (BITE) test
- 'special-to-type' tests

using one of the following:

- aircraft power source/pumps
- ground test rig

1.11 carry out maintenance on aircraft engine water injection system components in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Extended Range Twin-engine Operations Procedures (ETOPS) (where appropriate)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/approved change documentation (service bulletin)

1.12 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.13 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:

- job cards/work sheets
- computer records
- aircraft technical log
- aircraft cabin log
- aircraft log book

1.14 dispose of waste materials in accordance with safe working practices and approved procedures

| **Learning outcome** |
| --- |
| The learner will:<br>2. Know how to maintain engine water injection systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>2.1 explain the specific safety practices and procedures that they need to observe when working on aircraft engine water injection systems<br>2.2 explain the importance of maintenance on aircraft engine water injection systems, and impact upon ETOPS systems, Electrical Wiring Interconnect Systems (EWIS), legislation and local procedures<br>2.3 explain the need to check that cabin/cockpit switches, selectors and circuit breakers are in the correct position before applying any form of external power<br>2.4 describe the hazards associated with carrying out maintenance activities on aircraft engine water injection systems, and with the tools and equipment used, and explain how to minimise them and reduce any risk<br>2.5 explain what protective equipment they need to use for both |

personal protection and protection of the aircraft

2.6 explain the importance of good aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft

2.7 explain how to extract and use information from aircraft manuals, log books, flight logs, charts, circuit and physical layouts, specifications, symbols used in aircraft engine water injection systems, and other documents needed in the maintenance activities

2.8 explain how to carry out currency/issue checks on the specifications they are working with

2.9 explain the terminology used in aircraft engine water injection systems, and the use of system diagrams and associated symbols

2.10 describe the various types of pipe and components that make up the aircraft engine water injection system

2.11 describe the basic principles of operation of the engine water injection system being worked on, and the function of the various units that make up the system

2.12 explain the techniques used to remove components from aircraft engine water injection systems without damage to the components or surrounding structure

2.13 describe the various mechanical fasteners to be removed and replaced, and explain their methods of removal and replacement

2.14 describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections

2.15 explain the need to label and store correctly components that require repair or overhaul, and to check that replacement components have the correct part/identification markings and accompanying release documentation

2.16 explain how to fit components into the system

2.17 explain how to make adjustments to components/assemblies to ensure that they function correctly

2.18 explain why securing devices need to be tightened to the correct torque, locked and labelled, and the different methods that are used

2.19 explain how to carry out routine checks and servicing of the aircraft engine water injection system

2.20 explain what types of test need to be carried out on the aircraft engine water injection system, and the test equipment to be used

2.21 explain the methods and procedures to be used to carry out the various tests

2.22 explain how to record the results of each individual test, and the documentation that must be used

2.23 explain how to analyse the test results, and how to make valid decisions about the acceptability of the aircraft engine water injection system

2.24 explain the procedures to be followed if the equipment or system fails to meet the test specification

2.25 explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation

| | |
|---|---|
| 2.26 | describe the procedure for the safe disposal of waste materials and scrap components |
| 2.27 | describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve |

# Unit 748 Maintaining engine water injection systems on aircraft

Supporting information

## Guidance

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

2.10 (such as tanks/bladder cells; pipes; pumps; valves; mechanical and electrical control devices)

2.12 (such as release of fluids, removal of components and the need to protect the circuit integrity by fitting blanking plugs and labelling exposed circuits)

2.13 (such as threaded fasteners, special securing devices)

2.16 (such as ensuring the correct tightness of fastenings, fittings and pump connections; eliminating stress on pipework/connections; correctly making electrical connections; carrying out visual checks of all components)

2.17 (such as flow settings, travel and working clearance)

2.19 (including checking for leaks, checking quality of water mixture)

