Level 3 Diploma in Aviation Maintenance (Military Development Competence) - Aircraft Mechanical Maintenance (4608-60)

Version 1.1 (November 2018)
Qualification at a glance

<table>
<thead>
<tr>
<th>Subject area</th>
<th>Mechanical</th>
</tr>
</thead>
<tbody>
<tr>
<td>City &amp; Guilds number</td>
<td>4608</td>
</tr>
<tr>
<td>Age group approved</td>
<td>16-19, 19+</td>
</tr>
<tr>
<td>Entry requirements</td>
<td>None</td>
</tr>
<tr>
<td>Assessment types</td>
<td>Portfolio</td>
</tr>
<tr>
<td>Approvals</td>
<td>Automatic approval</td>
</tr>
<tr>
<td>Registration and certification</td>
<td>Consult the Walled Garden/Online Catalogue for last dates</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Title and level</th>
<th>GLH</th>
<th>TQT</th>
<th>City &amp; Guilds qualification number</th>
<th>Ofqual accreditation number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 3 Diploma Aviation Maintenance (Military Development Competence) - Aircraft Mechanical Maintenance</td>
<td>831</td>
<td>3329</td>
<td>4608-60</td>
<td>603/2068/0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Version</th>
<th>Amendment</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 November 2018</td>
<td>Various typographical errors</td>
<td>Units</td>
</tr>
</tbody>
</table>

This unit pack must be read in conjunction with the main qualification handbook.
##Contents

<table>
<thead>
<tr>
<th>Qualification at a glance</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contents</td>
<td>3</td>
</tr>
<tr>
<td>Introduction</td>
<td>4</td>
</tr>
<tr>
<td>1 Units</td>
<td>6</td>
</tr>
<tr>
<td>Unit 375</td>
<td>Carrying out fault diagnosis on aircraft airframe, mechanical components and systems</td>
</tr>
<tr>
<td>Unit 376</td>
<td>Undertaking scheduled maintenance of aircraft airframe and mechanical equipment</td>
</tr>
<tr>
<td>Unit 377</td>
<td>Repairing airframes and structures</td>
</tr>
<tr>
<td>Unit 381</td>
<td>Removing and replacing components of aircraft fuel and lubrication systems</td>
</tr>
<tr>
<td>Unit 382</td>
<td>Removing and replacing components of aircraft hydraulic systems</td>
</tr>
<tr>
<td>Unit 383</td>
<td>Removing and replacing components of aircraft pneumatic and vacuum systems</td>
</tr>
<tr>
<td>Unit 384</td>
<td>Removing and replacing components of aircraft environmental systems</td>
</tr>
<tr>
<td>Unit 385</td>
<td>Removing and replacing components of aircraft power transmission systems</td>
</tr>
<tr>
<td>Unit 386</td>
<td>Removing and replacing components of aircraft cabin systems</td>
</tr>
<tr>
<td>Unit 387</td>
<td>Removing and replacing major assemblies of aircraft airframes</td>
</tr>
<tr>
<td>Unit 388</td>
<td>Modifying aircraft propulsion equipment and systems</td>
</tr>
<tr>
<td>Unit 389</td>
<td>Carrying out tests on aircraft engines and systems</td>
</tr>
<tr>
<td>Unit 390</td>
<td>Carrying out tests on aircraft control systems</td>
</tr>
<tr>
<td>Unit 391</td>
<td>Carrying out tests on aircraft fuel and storage systems</td>
</tr>
<tr>
<td>Unit 392</td>
<td>Carrying out tests on aircraft hydraulic systems</td>
</tr>
<tr>
<td>Unit 393</td>
<td>Carrying out tests on aircraft pneumatic and vacuum systems</td>
</tr>
<tr>
<td>Unit 394</td>
<td>Carrying out tests on aircraft environmental systems</td>
</tr>
<tr>
<td>Unit 395</td>
<td>Carrying out tests on aircraft power transmission systems</td>
</tr>
<tr>
<td>Unit 396</td>
<td>Carrying out checks and tests on replaced airframe major assemblies</td>
</tr>
<tr>
<td>Appendix 1</td>
<td>Relationships to other qualifications</td>
</tr>
<tr>
<td>Appendix 2</td>
<td>Sources of general information</td>
</tr>
<tr>
<td>Appendix 3</td>
<td>Useful contacts</td>
</tr>
</tbody>
</table>
## Introduction

Level 3 Diploma in Aviation Maintenance (Military Development Competence) - Aircraft Mechanical Maintenance

## Structure

Learners must complete 301, 302, 304, 375, 376, 455 plus two from 377–388 and plus two from 389–396.

<table>
<thead>
<tr>
<th>City &amp; Guilds unit number</th>
<th>Unit title</th>
<th>GLH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Mandatory</strong></td>
<td></td>
</tr>
<tr>
<td>301</td>
<td>Complying with statutory regulations and organisational safety requirements</td>
<td>35</td>
</tr>
<tr>
<td>302</td>
<td>Using and interpreting engineering data and documentation</td>
<td>25</td>
</tr>
<tr>
<td>304</td>
<td>Reinstating the work area on completion of activities</td>
<td>25</td>
</tr>
<tr>
<td>375</td>
<td>Carrying out fault diagnosis on aircraft airframe, mechanical components and systems</td>
<td>119</td>
</tr>
<tr>
<td>376</td>
<td>Undertaking scheduled maintenance of aircraft airframe and mechanical equipment</td>
<td>91</td>
</tr>
<tr>
<td>455</td>
<td>Working efficiently and effectively in engineering</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td><strong>Optional</strong></td>
<td></td>
</tr>
<tr>
<td>377</td>
<td>Repairing airframes and structures</td>
<td>133</td>
</tr>
<tr>
<td>378</td>
<td>Modifying airframes</td>
<td>126</td>
</tr>
<tr>
<td>379</td>
<td>Removing and replacing aircraft power plant and components</td>
<td>175</td>
</tr>
<tr>
<td>380</td>
<td>Removing and replacing components of aircraft control systems</td>
<td>175</td>
</tr>
<tr>
<td>381</td>
<td>Removing and replacing components of aircraft fuel and lubrication systems</td>
<td>175</td>
</tr>
<tr>
<td>382</td>
<td>Removing and replacing components of aircraft hydraulic systems</td>
<td>175</td>
</tr>
<tr>
<td>383</td>
<td>Removing and replacing components of aircraft pneumatic and vacuum systems</td>
<td>175</td>
</tr>
<tr>
<td>384</td>
<td>Removing and replacing components of aircraft environmental systems</td>
<td>175</td>
</tr>
<tr>
<td>385</td>
<td>Removing and replacing components of aircraft power transmission systems</td>
<td>175</td>
</tr>
<tr>
<td>386</td>
<td>Removing and replacing components of aircraft cabin systems</td>
<td>161</td>
</tr>
</tbody>
</table>
### Optional

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>387</td>
<td>Removing and replacing major assemblies of aircraft airframes</td>
<td>175</td>
</tr>
<tr>
<td>388</td>
<td>Modifying aircraft propulsion equipment and systems</td>
<td>175</td>
</tr>
<tr>
<td>389</td>
<td>Carrying out tests on aircraft engines and systems</td>
<td>133</td>
</tr>
<tr>
<td>390</td>
<td>Carrying out tests on aircraft control systems</td>
<td>126</td>
</tr>
<tr>
<td>391</td>
<td>Carrying out tests on aircraft fuel and storage systems</td>
<td>133</td>
</tr>
<tr>
<td>392</td>
<td>Carrying out tests on aircraft hydraulic systems</td>
<td>133</td>
</tr>
<tr>
<td>393</td>
<td>Carrying out tests on aircraft pneumatic and vacuum systems</td>
<td>133</td>
</tr>
<tr>
<td>394</td>
<td>Carrying out tests on aircraft environmental systems</td>
<td>133</td>
</tr>
<tr>
<td>395</td>
<td>Carrying out tests on aircraft power transmission systems</td>
<td>133</td>
</tr>
<tr>
<td>396</td>
<td>Carrying out checks and tests on replaced airframe major assemblies</td>
<td>126</td>
</tr>
</tbody>
</table>
1 Units

Structure of the units

These units each have the following:

- City & Guilds reference number
- Title
- Guided learning hours (GLH)
- Learning outcomes, which are comprised of a number of assessment criteria

Centres must deliver the full breadth of the range. Specialist equipment or commodities may not be available to all centres, so centres should ensure that their delivery covers their use. This may be covered by a practical demonstration (e.g. video). For the practical assessments for this qualification, centres should ensure that there are sufficient resources to complete the task but are not required to use all the equipment or commodities in the range.

Please refer to the main qualification handbook for full information on the qualification and the shared mandatory units.
Unit 375  
Carrying out fault diagnosis on aircraft airframe, mechanical components and systems

GLH: 119

Unit aim:
This Employer Unit of Competence (EUC) has been developed by employers in the Aerospace and Aviation Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief.

This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to carry out fault diagnosis on aircraft airframe and mechanical components and systems, in accordance with approved procedures. It covers both fixed wing and rotary winged aircraft, and covers a range of mechanical equipment and systems such as power plant and auxiliary engines, flying controls, engine starting and monitoring, fuel and lubrication, hydraulic, pneumatic, environmental, power transmission, ice and rain protection, propeller control, cabin equipment and furnishings and airframe, at sub-assembly or component level, as applicable.

They will be expected to use a variety of fault diagnostic methods and techniques, and to utilise a number of diagnostic aids and equipment. From the evidence gained, they will be expected to identify the fault and its probable cause and to determine appropriate action to remedy the problem.

Their responsibilities will require them to comply with organisational policy and procedures for the fault diagnostic activities undertaken and to report any problems with these activities or with the tools and equipment used that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. They 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. They must ensure that all tools, equipment and materials used in the maintenance activities are removed from the aircraft on completion of the activities and that all necessary job/task documentation is completed, accurately and legibly.

The apprentice’s knowledge will provide a good understanding of their work and will provide an informed approach to applying appropriate fault diagnostic procedures to aircraft airframe and mechanical equipment and systems. They will understand the various fault diagnostic methods and techniques used and their application. They will know how to apply and interpret information obtained from diagnostic aids and equipment, in adequate depth to provide a sound basis for carrying out the activities and for identifying faults or conditions that are outside the required specification.

They will understand the safety precautions required when carrying out the fault diagnostic activities, especially those for isolating the equipment. They 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.

They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall objectives of the organisation, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity, motivation and commitment.
Learning outcome

Performance Requirements

Assessment criteria

The learner can:

P1 work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines
P2 demonstrate the required behaviours in line with the job role and organisational objectives
P3 review and use all relevant information on the symptoms and problems associated with the products or assets
P4 investigate and establish the most likely causes of the faults
P5 select, use and apply diagnostic techniques, tools and aids to locate faults
P6 complete the fault diagnosis within the agreed time and inform the appropriate people when this cannot be achieved
P7 determine the implications of the fault for other work and for safety considerations
P8 use the evidence gained to draw valid conclusions about the nature and probable cause of the fault
P9 record details on the extent and location of the faults in an appropriate format

Learning outcome

The learner will:

1 Carry out all of the following during the fault diagnostic activities:

1.1 plan the fault diagnosis activities prior to beginning the work
1.2 obtain and use the appropriate documentation (such as job instructions, aircraft manuals, technical instructions, and other relevant maintenance documentation)
1.3 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
1.4 obtain clearance to work on the aircraft, and observe all relevant isolation and safety procedures (such as mechanical, electricity, gas, air or fluids
1.5 obtain the correct tools and equipment for the activity and check that they are in a safe, tested and usable condition and within current certification/calibration date
1.6 where appropriate, apply electrostatic discharge (ESD) protection procedures
1.7 provide and maintain a safe working environment for the diagnostic activities
1.8 carry out the fault diagnostic activities, using approved techniques and procedures
1.9 collect equipment fault diagnostic evidence from live and isolated systems
1.10 disconnect or isolate components or parts of the system, when appropriate, to confirm the diagnosis
1.11 identify the fault and determine the appropriate corrective action
1.12 return all tools and equipment to the correct location on completion of the activities
1.13 leave the aircraft and system in a safe and appropriate condition, free from foreign object debris on completion of the activities

**Learning outcome**

The learner will:

2 Carry out fault diagnosis on **three** of the following aircraft airframe/mechanical systems, to sub-assembly or component level, as appropriate:

2.1 power plant (including APU)
2.2 propeller control
2.3 auxiliary engines
2.4 hydraulic
2.5 engine starting and monitoring
2.6 pneumatic
2.7 fuel
2.8 environmental (cabin conditioning, pressurisation, oxygen)
2.9 lubrication
2.10 ice and rain protection
2.11 power transmission
2.12 cabin equipment and furnishings
2.13 flying controls
2.14 airframe (including freight)
2.15 undercarriage
2.16 cabin systems (such as water, galley, sanitary)

**Learning outcome**

The learner will:

3 Collect information about the fault from **four** of the following sources:

3.1 the person who reported the fault
3.2 approved sensory checks (such as sight, sound, smell, touch)
3.3 monitoring equipment or gauges
3.4 aircraft log/documentation
3.5 recording devices
3.6 operation of the equipment
3.7 aircraft self-diagnostics
3.8 fault records
Learning outcome

The learner will:

4 Use a range of fault diagnostic techniques, to include three of the following:

4.1 pressure/leak test
4.2 injection and sampling
4.3 six point technique
4.4 functional testing
4.5 half-split technique
4.6 non-destructive testing techniques
4.7 input-to-output
4.8 unit substitution

Learning outcome

The learner will:

5 Use a variety of diagnostic aids and equipment, to include two of the following:

5.1 aircraft maintenance manual (AMM)
5.2 fault analysis charts (such as fault trees)
5.3 equipment self-diagnostics
5.4 troubleshooting guides
5.5 circuit diagrams/specifications
5.6 algorithms/flow charts

Learning outcome

The learner will:

6 Use two of the following types of test equipment to help in the fault diagnosis:

6.1 mechanical measuring equipment (such as measuring instruments, dial test indicators, torque instruments)
6.2 electrical/electronic measuring instruments (such as a multimeter)
6.3 fluid power test equipment (such as test rigs, flow meters, pressure gauges)
6.4 built in test equipment (BITE)
6.5 ‘special-to-type’ test equipment
6.6 ferrous or non-ferrous crack detection equipment
Learning outcome
The learner will:
7 Diagnose faults from two of the following breakdown categories:
    7.1 intermittent problem
    7.2 partial failure or reduced performance
    7.3 complete breakdown

Learning outcome
The learner will:
8 Provide a record of the outcome of the fault diagnosis, using one of the following:
    8.1 step-by-step analytical report
    8.2 aircraft service/flight log
    8.3 aircraft log book
    8.4 corrective action report
    8.5 organisation-specific reporting procedure
    8.6 computer records

Learning outcome
Knowledge and understanding
Assessment criteria
The learner must know and understand:

K1 the health and safety requirements of the area in which they are carrying out the fault diagnostic activities and the responsibility these requirements place on them
K2 the specific safety precautions to be taken when carrying out the fault diagnosis of the particular aircraft airframe/mechanical system
K3 the isolation and lock-off procedure or permit-to-work procedure that applies
K4 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the organisation if these are not adhered to
K5 the requirements and importance of understanding and applying human factors as defined by the regulatory requirements and the potential impact if these are not adhered to
K6 the importance of wearing protective clothing (PPE) and other appropriate safety equipment during the fault diagnostic activities, the type of safety equipment to be used and where to obtain it
K7 hazards associated with carrying out fault diagnosis on aircraft mechanical systems (such as working on pressurised systems, hot or moving parts, using faulty or damaged tools and equipment, using practices and procedures that do not follow laid-down procedures) and how to minimise them and reduce any risks
K8 what constitutes a hazardous voltage and how to recognise victims of electric shock
K9 how to reduce the risks of a phase to earth shock (such as insulated tools, rubber matting and isolating transformers)
K10 where to obtain, and how to interpret drawings, circuit diagrams, specifications, manufacturers' manuals and other documents needed for the fault diagnostic activities
K11 the basic principles of how the mechanical system functions and the working purpose of the various units and components
K12 the various fault finding techniques that can be used and how they are applied (such as half-split, input-to-output, six point technique, functional testing, unit substitution, injection and sampling techniques, and equipment self-diagnostics)
K13 the importance of applying electrostatic discharge (ESD) procedures when working on sensitive equipment or devices
K14 how to evaluate the various types of information available for fault diagnosis (such as pilot reports, monitoring equipment, aircraft history records, function of the equipment/system)
K15 how to evaluate sensory information from sight, sound, smell, touch
K16 how to conduct test for cracks or fatigue in airframe structure components
K17 the procedures to be followed to investigate faults and how to deal with intermittent conditions
K18 how to use the various aids and reports available for fault diagnosis
K19 mechanical measuring instruments, electrical measuring instruments, test rigs, pressure and flow devices), and how to check that the equipment is calibrated or configured correctly for the intended use, and that it is free from damage and defects
K20 the application of specific fault finding methods and techniques that are best suited to the problem
K21 how to analyse and evaluate possible characteristics and causes of specific faults/problems
K22 how to make use of previous reports/records of similar fault conditions
K23 how to evaluate the likely risk of running the aircraft with the displayed fault and the effects the fault could have on the aircraft performance and safety
K24 how to prepare a report which complies with the organisations policy on fault diagnosis
K25 the extent of their own authority and to whom they should report if they have problems that they cannot resolve
Unit 375  Carrying out fault diagnosis on aircraft airframe, mechanical components and systems

Unit guidance
Assessment requirements for this have been developed by employers for the occupational competency units and qualifications for the Aerospace and Aviation Sector. These assessment requirements are set down in the Aerospace Engineering Employer Occupational Unit Assessment Strateg.

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems. This will allow each organisation to develop their own specific and tailored apprentice training programme whilst meeting their own requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers.
Unit 376  
Undertaking scheduled maintenance of aircraft airframe and mechanical equipment

GLH: 91

Unit aim:
This Employer Unit of Competence (EUC) has been developed by employers in the Aerospace and Aviation Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief.

This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to carry out scheduled maintenance activities on aircraft airframes and mechanical equipment, in accordance with approved procedures. It covers both fixed wing and rotary winged aircraft and covers a range of mechanical equipment such as power plant and auxiliary engines, flying controls, engine starting and monitoring, fuel and lubrication, hydraulic, pneumatic, environmental equipment (such as cabin conditioning, oxygen, pressurisation), power transmission, ice and rain protection, propeller control, cabin equipment and furnishings and airframe components.

They will need to organise and carry out the maintenance activities to minimise down time, and ensure that the maintained equipment/system meets airworthiness standards, and performs at operational levels and to the required specification.

Their responsibilities will require them to comply with organisational policy and procedures for the maintenance activities undertaken and to report any problems with the maintenance activities, tools or equipment used that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. They must ensure that all tools, equipment, and materials used in the maintenance activities are removed from the work area on completion of the work, and that all necessary job/task documentation is completed, accurately and legibly. They 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 apprentice’s knowledge will provide a good understanding of their work and will provide an informed approach to applying scheduled maintenance procedures on aircraft airframe/mechanical equipment. They will know how the system and equipment functions and potential problems or defects that may occur. They will understand the process of developing scheduled maintenance, and its application, and will know about the maintenance criteria, in adequate depth to provide a sound basis for carrying out the activities safely and effectively and for ensuring that the equipment is maintained to the required specification. In addition, they will be expected to report where the outcome of the maintenance activity identifies the need for further investigation or maintenance work.

They will understand the safety precautions required when carrying out the maintenance activities, especially those for isolating the equipment. They 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.

They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall objectives of the organisation, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity, motivation and commitment.
Learning outcome

Performance Requirements

Assessment criteria

The learner can:

P1 work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines.
P2 demonstrate the required behaviours in line with the job role and organisations objectives.
P3 follow the relevant maintenance schedules to carry out the required work.
P4 carry out the maintenance activities within the limits of their personal authority.
P5 carry out the maintenance activities in the specified sequence and in an agreed timescale.
P6 report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule.
P7 complete the relevant maintenance records accurately and pass them on to the appropriate person.
P8 dispose of waste materials in accordance with safe working practices and approved procedures.

Learning outcome

The learner will:

1 Carry out **all** of the following during the scheduled maintenance activities:

1.1. plan the scheduled maintenance activities to cause minimal disruption to normal working
1.2. obtain and use the appropriate documentation (such as job instructions, aircraft manuals, technical instructions, and other relevant maintenance documentation)
1.3. 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
1.4. obtain clearance to work on the aircraft, and observe all relevant isolation and safety procedures (such as mechanical, electricity, gas, air or fluids)
1.5. provide and maintain a safe working environment for the maintenance activities
1.6. obtain the correct tools and equipment for the activity and check that they are in a safe, tested and usable condition and within current certification/calibration date
1.7. carry out the maintenance activities, using approved techniques and procedures
1.8. where appropriate, apply electrostatic discharge (ESD) protection procedures
1.9. re-connect and return the system to service on completion of the maintenance activities
1.10. dispose of waste items in a safe and environmentally acceptable manner
1.11. return all tools and equipment to the correct location on completion of the activities
1.12. leave the aircraft and system in a safe and appropriate condition, free from foreign object debris on completion of the activities.