# Unit 749 Maintaining radar systems on aircraft

| | |
|---|---|
| **UAN:** | **A/601/6372** |
| **Level:** | 3 |
| **Credit value:** | 86 |
| **GLH:** | 168 |
| **Relationship to NOS:** | This unit has been derived from national occupational standard Aeronautical Engineering Unit 349: Maintaining Radar Systems on Aircraft (Suite 3). |
| **Endorsement by a sector or regulatory body:** | This unit is endorsed by Semta, the Sector Skills Council for science, engineering and manufacturing |
| **Aim:** | This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on aircraft radar systems, in accordance with the approved aircraft maintenance manual, approved change documentation (service bulletin) and airworthiness requirements. It covers both fixed wing and rotary winged aircraft, and includes units and components associated with surveillance radar (including supplementary surveillance radar), weather radar, and obstacle warning systems (such as enhanced ground proximity warning systems - EGPWS), traffic collision and avoidance systems (TCAS), towed radar decoys, radar (radio) altimeter, tactical air navigation (TACAN), identification friend or foe (IFF), Doppler, and radar jamming devices, as applicable to the aircraft type. The maintenance activities will include the removal, fitting and testing of a range of radar components. The learner will be required to select the correct tools and equipment to use, based on the operations to be performed and the components to be removed or replaced.<br>The aircraft radar components will include items such as scanners, aerials, transponders, transmitters, receiver units, microwave generators, processors, power supply units, waveguides, intermediate frequency units, indicator units, radar displays, coolant units and control units, and other devices, as applicable to the aircraft type.<br>The learner will remove the required components and fit approved replacements, as appropriate. |

The learner will then need to test and adjust the completed system to meet the aircraft maintenance manual, change documentation (service bulletin) and airworthiness requirements.

The learner's responsibilities will require them to comply with the specific practices and procedures identified in the aircraft manual, change/service bulletin documentation and airworthiness requirements for the maintenance activities undertaken, and to report any problems with these requirements 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 are correctly accounted for on completion of the activities, and that all necessary job/task documentation is completed thoroughly, accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate maintenance techniques and procedures to aircraft radar systems. The learner will understand the removal, fitting and testing methods and procedures, and their application, along with the radar system maintenance requirements. The learner will know how the equipment functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and for ensuring that the equipment is maintained to the required standard.

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

**Notes:** 1. This unit is designed to cover the requirements of military aircraft radar systems and will cover some of the practical experience requirements of the Airline Transport Association (ATA) Chapter 34 Navigation. 2. To display competence in this unit, it is necessary to both remove and fit aircraft radar system components. The learner must remove components; however, they may fit a replacement component where the original was previously removed by another person. The learner should also be aware of how

to leave a system in a safe condition if maintenance tasks cannot be completed. This covers both the physical systems and the job documentation.

| **Learning outcome** |
| --- |
| The learner will:<br>1. Be able to maintain radar systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>1.1 work safely at all times, complying with health and safety and other relevant regulations and guidelines<br>1.2 carry out all of the following during the maintenance of the aircraft radar system:<br>• ensure that appropriate authorisation to work on the aircraft is obtained, and observe all relevant isolation and safety procedures<br>• obtain and use the correct documentation (such as job instructions, technical instructions, aircraft manuals and maintenance documentation)<br>• obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current calibration dates<br>• 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<br>• ensure that the relevant safety devices and mechanical/physical locks are in place (where appropriate)<br>• where appropriate, apply electrostatic discharge (ESD) avoidance procedures<br>• use approved removal, fitting and testing techniques and procedures at all times<br>• leave the aircraft and equipment in a safe and appropriate condition, and ensure that components and surrounding structures are maintained free from damage and foreign object debris<br>• return tools and equipment to the correct storage location on completion of the activities<br>• ensure that work carried out is correctly documented and recorded<br>• ensure that any outstanding tests are correctly documented<br>1.3 follow the relevant maintenance schedules to carry out the required work<br>1.4 carry out the maintenance activities within the limits of their personal authority<br>1.5 carry out maintenance on the following aircraft radar systems:<br>either one of the following:<br>• surveillance radar<br>• radar jamming<br>or three of the following: |

- towed radar decoys
- radar (radio) altimeter
- supplementary surveillance radar
- Doppler
- obstacle warning systems
- identification friend or foe (IFF)
- tactical air navigation (TACAN)
- weather radar/predictive wind shear
- enhanced ground proximity warning system (EGPWS)
- traffic collision avoidance system (TCAS)

1.6 carry out the maintenance activities in the specified sequence and in an agreed timescale

1.7 carry out fifteen of the following maintenance activities:

- removing access panels and covers to expose components to be removed
- carrying out fault diagnosis and system checks
- preparing the system for maintenance (such as isolating)
- disconnecting electrical connections
- removal of bonding
- removing cable securing devices
- removing securing devices and mechanical fasteners
- supporting equipment to be removed
- dismantling equipment to an appropriate level
- covering (protecting) exposed components, wires, pipework or vents
- checking components for serviceability
- replacing damaged/defective components
- refitting components in the correct position, orientation and alignment
- setting and adjusting/tuning replaced components (such as power output, voltage)
- making mechanical connections
- making electrical connections
- carrying out bonding
- installing cable securing devices
- torque loading as required
- pressurising systems (waveguide, coolant)
- ensuring that replacement components have the correct part numbers
- labelling (and storing in the correct location) components that require repair or overhaul
- applying bolt locking methods (such as split pins, wire locking, lock nuts)
- carrying out area inspections prior to task close down