Learning outcome

The learner will:

2  Carry out the scheduled maintenance on three of the following aircraft airframe, mechanical equipment/systems:

2.1  power plant (including APU)
2.2  lubrication
2.3  ice and rain protection
2.4  auxiliary engines
2.5  flying controls
2.6  cabin equipment and furnishings
2.7  engine starting and monitoring
2.8  propeller control
2.9  airframe (including freight)
2.10  power transmission
2.11  hydraulic
2.12  undercarriage
2.13  fuel
2.14  pneumatic
2.15  cabin systems (such as water, galley, sanitary)
2.16  environmental (such as cabin conditioning, oxygen, pressurisation)

Learning outcome

The learner will:

3  Carry out twelve of the following scheduled maintenance procedures

3.1  carrying out specified visual inspections
3.2  carrying out testing of equipment against the maintenance schedule
3.3  replacing 'lifed' consumables (such as oils, grease, belts, gaskets, seals and filters)
3.4  replacing 'lifed' components
3.5  checking the condition of operating mechanisms (such as levers and links, bearings, turnbuckles)
3.6  checking the operation of all gauges and sensors
3.7  inspecting and cleaning sensors
3.8  checking alignment of running/sliding components
3.9  making approved sensory checks (such as sight, sound, smell, touch)
3.10  making routine adjustments to components
3.11  carrying out leak checks on all connections
3.12  checking airframe components for damage/fatigue
3.13 inspections of equipment and cables
3.14 carrying out system self-analysis checks
3.15 checking the integrity of all connections
3.16 checking and adjusting shock mountings
3.17 torque testing critical fastenings
3.18 carrying out specified lubrication
3.19 replacing missing or damaged locking and retaining devices (such as proprietary fasteners, locking wires)
3.20 testing and reviewing the system operation
3.21 recording the results of the maintenance activity and reporting any defects found

**Learning outcome**

The learner will:

4 Carry out planned maintenance based on **one** of the following

4.1 condition based maintenance
4.2 scheduled maintenance
4.3 depth maintenance
4.4 total preventative maintenance (TPM).

**Learning outcome**

The learner will:

5 Carry out **three** of the following checks during the maintenance activities:

5.1 mechanical measuring checks (such as measuring operating clearance, travel, timings, symmetry checks)
5.2 fluid power checks (such as pressure, flow, leak)
5.3 ‘special-to-type’ tests
5.4 ferrous or non-ferrous crack detection tests
5.5 functional tests
5.6 zonal inspections

**Learning outcome**

The learner will:

6 Ensure that the maintained equipment/system meets **all** of the following:

6.1 all components and units are fit for purpose
6.2 all connections are safe and sound
6.3 systems are leak free
6.4 equipment operates within acceptable limits for successful continuous operation
6.5 any potential defects are identified and reported for future action.
Learning outcome

The learner will:

7. Ensure that the maintained equipment complies with one of the following:

7.1 Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
7.2 extended twin operations procedures (ETOpS) (where appropriate)
7.3 Military Aviation Authority (MAA)
7.4 Aerospace Quality Management Standards (AS)
7.5 Federal Aviation Authority (FAA)
7.6 BS, ISO or BSEN standards and procedures
7.7 customer standards and requirements
7.8 organisations standards and procedures
7.9 aircraft manufacturer's requirements.

Learning outcome

The learner will:

8. Complete the relevant paperwork, to include one of the following and pass it to the appropriate people:

8.1 computer records
8.2 job cards
8.3 aircraft service/flight log
8.4 aircraft log book
8.5 permit to work/formal risk assessment

Learning outcome

Knowledge and understanding

Assessment criteria

The learner must know and understand:

K1 the specific safety precautions and procedures to be observed whilst carrying out the maintenance (including any specific legislation regulations or codes of practice relating to the activities, equipment or materials)
K2 the importance of maintenance on and impact upon (extended twin operations procedures) ETOpS systems legislation and local procedures
K3 the health and safety requirements of the area in which the scheduled maintenance activity is to take place and the responsibility these requirements place on them
K4 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the organisation if these are not adhered to
K5 the isolation and lock-off procedure or permit-to-work procedure that applies to the aircraft system being maintained
K6 the requirements and importance of understanding and applying human factors as defined by the regulatory requirements and the potential impact if these are not adhered to
K7 the importance of wearing protective clothing (PPE) and other appropriate safety equipment during the maintenance activities and where it may be obtained
K8 hazards associated with carrying out maintenance activities on aircraft airframe/mechanical equipment (such as working with pressurised systems, handling fluids, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures) and how to minimise them and reduce any risks
K9 what constitutes a hazardous voltage and how to recognise victims of electric shock
K10 how to reduce the risks of a phase to earth shock (such as insulated tools, rubber matting and isolating transformers)
K11 how to obtain and interpret drawings, charts, specifications, aircraft manuals, history/maintenance reports and other documents needed for the maintenance activities
K12 the various planned maintenance schedules that are generally used (such as condition based maintenance, scheduled maintenance, and total preventative maintenance (TPM)) and the methods to be followed to comply with the organisations procedures for the maintenance of the aircraft airframe/mechanical equipment
K13 the equipment operating and control procedures and how to apply them in order to carry out the scheduled maintenance activities
K14 the importance of applying electrostatic discharge (ESD) procedures when working on sensitive equipment or devices
K15 the basic principle of operation of the equipment or system being maintained and the purpose of individual units/components and how they interact
K16 the application and use of a range of mechanical operating mechanisms (such as levers and links, pulleys and pivots, bearings, turnbuckles) and the likely functions that will require checking
K17 the different types of pipe and hose that are used and what to check during the maintenance activities
K18 methods of checking that components are fit for purpose and the need to replace `lifed' items
K19 how to recognise defects in aircraft airframe/mechanical equipment (such as under or over performance)
K20 the adjustments/corrections/tuning required to maintain the equipment/system at operational standard through full range parameters
K21 methods of checking airframe structure components for damage, wear and fatigue
K22 the testing methods and procedures to be used to check that the system conforms to acceptable limits
K23 how to make sensory checks by sight, sound, smell, touch
K24 the organisations policy on repair/replacement of components during the maintenance activities
K25 the importance of ensuring that the equipment is maintained to the prescribed category of cleanliness
K26 the generation of maintenance documentation and/or reports on completion of the maintenance activity
K27 the problems that can occur whilst carrying out the maintenance activities and how they can be avoided
K28 the organisational procedure to be adopted for the safe disposal of waste of all types of materials
K29 the extent of their own authority and to whom they should report if they have a problem that they cannot resolve
Unit 376  
Undertaking scheduled maintenance of aircraft airframe and mechanical equipment

Unit guidance
Assessment requirements for this have been developed by employers for the occupational competency units and qualifications for the Aerospace and Aviation Sector. These assessment requirements are set down in the Aerospace Engineering Employer Occupational Unit Assessment Strategy.

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems.
This will allow each organisation to develop their own specific and tailored apprentice training programme whilst meeting their own requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers.
Unit 377  Repairing airframes and structures

GLH: 133

Unit aim:

This Employer Unit of Competence (EUC) has been developed by employers in the Aerospace and Aviation Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief.

This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to repair airframes and structures, in accordance with approved procedures. It covers both fixed wing and rotary winged aircraft. They will be required to select the appropriate tools and equipment to use, based on the repair operations required and to check that they are in a safe and serviceable condition. In carrying out the repair operations, they will be required to follow laid-down procedures and specific repair techniques, such as insertion repair, primary structure repair, secondary structure repair, tertiary structure repair and patch repair, in order to satisfy the repair scheme in the aircraft structural repair manual. The repair activities will also include making all necessary checks.

Their responsibilities will require them to comply with organisational policy and procedures for the repair activities undertaken and to report any problems with the repair activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. They 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.

Their underpinning knowledge will provide a good understanding of their work and will provide an informed approach to applying the appropriate repair techniques and procedures. They will understand the airframe structure being repaired and will know about the components, repair techniques and fastening devices used during the repair operation, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

They will understand the safety precautions required when carrying out the repair operations. They will be required to demonstrate safe working practices throughout and will understand the responsibility they owe to themselves and others in the workplace.

They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall objectives of the organisation, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity, motivation and commitment.
Learning outcome

Performance Requirements

Assessment criteria

The learner can:

P1  work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines.
P2  demonstrate the required behaviours in line with the job role and organisational objectives
P3  follow the relevant specifications for the component to be repaired
P4  prepare the component for repair
P5  carry out the repairs within agreed timescale using approved materials and components and methods and procedures
P6  ensure that the repaired component meets the specified operating conditions
P7  produce accurate and complete records of all repair work carried out

Learning outcome

The learner will:

1  Carry out all of the following activities during the repair:

1.1  obtain and use the appropriate documentation (such as job instructions, aircraft assembly/repair drawings, planning and quality control documentation, aircraft procedures and specifications)
1.2  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
1.3  provide and maintain a safe working environment for the repair activities
1.4  obtain the correct tools and equipment for the activity, and check that they are in a safe, tested and usable condition and within current calibration date
1.5  follow safe practice/approved repair techniques and procedures at all times
1.6  ensure that correct part numbers are used, including (where appropriate) left or right handed parts
1.7  return all tools and equipment to the correct location on completion of the repair activities
1.8  dispose of waste materials in accordance with approved procedures
1.9  leave the work area and assembly in a safe and appropriate condition, free from foreign object debris on completion of the activities

Learning outcome

The learner will:

2  Repair one type of airframe or structure from:
2.1 commercial aircraft
2.2 light aircraft
2.3 military aircraft
2.4 helicopters

Learning outcome
The learner will:
3  Undertake three of the following types of repair:

3.1 primary structure repair
3.2 secondary structure repair
3.3 tertiary structure repair
3.4 structurally significant item repair
3.5 non-structurally significant item repair
3.6 patch repair
3.7 insertion repair
3.8 composite structure repair
3.9 other specific repair type

Learning outcome
The learner will:
4  Repair airframes or structures, to include five the following methods and techniques:

4.1 making holes in airframe
4.2 profiling
4.3 blending
4.4 materials marking out
4.5 deburring
4.6 cutting
4.7 securing and locking components

Learning outcome
The learner will:
5  Use three of the following types of joining method during repairs:

5.1 adhesives/sealants
5.2 rivets
5.3 special fasteners
5.4 locking devices
5.5 threaded fasteners
Learning outcome

The learner will:

6  Ensure that repairs comply with one of the following:

6.1 Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
6.2 Extended twin operations procedures (ETOps) (where appropriate)
6.3 Military Aviation Authority (MAA)
6.4 Aerospace Quality Management Standards (AS)
6.5 customer standards and requirements
6.6 Federal Aviation Authority (FAA)
6.7 organisation standards and procedures
6.8 BS, ISO or BSEN standards and procedures
6.9 aircraft design/manufacturer's requirements

---

Learning outcome

The learner will:

7  Complete the relevant paperwork, to include one from the following and pass it to the appropriate people:

7.1 build records
7.2 job cards
7.3 log cards
7.4 aircraft flight log
7.5 aircraft log book
7.6 other specific recording method
Learning outcome

Knowledge and understanding:

Assessment criteria

The learner must know and understand:

K1 the specific safety precautions and procedures that they need to observe whilst carrying out the repairs (such as any specific legislation, regulations or codes of practice relating to the activities, equipment or materials)

K2 the importance of maintenance on and impact upon extended twin operations procedures (ETOpS) systems, legislation and local procedures

K3 the health and safety requirements of the work area in which they are carrying out the repair activities and the responsibility these requirements place on them

K4 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the organisation if these are not adhered to

K5 the hazards associated with repairing airframes and systems and with the tools and equipment used and how to minimise them and reduce any risks

K6 the requirements and importance of understanding and applying human factors as defined by the regulatory requirements and the potential impact if these are not adhered to

K7 the protective equipment that they need to use for both personal protection (PPE) and protection of the aircraft

K8 the interpretation of drawings, standards, quality control procedures and specifications used for the repair (such as BS, ISO or BSEN schematics, symbols and terminology)

K9 how to carry out currency/issue checks on the repair scheme/specification they are working with

K10 how to identify the components to be used; component identification systems (such as codes and component orientation indicators)

K11 preparations to be undertaken on the airframe or structure, prior to repair

K12 the repair methods and procedures to be used and the importance of adhering to these procedures

K13 the various mechanical fasteners that will be used, and their method of installation (such as open and blind rivets, threaded fasteners, special securing devices)

K14 the importance of using the specified fasteners for the repair and why they must not use substitutes

K15 the application of sealants and adhesives within the repair activities and the precautions that must be taken when working with them

K16 the quality control procedures to be followed during the repair operations

K17 how to conduct any necessary checks to ensure the accuracy and quality of the repair

K18 recognising defects (such as skin blemishes, poor skin lines, ineffective fasteners, foreign object damage)

K19 the methods and equipment used to transport, handle and lift the structures into position and how to check that the equipment is within its current certification dates

K20 the tools and equipment used in the repair activities and their calibration/care and control procedures
K21 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

K22 the problems that can occur with the repair operations and how these can be overcome

K23 the recording documentation 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

K24 the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve
Unit 377  
Repairing airframes and structures

Supporting Information

Unit guidance
Assessment requirements for this have been developed by employers for the occupational competency units and qualifications for the Aerospace and Aviation Sector. These assessment requirements are set down in the Aerospace Engineering Employer Occupational Unit Assessment Strategy.

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems.

This will allow each organisation to develop their own specific and tailored apprentice training programme whilst meeting their own requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers.
Unit 378  
Modifying airframes

This Employer Unit of Competence (EUC) has been developed by employers in the Aerospace and Aviation Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief.

This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to modify airframes, in accordance with approved procedures. They will be required to select the appropriate tools and equipment to use, based on the modification operations required and to check that they are in a safe and serviceable condition. In carrying out the modification operations, they will be required to follow laid-down procedures and to use specific modification leaflets or service bulletins. This standard covers both fixed wing and rotary winged aircraft and the modification requirements will include such items as fuselage sections, under- floor structures, floors, flaps/ailerons, wings, fins, nose areas, tail sections, doors, cockpit/cabin areas, hatches, windows, bulkheads, mission consoles, galleys, stairs, trunking/ducting, engine nacelles, box sections and avionics cabinets. The modification activities will also include making all necessary checks.

Their responsibilities will require them to comply with organisational policy and procedures for the modification activities undertaken and to report any problems with the modification activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. They will be expected to work with minimal supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

Their underpinning knowledge will provide a good understanding of their work and will provide an informed approach to applying the appropriate modification techniques and procedures. They will understand the airframe structure being modified and will know about the components, modification methods and techniques and fastening devices used during the modification activities, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

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

They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall objectives of the organisation, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity, motivation and commitment.

Note
This standard is intended to cover airframe modifications of a significant or complex nature, involving the use of a range of techniques and a number of different components. The nature of the complexity will take into account the class of structure, primary, secondary, the size and timescale of the modification, the tolerances required and the difficulty of access. This standard should not be used solely for simple modifications, such as changes to, or the addition of, simple platework or brackets.
Learning outcome
Performance Requirements

Assessment criteria

The learner can:
P1  work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines
P2  demonstrate the required behaviours in line with the job role and organisational objectives
P3  obtain and follow the relevant modification specifications and job instructions
P4  confirm and agree what modifications are to be carried out to meet the specification
P5  prepare the airframe for the required modification
P6  carry out the airframe modification, using approved materials, methods and procedures
P7  complete the modification within the agreed timescale
P8  ensure that the modified airframe meets the specified operating conditions
P9  produce accurate and complete records of all modification work carried out
P10 deal promptly and effectively with problems within their control and report those that cannot be solved

Learning outcome
The learner will:

1  Carry out all of the following during the modification activities:

1.1. obtain and use the appropriate documentation (such as job instructions, aircraft modification drawings, planning and quality control documentation, aircraft procedures and specifications)
1.2. 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
1.3. provide and maintain a safe working environment for the modification activities
1.4. obtain the correct tools and equipment for the activity, and check that they are in a safe, tested and usable condition and within current calibration date
1.5. obtain clearance to work on the aircraft and observe the power isolation and safety procedures
1.6. ensure that correct part numbers are used, including (where appropriate) left or right handed parts
1.7. follow safe practice/approved modification techniques and procedures at all times
1.8. return all tools and equipment to the correct location on completion of the modification activities
1.9. dispose of waste materials in accordance with approved procedures
1.10. leave the work area and aircraft in a safe and appropriate condition, free from foreign object debris on completion of the activities
Learning outcome

The learner will:

2   Modify airframes from **one** of the following types of aircraft:

2.1   commercial aircraft
2.2   light aircraft
2.3   military aircraft
2.4   helicopters

Learning outcome

The learner will:

3   Modify an airframe/structure, to include at least **three** from:

3.1   fuselage sections
3.2   fin
3.3   hatches
3.4   stairs
3.5   under-floor structures
3.6   nose
3.7   windows
3.8   trunking/ducting
3.9   floor
3.10  tail
3.11  bulkheads
3.12  engine nacelle
3.13  flying controls
3.14  doors
3.15  mission consoles
3.16  box sections
3.17  wing
3.18  cockpit/cabin
3.19  galleys
3.20  avionics cabinets
Learning outcome

The learner will:

4 Use **five** of the following methods and techniques during the modification activities:

4.1 making holes in airframe materials
4.2 securing and locking components
4.3 marking out
4.4 assembling
4.5 deburring
4.6 cutting
4.7 profiling

Learning outcome

The learner will:

5 Use **three** of the following types of joining method during the modifications:

5.1 adhesives/sealants
5.2 locking devices
5.3 rivets
5.4 threaded fasteners
5.5 special fasteners

Learning outcome

The learner will:

6 Produce modifications, which comply with **one** of the following:

6.1 Civil Aviation Authority (CAA) / European Aviation Safety Agency (EASA)
6.2 extended twin operations procedures (ETOpS) (where appropriate)
6.3 Military Aviation Authority (MAA)
6.4 Aerospace Quality Management Standards (AS)
6.5 customer standards and requirements
6.6 Federal Aviation Authority (FAA)
6.7 organisation standards and procedures
6.8 BS, ISO or BSEN standards and procedures
6.9 aircraft manufacturer’s requirements
Learning outcome

The learner will:

7 Complete the relevant paperwork, to include one from the following and pass it to the appropriate people:

7.1 modification records
7.2 aircraft log book
7.3 aircraft flight log
7.4 log cards
7.5 job cards
7.6 other specific recording method

Learning outcome

Knowledge and understanding:

Assessment criteria

The learner must know and understand:

K1 the specific safety precautions and procedures to be observed whilst carrying out the modifications (such as any specific legislation, regulations or codes of practice relating to the activities, equipment or materials)
K2 the importance of maintenance on and impact upon extended twin operations procedures (ETOpS) systems, legislation and local procedures
K3 the health and safety requirements of the work area in which they are carrying out the modification activities and the responsibility these requirements place on them
K4 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the organisation if these are not adhered to
K5 the hazards associated with modifying airframes and systems and with the tools and equipment used and how to minimise them and reduce any risks
K6 the requirements and importance of understanding and applying human factors as defined by the regulatory requirements and the potential impact if these are not adhered to
K7 the personal protective equipment and clothing (PPE) to be worn during the modification activities
K8 the various types of drawing and specification that are used during the modification
K9 how to identify the components to be used; component identification systems (such as codes and component orientation indicators)
K10 preparations to be undertaken on the airframe or structure, prior to modification
K11 the methods and procedures to be used for removing and replacing components and the importance of adhering to these procedures
K12 the various mechanical fasteners that will be used and their method of installation (such as open and blind rivets, threaded fasteners, special securing devices)
K13 the importance of using the specified fasteners for the modification and why they must not use substitutes
K14 the application of sealants and adhesives within the modification activities and the precautions that must be taken when working with them
K15 the quality control procedures to be followed during the modification operations
K16 how to conduct any necessary checks to ensure the accuracy and quality of the modification
K17 how to recognise defects (such as skin blemishes, poor skin lines, ineffective fasteners, foreign object damage)
K18 the methods and equipment used to transport, handle and lift the structures into position and how to check that the equipment is within its current certification dates
K19 the tools and equipment used in the modification activities and their calibration/care and control procedures
K20 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
K21 the problems that can occur with the modification operations and how these can be overcome
K22 the recording documentation 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
K23 the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve
Unit 377  Repairing airframes and structures

Supporting Information

Unit guidance

Assessment requirements for this have been developed by employers for the occupational competency units and qualifications for the Aerospace and Aviation Sector. These assessment requirements are set down in the Aerospace Engineering Employer Occupational Unit Assessment Strategy.

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems. This will allow each organisation to develop their own specific and tailored apprentice training programme whilst meeting their own requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers.
Unit 379  
Removing and replacing aircraft power plant and components

GLH: 126

Unit aim:
This Employer Unit of Competence (EUC) has been developed by employers in the Aerospace and Aviation Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief.

This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to carry out the removal and replacement of a complete engine exchange unit and the removal and replacement of components of aircraft power plant, in accordance with approved procedures. It covers both fixed wing and rotary winged aircraft and includes a range of power plant such as turbo prop, turbo jet, by-pass, ducted fan, turbo shaft, piston engines and auxiliary power units (APU) or ground turbine start (GTS units). The removal and replacement activities will include taking all necessary safeguards to isolate the system, support and lift removed and replaced parts, replacing faulty equipment at component or unit level, replenishing fluids, setting and adjusting replaced components and leaving the power plant in a safe condition and ready for testing.

Their responsibilities will require them to comply with organisational policy and procedures for the removal and replacement 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. They 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, accurately and legibly. They 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 apprentice’s knowledge will provide a good understanding of their work and will provide an informed approach to applying the appropriate removal and replacement techniques and procedures to aircraft power plant. They will understand the removal and replacement methods and procedures, and their application, along with the power plant maintenance requirements. They will know how the power plant 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 removal and replacement activities and for ensuring that the equipment is replaced to the required standard. In addition, they will have sufficient knowledge of these components to ensure that they are fit for purpose and meet the specifications, thus providing a sound basis for carrying out the replacement.

They will understand the safety precautions required when working on aircraft power plant, especially those for isolating the equipment. They 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.

They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall objectives of the organisation, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity, motivation and commitment.
Learning outcome

Performance Requirements

Assessment criteria

The learner can:
P1 work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines.
P2 demonstrate the required behaviours in line with the job role and organisational objectives.
P3 follow the relevant aircraft manuals and publications to carry out the required work.
P4 establish and where appropriate, mark component orientation for re-assembly.
P5 ensure that any stored energy or substances are released safely and correctly.
P6 carry out the removal and replacement activities, within the limits of their personal authority.
P7 remove and replace the required components, using approved tools and techniques.
P8 take suitable precautions to prevent damage to components and the surrounding structure.
P9 complete the relevant documentation, in accordance with organisational requirements.
P10 label and store (in an appropriate location) components that require repair or overhaul.
P11 dispose of waste materials and scrap components, in accordance with safe working practices and approved procedures.