1.8 remove and fit six different aircraft radar system components (at least three must be from group A):

group a:

- scanners
- aerials
- transformers
- transmitter units
- computers
- transponders
- interface units
- line replacement units (LRU)
- radar displays
- receiver units
- processors
- control units
- microwave generators
- intermediate frequency unit (IFU)
- analogue/digital converters (A-D/D-A)
- satellite beacons
- power supply units (PSU)
- waveguides
- radar packs
- coolant units

group b:

- batteries
- switches
- relays
- circuit breakers
- instruments/gauges/indicators
- desiccant units
- unit trays
- wires/cables
- plugs/sockets
- coolant
- other specific components

1.9 service/check the aircraft radar systems, to include carrying out three of the following:

- functional check surveillance radar
- functional check towed radar decoys
- functional check radar (radio) altimeter
- functional check Doppler
- functional check radar jamming
- functional check obstacle warning systems
- functional check supplementary surveillance radar
- functional check identification friend or foe (IFF)
- functional check tactical air navigation (TACAN)
- functional check weather radar/predictive wind shear
- functional check traffic collision avoidance system (TCAS)
- functional check enhanced ground proximity warning system

(EGPWS)

1.10 carry out four of the following types of test/check on aircraft radar systems:

- standard serviceability checks of all equipment
- continuity check
- bonding tests
- applying a dummy load
- BITE test
- signal injection tests
- distant object test
- distortion checks
- voltage standing wave ratio (VSWR) checks
- range checks
- power output
- receiver sensitivity
- signal-to-noise checks
- TDR checks
- 'special-to-type' tests

using four of the following:

- multimeter
- bonding tester
- 'special to type' test equipment
- radio frequency (RF) signal generators
- external power source (electrical/hydraulic)
- aircraft power source (electrical/hydraulic)
- pressure tester (hydraulic, pneumatic, coolant)
- dummy load
- modulation analyser
- oscilloscope
- delay lines
- time-domain reflectometer (TDR) equipment
- voltage standing wave ratio (VSWR) equipment

1.11 carry out maintenance on aircraft radar systems in compliance with one of the following:

- Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
- Ministry of Defence (MoD)
- Federal Aviation Authority (FAA)
- aircraft maintenance manual/approved change documentation (service bulletin)

1.12 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

1.13 complete the relevant maintenance records accurately and pass them on to the appropriate person, to include one of the following:

- job cards/work sheets
- computer records

- aircraft technical log
- aircraft cabin log
- aircraft log book

1.14 dispose of waste materials in accordance with safe working practices and approved procedures

| **Learning outcome** |
| --- |
| The learner will:<br>2. Know how to maintain radar systems on aircraft |
| **Assessment criteria** |
| The learner can:<br>2.1 explain the specific safety practices and procedures that they need to observe when working with aircraft radar systems<br>2.2 explain the importance of maintenance on aircraft radar systems, and impact upon ETOPS systems, Electrical Wiring Interconnect Systems (EWIS), legislation and local procedures<br>2.3 describe the hazards associated with removing, fitting and testing aircraft radar system components, and with the tools and equipment used, and explain how to minimise them and reduce any risk<br>2.4 explain what protective equipment they need to use for both personal protection and protection of the aircraft<br>2.5 explain the importance of aircraft husbandry and of ensuring that, throughout the maintenance activity, the aircraft and work area are maintained free from foreign objects, and the implications of FOD to the safety of the aircraft<br>2.6 explain how to extract and use information from aircraft manuals, log books, flight logs, charts, circuit and physical layouts, specifications, symbols used in aircraft radar systems, and other documents needed in the maintenance process<br>2.7 explain how to carry out currency/issue checks on the specifications they are working with<br>2.8 explain the terminology used in aircraft radar systems, and the use of system diagrams and associated symbols<br>2.9 describe the basic principles of operation of the aircraft radar system being worked on, and the function of the various units within the system<br>2.10 describe the various mechanical fasteners that are used, and their methods of removal and replacement<br>2.11 explain the importance of using the specified fasteners for the installation, and why they must not substitute others<br>2.12 explain why securing devices need to be locked and labelled, and the different methods that are used to remove and install them<br>2.13 explain the torque loading requirements on the fasteners, and what to do if these loadings are exceeded or not achieved<br>2.14 describe the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections<br>2.15 explain the techniques used to remove components from aircraft radar systems without damage to the components or surrounding structure (such as proof marking, the need to protect the circuit integrity by covering and labelling exposed circuits) |