Learning outcome

The learner will:
1 Carry out all of the following during the removal and replacement activity:

1.1. obtain clearance to work on the aircraft, and observe all relevant safety procedures
1.2. obtain and use the appropriate documentation (such as job instructions, aircraft manuals, technical instructions and other relevant maintenance documentation)
1.3. 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
1.4. ensure the safe isolation of the power plant before carrying out work on the equipment
1.5. ensure that all relevant safety devices and mechanical/physical locks are in place (where appropriate)
1.6. obtain the correct tools and equipment for the activity and check that they are in a safe, tested and usable condition and within current certification/calibration date
1.7. use approved removal and replacement techniques and procedures at all times
1.8. where appropriate, apply electrostatic discharge (ESD) protection procedures
1.9. ensure that components and surrounding structures are maintained free from damage
1.10. return all tools and equipment to the correct location on completion of the activities
1.11. leave the aircraft and the power plant in a safe and appropriate condition, free from foreign object debris and in a condition ready for testing

Learning outcome
The learner will:

2  Remove and replace one of the following types of aircraft power plant assembly

   2.1  turbo prop
   2.2  turbo-shaft
   2.3  auxiliary power unit (APU)
   2.4  ducted fan
   2.5  turbo-fan
   2.6  ground turbine start (GTS)
   2.7  turbo jet
   2.8  piston

Learning outcome
The learner will:

3  Remove and replace components from each of the following groups: Group A: Major engine components: Remove and replace one of the following:

   3.1  air intake
   3.2  starter motor
   3.3  turbochargers
   3.4  exhaust unit
   3.5  gearbox ancillaries
   3.6  pumps (fuel, oil)
   3.7  propellers
   3.8  coolers (air, oil, fuel)
   3.9  cylinder heads
   3.10 gear box
   3.11 heat exchangers (oil, fuel)
   3.12 valve mechanisms
   3.13 reverse thrusters
   3.14 torque converters
   3.15 magneto
   3.16 fuel control unit
   3.17 superchargers
   3.18 constant pitch and speed units
   3.19 filters (fuel, oil, air)
   3.20 levers and linkages
   3.21 fire detection units
3.22 pipes and hoses
3.23 damper/connector arm
3.24 fire wire
3.25 igniters
3.26 spark plugs
3.27 magnetic chip detectors
3.28 sensors
3.29 fire bottle
3.30 other specific components

Learning outcome

The learner will:

4 Carry out all of the following removal and replacement activities as applicable to the equipment:

4.1 disconnecting electrical connections (where appropriate)
4.2 positioning and aligning replaced components
4.3 disconnect/removing hoses and pipes
4.4 setting and adjusting replaced components
4.5 supporting equipment to be removed
4.6 making mechanical connections
4.7 dismantling equipment to an appropriate level
4.8 making electrical connections (where appropriate)
4.9 proof marking components to aid reassembly
4.10 tightening fastenings to the required torque
4.11 applying and removing covering/protection to exposed components, wires, pipework or vents
4.12 making `off-load' checks before starting up
4.13 replenishing fluids, oils and greases
4.14 checking components for serviceability
4.15 use of ground support equipment
4.16 replacing all damaged/defective components (where appropriate)
4.17 using lifting operations (manual or automated)
4.18 applying gaskets and sealant/adhesives
4.19 securing components using mechanical fasteners and threaded devices
4.20 applying bolt locking methods (such as split pins, wire locking, lock nuts)
4.21 labelling (and storing in the correct location) components that require repair or overhaul
4.22 protecting and preparing removed components for transportation for overhaul
Learning outcome
The learner will:
5 Remove and replace aircraft power plant and components in compliance with one of the following:

5.1 Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
5.2 extended twin operations procedures (ETOpS) (where appropriate)
5.3 Military Aviation Authority (MAA)
5.4 Aerospace Quality Management Standards (AS)
5.5 Federal Aviation Authority (FAA)
5.6 BS, ISO or BSEN standards and procedures
5.7 customer standards and requirements
5.8 organisations standards and procedures
5.9 aircraft manufacturer's requirements

Learning outcome
The learner will:
6 Complete the relevant paperwork, to include one from the following and pass it to the appropriate people:

6.1 computer records
6.2 job cards
6.3 aircraft service/flight log
6.4 aircraft log book
6.5 permit to work/formal risk assessment

Learning outcome
The learner will:
Knowledge and understanding:

Assessment criteria
The learner must know and understand:

K1 the specific safety practices and procedures that they need to observe when working on aircraft power plant (including any specific legislation, regulations/codes of practice for the activities, equipment or materials)

K2 the importance of maintenance on and impact upon (extended twin operations procedures) ETOpS systems, legislation and local procedures

K3 hazards associated with removing and replacing aircraft power plant components, and with the tools and equipment used (such as handling oils, greases, aviation fuel, stored
pressure/force, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures) and how to minimise them and reduce any risks

K4 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the organisation if these are not adhered to

K5 the requirements and importance of understanding and applying human factors as defined by the regulatory requirements and the potential impact if these are not adhered to

K6 the protective equipment that they need to use for both personal protection (PPE) and protection of the aircraft

K7 what constitutes a hazardous voltage and how to recognise victims of electric shock

K8 how to reduce the risks of a phase to earth shock (such as insulated tools, rubber matting and isolating transformers)

K9 how to extract and use information from aircraft maintenance manuals, history/maintenance reports, flight logs and other documents needed in the removal and replacement process

K10 how to carry out currency/issue checks on the specifications they are working with

K11 terminology used in aircraft power plant systems

K12 the basic principles of how the equipment functions, its operating sequence, the working purpose of individual units/components and how they interact

K13 the techniques used to remove components from aircraft power plant without damage to the components or surrounding structure (such as release of pressures/force, draining of fluids, 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

K14 the importance of applying electrostatic discharge (ESD) procedures when working on sensitive equipment or devices

K15 the various mechanical fasteners that will need to be removed and replaced and their method of removal and replacement (such as threaded fasteners, special securing devices)

K16 the various types of electrical connectors that are used, methods of unlocking, orientation indicators and locating and locking in of the connections

K17 during the removal and replacement activities

K18 the identification and application, fitting and removal of different types of bearings (such as roller, ball, thrust)

K19 identify defects and wear characteristics

K20 the uses of measuring equipment (such as micrometers, Verniers, expansion indicators and other measuring devices)

K21 the need to replace 'lifed' items (such as seals and gaskets)

K22 the need to correctly label and store components that require repair or overhaul and the importance of checking that replacement components have the correct part/identification markings

K23 how to replace and re-connect components into the system (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)

K24 how to make adjustments to components/assemblies to ensure that they function correctly (such as balancing of rotating components, setting working clearance, setting travel, setting backlash in gears, preloading bearings)

K25 why securing devices need to be tightened to the correct torque, locked and labelled, and the different methods that are used

K26 why electrical bonding is critical and why it must be both mechanically and electrically secure

K27 the importance of making 'off-load' checks before running the equipment under power

K28 how to check that tools and equipment are free from damage or defect, are in a safe, tested and usable condition and are configured correctly for the intended purpose

K29 the need to control and account for all tools and equipment used during the removal and replacement activity

K30 how to use lifting and handling equipment in the maintenance activity

K31 the recording documentation 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

K32 the procedure for the safe disposal of waste materials, scrap components, oils and fluids

K33 the problems associated with removing and replacing power plant components and how they can be overcome

K34 the extent of their own authority and to whom they should report if they have a problem that they cannot resolve
Unit 377  
**Repairing airframes and structures**

Supporting Information

**Unit guidance**

Assessment requirements for this have been developed by employers for the occupational competency units and qualifications for the Aerospace and Aviation Sector. These assessment requirements are set down in the Aerospace Engineering Employer Occupational Unit Assessment Strategy.

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems.

This will allow each organisation to develop their own specific and tailored apprentice training programme whilst meeting their own requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers.
Unit 380  Removing and replacing components of aircraft control systems

This Employer Unit of Competence (EUC) has been developed by employers in the Aerospace and Aviation Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief.

This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to carry out the removal and replacement of components of aircraft control systems, in accordance with approved procedures. It covers both fixed wing and rotary winged aircraft and includes equipment and components associated with flying controls and powerplant. The removal and replacement activities will include taking all necessary safeguards to isolate the system, supporting and lifting removed and replaced parts, replacing faulty equipment at component or unit level, setting and adjusting replaced components and leaving the control system in a safe condition and ready for testing.

Their responsibilities will require them to comply with organisational policy and procedures for the removal and replacement 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. They 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, accurately and legibly. They 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 apprentice’s knowledge will provide a good understanding of their work and will provide an informed approach to applying the appropriate removal and replacement techniques and procedures to aircraft control system components. They will understand the removal and replacement methods and procedures, and their application, along with the aircraft control system maintenance requirements. They will know how the aircraft 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 removal and replacement activities and for ensuring that the equipment is replaced to the required standard. In addition, they will have sufficient knowledge of these components to ensure that they are fit for purpose and meet the specifications, thus providing a sound basis for carrying out the replacement.

They will understand the safety precautions required when working on aircraft controls, especially those for isolating the equipment, lifting and handling control components. They 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.

They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall objectives of the organisation, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity, motivation and commitment.
Learning outcome

Performance Requirements

Assessment criteria

The learner can:

P1 work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines

P2 demonstrate the required behaviours in line with the job role and organisational objectives

P3 follow the relevant aircraft manuals and publications to carry out the required work

P4 establish and where appropriate, mark component orientation for re-assembly

P5 ensure that any stored energy or substances are released safely and correctly

P6 carry out the removal and replacement activities, within the limits of their personal authority

P7 remove and replace the required components, using approved tools and techniques

P8 take suitable precautions to prevent damage to components and the surrounding structure

P9 complete the relevant documentation, in accordance with organisational requirements

P10 label and store (in an appropriate location) components that require repair or overhaul

P11 dispose of waste materials and scrap components in accordance with safe working practices and approved procedures

Learning outcome

The learner will:

1  Carry out all of the following during the removal and replacement activity:

1.1. obtain clearance to work on the aircraft and observe all relevant safety procedures

1.2. obtain and use the appropriate documentation (such as job instructions, aircraft manuals, technical instructions and other relevant maintenance documentation)

1.3. 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

1.4. ensure the safe isolation of the control system before carrying out work on the equipment

1.5. ensure that all relevant safety devices and mechanical/physical locks are in place (where appropriate)

1.6. obtain the correct tools and equipment for the activity and check that they are in a safe, tested and usable condition and within current certification/calibration date

1.7. use approved removal and replacement techniques and procedures at all times

1.8. ensure that components and surrounding structures are maintained free from spillages, damage and foreign objects

1.9. return all tools and equipment to the correct location on completion of the activities
1.10. leave the aircraft and the control system in a safe and appropriate condition, free from foreign object debris and in a condition ready for testing

Learning outcome

The learner will:

2 Remove components from three of the following aircraft control systems, and replace components from three of the following aircraft control systems:

2.1 air brakes
2.2 flaperons
2.3 elevators
2.4 main rotor blades
2.5 spoilers/speed brakes
2.6 cyclic
2.7 trim tabs
2.8 horizontal stabilisers
2.9 flaps/slats
2.10 reaction control
2.11 powerplant
2.12 tail rotor blades/yaw
2.13 tailplane
2.14 wing sweep
2.15 collective
2.16 power augmentation
2.17 propeller
2.18 auxiliary transmission
2.19 auxiliary power
2.20 vectored thrust
2.21 rudders/yaw
2.22 canards
2.23 thrust reverse
2.24 nose wheel steering
2.25 ailerons/tailerons
2.26 main gear steering
2.27 varicowl intake
2.28 other specific control system

Learning outcome

The learner will:

3 During the activities identified in scope 2 above, the learner must cover the removal and replacement of the following:
3.1 pedals
3.2 powered flying control units
3.3 control surfaces
3.4 flap selectors
3.5 fuel control units
3.6 gradient boxes
3.7 control columns/sticks
3.8 auto pilot system components
3.9 AFCS series and parallel actuators
3.10 air/speed brake selectors
3.11 auxiliary controls
3.12 mixer units
3.13 trim wheels
3.14 throttle boxes
3.15 artificial feel units
3.16 reaction control nozzles
3.17 torque tubes
3.18 primary flight computers (including actuator control electronic (ACE))
3.19 full authority digital engine control and full authority fuel control units (FADEC and FAFC)
3.20 other specific major component
3.21 turnbuckles
3.22 levers and linkages
3.23 pedal shakers
3.24 cables and pulleys
3.25 sensors
3.26 locks and stops
3.27 connecting rods
3.28 actuators/motors
3.29 bell cranks
3.30 position transmitters/desyns
3.31 reaction control ducting
3.32 other specific components

**Learning outcome**

The learner will:

4 Carry out all of the following removal and replacement activities as applicable to the equipment:

4.1 releasing stored pressure (where appropriate)
4.2 positioning and aligning replaced components
4.3 disconnecting electrical connections
4.4 removing mechanical fasteners and securing devices
Learning outcome

The learner will:

5 Remove and replace aircraft control components in compliance with **one** of the following:

5.1 Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
5.2 extended twin operations procedures (ETOpS) (where appropriate)
5.3 Military Aviation Authority (MAA)
5.4 Aerospace Quality Management Standards (AS)
5.5 Federal Aviation Authority (FAA)
5.6 BS, ISO or BSEN standards and procedures
5.7 customer standards and requirements
5.8 organisation standards and procedures
5.9 aircraft manufacturer’s requirements

Learning outcome

The learner will:

6 Complete the relevant paperwork, including **one** from the following and pass it to the appropriate people

6.1 Job cards
6.2 computer records
6.3 aircraft service/flight log
6.4 aircraft log book
6.5 permit to work/formal risk assessment

Learning outcome
Knowledge and understanding

Assessment criteria

The learner must know and understand:

K1 the specific safety practices and procedures that they need to observe when working on aircraft control systems (including any specific legislation, regulations/codes of practice for the activities, equipment or materials)

K2 the importance of maintenance on, and impact upon (extended twin operations procedures) ETOpS systems, legislation and local procedures

K3 hazards associated with removing and replacing aircraft control components, and with the tools and equipment used (such as handling oils, greases, stored pressure/force, lifting and moving components, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures) and how to minimise them and reduce any risks

K4 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the organisation if these are not adhered to

K5 the requirements and importance of understanding and applying human factors as defined by the regulatory requirements and the potential impact if these are not adhered to

K6 the protective equipment that they need to use for both personal protection (PPE) and protection of the aircraft

K7 what constitutes a hazardous voltage and how to recognise victims of electric shock

K8 how to reduce the risks of a phase to earth shock (such as insulated tools, rubber matting and isolating transformers)

K9 how to extract and use information from aircraft maintenance manuals, history/maintenance reports, flight logs and other documents needed in the removal and replacement process

K10 how to carry out currency/issue checks on the specifications they are working with

K11 terminology used in aircraft control systems

K12 the basic principles of how the equipment functions, its operating sequence, the working purpose of individual units/components and how they interact

K13 the techniques used to remove components from aircraft controls without damage to the components or surrounding structure (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

K14 the various mechanical fasteners to be removed and replaced and their method of removal and replacement (such as threaded fasteners, special securing devices)

K15 the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking in of the connections
K16 the importance of applying electrostatic discharge (ESD) procedures when working on sensitive equipment or devices
K17 during the removal and replacement activities
K18 methods of checking that components are fit for purpose and how to identify defects and wear characteristics
K19 the uses of measuring equipment (such as micrometers, Verniers, expansion indicators and other measuring devices)
K20 the need to replace 'lifed' items (such as seals and gaskets)
K21 the need to correctly label and store components that require repair or overhaul and to check that replacement components have the correct part/identification markings
K22 how to replace and re-connect components into the system (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)
K23 how to make adjustments to components/assemblies to ensure that they function correctly (such as setting working clearance, setting travel, pre-loading bearings)
K24 why securing devices need to be tightened to the correct torque, locked and labelled, and the different methods that are used
K25 why electrical bonding is critical and why it must be both mechanically and electrically secure
K26 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
K27 how to check that tools and equipment are free from damage or defect, are in a safe, tested and usable condition and are configured correctly for the intended purpose
K28 the need to control and account for all tools and equipment used during the removal and replacement activity
K29 how to use lifting and handling equipment in the maintenance activity
K30 the recording documentation 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
K31 the procedure for the safe disposal of waste materials, scrap components, oils and fluids
K32 the problems associated with removing and replacing control system components and how they can be overcome
K33 the extent of their own authority and to whom they should report if they have a problem that they cannot resolve
Unit 377  Repairing airframes and structures

Supporting Information

Unit guidance
Assessment requirements for this have been developed by employers for the occupational competency units and qualifications for the Aerospace and Aviation Sector. These assessment requirements are set down in the Aerospace Engineering Employer Occupational Unit Assessment Strategy.

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems. This will allow each organisation to develop their own specific and tailored apprentice training programme whilst meeting their own requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers.
Unit 381 Removing and replacing components of aircraft fuel and lubrication systems
Unit aim:

This Employer Unit of Competence (EUC) has been developed by employers in the Aerospace and Aviation Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief.

This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to carry out the removal and replacement of components of aircraft fuel and lubrication systems, in accordance with approved procedures. It covers both fixed wing and rotary winged aircraft and includes a range of fuel and lubrication equipment associated with propulsion units/power plant, auxiliary engines and transmission systems, main and auxiliary fuel tanks and in flight refuelling equipment, as applicable to the aircraft type.

They will be required to select the appropriate tools and equipment to use, based on the operations to be performed and the components to be removed. The removal and replacement activities will include taking all necessary safeguards to isolate the system, drain fluids, support and lift removed and replaced parts, and will also include replacing faulty equipment at component or unit level, replenishing fluids, setting and adjusting replaced components, and leaving the system in a safe condition and ready for testing.

Their responsibilities will require them to comply with organisational policy and procedures for the removal and replacement 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. They 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 accurately and legibly. They 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 apprentice’s knowledge will provide a good understanding of their work and will provide an informed approach to applying the appropriate removal and replacement techniques and procedures to aircraft fuel and lubrication equipment and systems. They will understand the removal and replacement methods and procedures, and their application, along with the systems maintenance requirements. They will know how the fuel and lubrication systems and 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 removal and replacement activities, and for ensuring that the equipment is replaced to the required standard. In addition, they will have sufficient knowledge of these components to ensure that they are fit for purpose and meet the specifications, thus providing a sound basis for carrying out the replacement. They will understand the safety precautions required when working on the aircraft fuel and lubrication system, especially those relating to the risk of spillage, fire and explosion.

They 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.

They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall objectives of the organisation, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity, motivation and commitment.
Learning outcome
Performance Requirements
Assessment criteria

The learner can:
P1 work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines
P2 demonstrate the required behaviours in line with the job role and organisational objectives
P3 follow the relevant aircraft manuals and publications to carry out the required work
P4 establish and where appropriate, mark component orientation for re-assembly
P5 ensure that any stored energy or substances are released safely and correctly
P6 carry out the removal and replacement activities, within the limits of their personal authority
P7 remove and replace the required components, using approved tools and techniques
P8 take suitable precautions to prevent damage to components and the surrounding structure
P9 complete the relevant documentation, in accordance with organisational requirements
P10 label and store (in an appropriate location) components that require repair or overhaul
P11 dispose of waste materials and scrap components, in accordance with safe working practices and approved procedures

Learning outcome
The learner will:
1 Carry out all of the following during the removal and replacement activity:

1.1 obtain clearance to work on the aircraft and observe all relevant safety procedures
1.2 obtain and use the appropriate documentation (such as job instructions, aircraft manuals, technical instructions, and other relevant maintenance documentation)
1.3 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
1.4 obtain the correct tools and equipment for the activity and check that they are in a safe, tested and usable condition and within current certification/calibration date
1.5 ensure the safe isolation and depressurisation of the fuel and lubrication system before breaking into the system
1.6 ensure that all relevant safety devices and mechanical/physical locks are in place (where appropriate)
1.7 where appropriate, apply electrostatic discharge (ESD) protection procedures
1.8 use approved removal and replacement techniques and procedures at all times
1.9 ensure that components and surrounding structures are maintained free from spillages, damage and foreign objects
1.10 return all tools and equipment to the correct location on completion of the activities
1.11 leave the aircraft and the fuel and lubrication system in a safe and appropriate condition, free from foreign object debris and in a condition ready for testing

Learning outcome
The learner will:

2 Remove components from three of the following aircraft fuel and lubrication systems, and replace components from three of the following aircraft fuel and lubrication systems:

2.1 propulsion/power plant fuel system
2.2 in-flight refuelling equipment
2.3 auxiliary engine fuel system
2.4 auxiliary fuel tank
2.5 propulsion/power plant lubrication system
2.6 external/drop down fuel tanks
2.7 auxiliary engine lubrication system
2.8 main fuel tanks
2.9 oil storage system
2.10 fuel drain/transfer and jettison system
2.11 transmission system
2.12 other specific system

Learning outcome
The learner will:

3 During the activities identified in scope 2 above, the learner must cover the removal and replacement of the following:

Major fuel or lubrication components: Remove and replace three of the following:

3.1 pumps
3.2 fuel manifold
3.3 control valves (drain, bleed, change-over valves, dump)
3.4 reservoirs/supply tanks
3.5 pressure intensifiers
3.6 fuel/oil cooling units
3.7 cylinders
3.8 electrical controls (solenoids, motors, pressure switches)
3.9 compressor
3.10 actuating mechanisms
3.11 fuel and de-fuel connections
3.12 carburettors
3.13 injectors
3.14 safety devices
3.15 fuel flow regulators
3.16 other specific components
3.17 fuel filters
3.18 fuel injectors
3.19 gaskets and seals
3.20 gauges
3.21 oil filters
3.22 rigid pipework
3.23 sensors
3.24 magnetic chips
3.25 strainers
3.26 hoses
3.27 dip sticks, drip sticks, drop sticks
3.28 other specific components