2.16 explain the importance of applying electrostatic discharge (ESD) avoidance procedures when working on sensitive equipment or devices

2.17 explain the need to label and store correctly components that require repair or overhaul, and to check that replaced components have the correct part/identification markings and accompanying release documentation

2.18 explain the techniques used to position, align, adjust and secure the replaced components to the aircraft without damage to the components or surrounding structure

2.19 explain the methods of lifting, handling and supporting the components/equipment during the maintenance activities

2.20 explain why electrical bonding is critical, and why it must be both mechanically and electrically secure

2.21 describe the tools and equipment used in the maintenance activities, and explain their calibration/care and control procedures

2.22 explain why tool/equipment control is critical, and what to do if a tool or piece of equipment is unaccounted for on completion of the activities

2.23 explain how to recognise defects

2.24 explain how to carry out routine checks and servicing of the aircraft radar system

2.25 explain the need to check that cabin/cockpit switches, selectors and circuit breakers are in the correct position before applying any form of external power

2.26 explain what types of test need to be carried out on the aircraft radar system, and the test equipment to be used

2.27 explain the methods and procedures to be used to carry out the various tests on the radar system

2.28 explain the importance of carrying out the tests in the specified sequence, checking readings and movements at each stage

2.29 explain how to record the results of each individual test, and the documentation that must be used

2.30 explain how to analyse the test results, and make valid decisions about the acceptability of the aircraft radar systems

2.31 explain the procedures to be followed if the equipment or system fails to meet the test specification

2.32 describe the problems that can occur with the aircraft radar system maintenance operations, and explain how these can be overcome

2.33 explain what recording documentation needs to be completed for the activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation

2.34 describe the procedure for the safe disposal of waste materials and scrap components

2.35 describe the extent of their own authority, and explain to whom they should report if they have problems that they cannot resolve

# Unit 749 Maintaining radar systems on aircraft

Supporting information

## Guidance

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

2.10 (such as threaded fasteners, special securing devices)

2.23 (such as incorrectly seated plugs and sockets, ineffective fasteners, foreign object damage or contamination)

2.25 (such as electrical, hydraulic, air or vacuum)

# 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**
- Essential Skills (Northern Ireland) – see **www.cityandguilds.com/essentialskillsni**
- Essential Skills Wales – see **www.cityandguilds.com/esw**.

# Appendix 2 Sources of general information

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

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

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

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

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

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

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

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

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

***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.

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# Useful contacts

| | |
|---|---|
| **UK learners**<br>**General qualification information** | **T: +44 (0)844 543 0033**<br>**E: learnersupport@cityandguilds.com** |
| **International learners**<br>General qualification information | T: +44 (0)844 543 0033<br>F: +44 (0)20 7294 2413<br>E: **intcg@cityandguilds.com** |
| **Centres**<br>Exam entries, Certificates, Registrations/enrolment, Invoices, Missing or late exam materials, Nominal roll reports, Results | T: +44 (0)844 543 0000<br>F: +44 (0)20 7294 2413<br>E: **centresupport@cityandguilds.com** |
| **Single subject qualifications**<br>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<br>F: +44 (0)20 7294 2413<br>F: +44 (0)20 7294 2404 (BB forms)<br>E: **singlesubjects@cityandguilds.com** |
| **International awards**<br>Results, Entries, Enrolments, Invoices, Missing or late exam materials, Nominal roll reports | T: +44 (0)844 543 0000<br>F: +44 (0)20 7294 2413<br>E: **intops@cityandguilds.com** |
| **Walled Garden**<br>Re-issue of password or username, Technical problems, Entries, Results, e-assessment, Navigation, User/menu option, Problems | T: +44 (0)844 543 0000<br>F: +44 (0)20 7294 2413<br>E: **walledgarden@cityandguilds.com** |
| **Employer**<br>Employer solutions, Mapping, Accreditation, Development Skills, Consultancy | T: +44 (0)121 503 8993<br>E: **business@cityandguilds.com** |
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**The City & Guilds Group operates from three major hubs: London (servicing Europe, the Caribbean and Americas), Johannesburg (servicing Africa), and Singapore (servicing Asia, Australia and New Zealand). The Group also includes the Institute of Leadership & Management (management and leadership qualifications), City & Guilds Land Based Services (land-based qualifications), the Centre for Skills Development (CSD works to improve the policy and practice of vocational education and training worldwide) and Learning Assistant (an online e-portfolio).**



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