Learning outcome

The learner will:

4. Carry out all of the following removal and replacement activities as applicable to the equipment:

4.1 releasing stored pressure (where appropriate)
4.2 replacing all 'lifed' items (seals, filters, gaskets)
4.3 draining and removing fluids (where appropriate)
4.4 positioning and aligning replaced components
4.5 disconnecting electrical connections
4.6 making mechanical connections
4.7 disconnecting/removing hoses and pipes
4.8 making electrical connections
4.9 ensuring that any part dismantled components are secure/supported
4.10 tightening fastenings to the required torque
4.11 replacing fluids and bleeding the system
4.12 applying and removing covering/protection to exposed components, wires, pipework or vents
4.13 making `off-load' checks before re-pressurising
4.14 re-pressurising the system (where applicable)
4.15 checking components for serviceability
4.16 use of ground support equipment
4.17 replacing damaged/defective components
4.18 labelling (and storing in the correct location) components that require repair or overhaul
4.19 setting, and adjusting replaced components (such as travel, working clearance)
4.20 applying bolt locking methods (such as split pins, wire locking, lock nuts)
4.21 fitting blanks to open systems to prevent entry of contaminating debris
4.22 securing components by using mechanical fasteners and threaded devices

Learning outcome
The learner will:

5 Remove and replace aircraft fuel and lubrication components in compliance with one of the following:

5.1 Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
5.2 extended twin operations procedures (ETOpS) (where appropriate)
5.3 Military Aviation Authority (MAA)
5.4 Aerospace Quality Management Standards (AS)
5.5 Federal Aviation Authority (FAA)
5.6 BS, ISO or BSEN standards and procedures
5.7 customer standards and requirements
5.8 organisation standards and procedures
5.9 aircraft manufacturer’s requirements

Learning outcome
The learner will:

6 Complete the relevant paperwork, to include one from the following and pass it to the appropriate people

6.1 job cards
6.2 computer records
6.3 aircraft service/flight log
6.4 aircraft log book
6.5 permit to work/formal risk assessment

Learning outcome
Knowledge and understanding

Assessment criteria
The learner must know and understand:

K1 the specific safety practices and procedures that they need to observe when working on aircraft fuel and lubrication systems (including any specific legislation, regulations/codes of practice for the activities, equipment or materials)
K2 the importance of maintenance on, and impact upon (extended twin operations procedures) ETOpS systems, legislation and local procedures
K3 the safety procedures that must be carried out before work is started on removing the fuel system components (such as displaying warning notices, ensuring adequate fire fighting equipment)

K4 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the organisation if these are not adhered to

K5 the hazards associated with removing aircraft fuel and lubrication system components, and with the tools and equipment used (such as handling fluids, flammable fluids, fire and explosion, misuse of tools) and how to minimise them and reduce any risks

K6 the requirements and importance of understanding and applying human factors as defined by the regulatory requirements and the potential impact if these are not adhered to

K7 the protective equipment that they need to use for both personal protection (PPE) and protection of the aircraft

K8 what constitutes a hazardous voltage and how to recognise victims of electric shock

K9 how to reduce the risks of a phase to earth shock (such as insulated tools, rubber matting and isolating transformers)

K10 how to extract and use information from aircraft manuals, history/maintenance reports, flight logs, charts, circuit and physical layouts, specifications, symbols used in aircraft fuel and lubrication systems, and other documents needed in the removal and replacement process

K11 how to carry out currency/issue checks on the specifications they are working with

K12 terminology used in aircraft fuel and lubrication systems, and the use of diagrams and associated symbols

K13 the various types of pipes and components that make up the aircraft fuel and lubrication system (such as rigid pipes, flexible hoses, pipe connectors, pipe sealing and supporting devices, valves used for flow and change over, fuel and lubrication pumps, pressure intensifiers, mechanical and electrical control devices)

K14 the basic principles of operation of the aircraft fuel or lubrication system being worked on, and the performance characteristics and function of the components within the circuit

K15 the techniques used to remove components from aircraft fuel and lubrication systems, without damage to the components or surrounding structure (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)

K16 the importance of applying electrostatic discharge (ESD) procedures when working on sensitive equipment or devices

K17 the various mechanical fasteners that will need to be removed and replaced and their method of removal and replacement (such as threaded fasteners, special securing devices)

K18 the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking in of the connections

K19 methods of lifting and supporting the components/equipment during the removal and replacement activities

K20 the importance of ensuring that the work area is free from dirt, swarf and foreign object damage and of ensuring that any exposed components or pipe ends are correctly covered/protected
K21 recognition of contaminants and the problems they can create; the effects and likely symptoms of contamination in the fuel or lubrication system

K22 the need to correctly label and store components that require repair or overhaul and to check that replacement components have the correct part/identification markings

K23 how to re-connect components into the system (such as the use of gaskets/seals and jointing/sealing compounds; ensuring the correct tightness of pipe fittings and valve connections; eliminating stress on pipework/connections; ensuring that pipework is supported at suitable intervals; carrying out visual checks of all components; checking the security of joints and that the system is safe to re-fill/pressurise)

K24 how to make adjustments to components/assemblies to ensure that they function correctly (such as flow and pressure settings and their effect on the system, travel and working clearance)

K25 why electrical bonding is critical and why it must be both mechanically and electrically secure

K26 why securing devices need to be tightened to the correct torque, locked and labelled, and the different methods that are used

K27 the tools and equipment used in the removal and replacement activities and their calibration/care and control procedures

K28 the need to control and account for all tools and equipment used during the removal and replacement activity

K29 the problems that can occur with the removal/replacing operations and how these can be overcome

K30 the recording documentation 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

K31 the procedure for the safe disposal of waste materials, scrap components, oils and fluids

K32 the extent of their own authority and to whom they should report if they have a problem that they cannot resolve
Unit 381  Removing and replacing components of aircraft fuel and lubrication systems

Supporting Information

Unit guidance
Assessment requirements for this have been developed by employers for the occupational competency units and qualifications for the Aerospace and Aviation Sector. These assessment requirements are set down in the Aerospace Engineering Employer Occupational Unit Assessment Strategy.

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems.
This will allow each organisation to develop their own specific and tailored apprentice training programme whilst meeting their own requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers.
Unit 382

Removing and replacing components of aircraft hydraulic systems
Unit aim:

This Employer Unit of Competence (EUC) has been developed by employers in the Aerospace and Aviation Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief.

This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to carry out the removal and replacement of components of aircraft hydraulic systems, in accordance with approved procedures. It covers both fixed wing and rotary winged aircraft, and includes a range of hydraulic equipment such as landing gear, flying controls, main and tail rotor control, blade fold, rotor brakes, nose wheel steering, cargo and weapon bay doors, emergency and utility systems and other aircraft specific equipment. The removal and replacement activities will include making all necessary checks to support and chock pistons/moving parts, isolating and de-pressurising the system, breaking into the system circuit, removing and replacing faulty equipment at component or unit level, replenishing fluids, pressurising the system, setting and adjusting the completed system, and leaving components in a safe condition and ready for testing.

Their responsibilities will require them to comply with organisational policy and procedures for the removal and replacement 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. They 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, accurately and legibly. They 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.

Their underpinning knowledge will provide a good understanding of their work and will provide an informed approach to applying the appropriate removal and replacement techniques and procedures on aircraft hydraulic equipment and systems. They will understand the removal and replacement methods and procedures, and their application, along with the systems maintenance requirements. They 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 removal and replacement activities, and for ensuring that the equipment is replaced to the required standard. In addition, they will have sufficient knowledge of these components to ensure that they are fit for purpose and meet the specifications, thus providing a sound basis for carrying out the replacement.

They will understand the safety precautions required when working on aircraft hydraulic systems, especially those for isolating the equipment. They 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.

They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall objectives of the organisation, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity, motivation and commitment.

Notes: 1. To display competence in this standard, it is necessary to both remove and replace components from aircraft hydraulic systems. They must remove components; however, they may fit a replacement component where the original was previously removed by another person. 2. The removal of major airframe assemblies, such as undercarriage and flying control surfaces, is covered by other standards.
Learning outcome

Performance Requirements

Assessment criteria

The learner can:

P1 work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines
P2 demonstrate the required behaviours in line with the job role and organisational objectives
P3 follow the relevant aircraft manuals and publications to carry out the required work
P4 establish and, where appropriate, mark component orientation for re-assembly
P5 ensure that any stored energy or substances are released safely and correctly
P6 carry out the removal and replacement activities, within the limits of their personal authority
P7 remove and replace the required components, using approved tools and techniques
P8 take suitable precautions to prevent damage to components and the surrounding structure
P9 complete the relevant documentation, in accordance with organisational requirements
P10 label and store (in an appropriate location) components that require repair or overhaul
P11 dispose of waste materials and scrap components, in accordance with safe working practices and approved procedures

Learning outcome

The learner will:

1 Carry out all of the following during the removal and replacement activity:

1.1. obtain clearance to work on the aircraft, and observe all relevant safety procedures
1.2. obtain and use the appropriate documentation (such as job instructions, aircraft manuals, technical instructions, and other relevant maintenance documentation)
1.3. 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
1.4. obtain the correct tools and equipment for the activity and check that they are in a safe, tested and usable condition and within current certification/calibration date
1.5. ensure the safe isolation and depressurisation of the hydraulic equipment before breaking into the system
1.6. ensure that all relevant safety devices and mechanical/physical locks are in place (where appropriate)
1.7. where appropriate, apply electrostatic discharge (ESD) protection procedures
1.8. use approved removal and replacement techniques and procedures at all times
1.9. ensure that components and surrounding structures are maintained free from spillages, damage and foreign objects
1.10. return all tools and equipment to the correct location on completion of the activities
1.11. leave the aircraft and the hydraulic system in a safe and appropriate condition, free from foreign object debris and in a condition ready for testing

---

**Learning outcome**

The learner will:

2. Remove components from three of the following aircraft hydraulic systems, and replace components from three of the following aircraft hydraulic systems:

   2.1 main undercarriage
   2.2 flying controls
   2.3 doors (such as cabin, cargo, hold)
   2.4 nose undercarriage
   2.5 rotor brakes
   2.6 weapon bay doors
   2.7 tail undercarriage
   2.8 blade fold
   2.9 emergency systems
   2.10 nose wheel steering
   2.11 main rotor control
   2.12 utility systems
   2.13 main gear steering
   2.14 tail rotor control
   2.15 ram air turbine (RAT)
   2.16 wheel braking system
   2.17 spoilers
   2.18 damping mechanisms
   2.19 outriggers
   2.20 other specific hydraulic systems (such as hoists)

---

**Learning outcome**

The learner will:

3. During the activities identified in scope 2 above, the learner must cover the removal and replacement of the following:

   **Major hydraulic components**: Remove and replace two of the following:

   3.1 pumps
   3.2 pressure intensifiers
   3.3 reservoirs/tanks
   3.4 hydraulic motors
   3.5 brake units
3.6 actuators/rams
3.7 oil coolers
3.8 accumulators
3.9 control valves
3.10 filters
3.11 pipes and hoses
3.12 gauges
3.13 non-return valves
3.14 pressure reducing valves
3.15 hydraulic fuses
3.16 regulators
3.17 sensors
3.18 computers/control cards

Learning outcome

The learner will:

4 Carry out all of the following removal and replacement activities as applicable to the equipment:

4.1 chocking and supporting components
4.2 replacing all 'lifed' items (seals, filters, gaskets)
4.3 releasing stored pressure
4.4 positioning and aligning replaced components
4.5 draining and removing fluids
4.6 making mechanical connections
4.7 disconnecting electrical connections
4.8 making electrical connections
4.9 disconnecting/removing hoses and pipes
4.10 tightening fastenings to the required torque
4.11 applying and removing covering/protection to exposed components, wires, pipework or vents
4.12 replacing damaged/defective components
4.13 applying bolt locking methods (such as split pins, wire locking, lock nuts)
4.14 replacing fluids and bleeding the system
4.15 making 'off-load' checks before re-pressurising
4.16 checking components for serviceability
4.17 re-pressurising the system
4.18 labelling (and storing in the correct location) components that require repair or overhaul
4.19 setting, and adjusting replaced components (such as travel, working clearance)
Learning outcome

The learner will:

5 Remove and replace aircraft hydraulic components in compliance with one of the following:

5.1 Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
5.2 extended twin operations procedures (ETOpS) (where appropriate)
5.3 Military Aviation Authority (MAA)
5.4 Aerospace Quality Management Standards (AS)
5.5 Federal Aviation Authority (FAA)
5.6 BS, ISO or BSEN standards and procedures
5.7 customer standards and requirements
5.8 organisation standards and procedures
5.9 aircraft manufacturer’s requirements

Learning outcome

The learner will:

6 Complete the relevant paperwork, to include one from the following and pass it to the appropriate people:

6.1 job cards
6.2 computer records
6.3 aircraft service/flight log
6.4 aircraft log book
6.5 permit to work/formal risk assessment

Learning outcome

Knowledge and understanding

Assessment criteria

The learner must know and understand:

K1 the specific safety practices and procedures that they need to observe when working on aircraft hydraulic systems and when using synthetic oils (including any specific legislation, regulations/codes of practice for the activities, equipment or materials)

K2 the importance of maintenance on, and impact upon (extended twin operations procedures) ETOpS systems, legislation and local procedures

K3 the hazards associated with removing and replacing aircraft hydraulic system components, and with the tools and equipment used (such as the need to support the aircraft and/or its components, the use of cylinder chocks and wedges, safe release of pressurised systems, handling hydraulic fluids, misuse of tools) and how to minimise them and reduce any risks
K4  the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the organisation if these are not adhered to
K5  the requirements and importance of understanding and applying human factors as defined by the regulatory requirements and the potential impact if these are not adhered to
K6  the protective equipment that they need to use for both personal protection (PPE) and protection of the aircraft
K7  what constitutes a hazardous voltage and how to recognise victims of electric shock
K8  how to reduce the risks of a phase to earth shock (such as insulated tools, rubber matting and isolating transformers)
K9  how to extract and use information from aircraft manuals, history/maintenance reports, flight logs, charts, circuit and physical layouts, specifications, symbols used in aircraft hydraulic systems and other documents needed in the removal and replacement process
K10 how to carry out currency/issue checks on the specifications they are working with
K11 terminology used in aircraft hydraulic systems and the use of fluid power diagrams and associated symbols
K12 the various types of pipe and component that make up the aircraft hydraulic system (such as rigid pipes; flexible hoses; pipe connectors; pipe sealing and supporting devices; valves used for pressure, flow and directional control; double and single action cylinders/actuators; pump; pressure intensifier, mechanical and electrical control device)
K13 the basic principles of operation of the hydraulic system being worked on and the performance characteristics and function of the valves, cylinders/actuators within the circuit
K14 the techniques used to remove components from aircraft hydraulic systems, without damage to the components or surrounding structure (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
K15 the various mechanical fasteners that will need to be removed and replaced and their method of removal and replacement (such as threaded fasteners, special securing devices)
K16 the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking in of the connections
K17 the importance of applying electrostatic discharge (ESD) procedures when working on sensitive equipment or devices
K18 methods of lifting, handling and supporting the components/equipment during the removal/replacement activities
K19 the importance of ensuring that the work area is free from dirt, swarf and foreign object damage, and of ensuring that any exposed components or pipe ends are correctly covered/protected
K20 recognition of contaminants and the problems they can create; the effects and likely symptoms of contamination in the hydraulic system
K21 the need to correctly label and store components that require repair or overhaul and to check that replacement components have the correct part/identification markings
K22 how to re-connect components into the circuit (such as the use of gaskets/seals and jointing/sealing compounds; ensuring correct tightness of pipe fittings and valve connections; eliminating stress on pipework/connections; ensuring that pipework is supported at suitable intervals; carrying out visual checks of all components; checking the security of joints and that the system is safe to re-pressurise)

K23 how to make adjustments to components/assemblies to ensure that they function correctly (such as pressure settings and their effect on the system, travel and working clearance)

K24 why electrical bonding is critical and why it must be both mechanically and electrically secure

K25 why securing devices need to be tightened to the correct torque, locked and labelled, and the different methods that are used

K26 the tools and equipment used in the removal and replacement activities and their calibration/care and control procedures

K27 the need to control and account for all tools and equipment used during the removal and replacement activity

K28 the problems that can occur with the removal/replacing operations and how these can be overcome

K29 the recording documentation 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

K30 the procedure for the safe disposal of waste materials, scrap components and hydraulic fluids

K31 the extent of their own authority and to whom they should report if they have a problem that they cannot resolve
Unit 382  Removing and replacing components of aircraft hydraulic systems

Supporting Information

Unit guidance
Assessment requirements for this have been developed by employers for the occupational competency units and qualifications for the Aerospace and Aviation Sector. These assessment requirements are set down in the Aerospace Engineering Employer Occupational Unit Assessment Strategy.

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems.
This will allow each organisation to develop their own specific and tailored apprentice training programme whilst meeting their own requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers.
Unit 383  Removing and replacing components of aircraft pneumatic and vacuum systems

GLH: 175

Unit aim:
This Employer Unit of Competence (EUC) has been developed by employers in the Aerospace and Aviation Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief.

This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to carry out the removal and replacement of components of aircraft pneumatic and vacuum systems, in accordance with approved procedures. It covers both fixed wing and rotary winged aircraft, and includes a range of air equipment such as emergency blow-down systems, de-icing systems, air stairs, sanitary and waste disposal systems, arrester mechanisms, deck locks, air start systems, weapons systems, flying controls and other aircraft specific equipment, as applicable to the aircraft type. The removal and replacement activities will include making all necessary checks to support and chock pistons/moving parts, isolating and de-pressurising the system, breaking into the system circuit, removing and replacing faulty equipment at component or unit level, pressurising the system, setting and adjusting the completed system, and leaving components in a safe condition and ready for testing.

Their responsibilities will require them to comply with organisational policy and procedures for the removal and replacement 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. They 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, accurately and legibly. They 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.

Their underpinning knowledge will provide a good understanding of their work and will provide an informed approach to applying the appropriate removal and replacement techniques and procedures to aircraft pneumatic and vacuum equipment and systems. They will understand the removal and replacement methods and procedures, and their application, along with the systems maintenance requirements. They 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 removal and replacement activities, and for ensuring that the equipment is replaced to the required standard. In addition, they will have sufficient knowledge of these components to ensure that they are fit for purpose and meet the specifications, thus providing a sound basis for carrying out the replacement. They will understand the safety precautions required when working on aircraft pneumatic and vacuum systems, especially those for isolating the equipment. They 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.

They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall objectives of the organisation, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity, motivation and commitment.

Notes: To display competence in this standard, it is necessary to both remove and replace components from aircraft pneumatic and vacuum systems. They must remove components; however, they may fit a replacement component where the original was previously removed by another person.
Learning outcome

Performance Requirements

Assessment criteria

The learner can:

P1 work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines
P2 demonstrate the required behaviours in line with the job role and company objectives
P3 follow the relevant aircraft manuals and publications to carry out the required work
P4 establish and where appropriate, mark component orientation for re-assembly
P5 ensure that any stored energy or substances are released safely and correctly
P6 carry out the removal and replacement activities, within the limits of their personal authority
P7 remove and replace the required components, using approved tools and techniques
P8 take suitable precautions to prevent damage to components and the surrounding structure
P9 complete the relevant documentation, in accordance with organisational requirements
P10 label and store (in an appropriate location) components that require repair or overhaul
P11 dispose of waste materials and scrap components, in accordance with safe working practices and approved procedures

Learning outcome

The learner will:

1 Carry out all of the following during the removal and replacement activity:

1.1 obtain clearance to work on the aircraft and observe all relevant safety procedures
1.2 obtain and use the appropriate documentation (such as job instructions, aircraft manuals, technical instructions, and other relevant maintenance documentation)
1.3 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
1.4 obtain the correct tools and equipment for the activity and check that they are in a safe, tested and usable condition and within current certification/calibration date
1.5 ensure the safe isolation and depressurisation of the equipment before breaking into the system
1.6 ensure that all relevant safety devices and mechanical/physical locks are in place (where appropriate)
1.7 where appropriate, apply electrostatic discharge (ESD) protection procedures
1.8 use approved removal and replacement techniques and procedures at all times
1.9 ensure that components and surrounding structures are maintained free from damage and foreign objects
1.10 return all tools and equipment to the correct location on completion of the activities
1.11 leave the aircraft and the pneumatic and vacuum systems in a safe and appropriate condition, free from foreign object debris and in a condition ready for testing

Learning outcome
The learner will:

2. Remove components from three of the following aircraft pneumatic and vacuum systems and replace components from three of the following aircraft pneumatic and vacuum systems:

   2.1 emergency blow down systems
   2.2 de-icing systems
   2.3 damping mechanisms
   2.4 air driven gyros
   2.5 air stairs
   2.6 deck locks
   2.7 spoilers
   2.8 engine air start
   2.9 arrester mechanisms
   2.10 slats
   2.11 waste disposal systems
   2.12 gun cocking
   2.13 flaps
   2.14 air intake shutters
   2.15 weapon bay doors
   2.16 flying controls
   2.17 sanitary systems
   2.18 nose wheel steering
   2.19 utility systems
   2.20 wheel braking
   2.21 fuel tank pressurisation
   2.22 other specific systems

Learning outcome
The learner will:

3. During the activities identified in scope 2 above, the learner must cover the removal and replacement of the following:

   Major components: Remove and replace two of the following:

   3.1 pumps
   3.2 pressure intensifiers
   3.3 air reservoirs/tanks
3.4 vacuum pumps
3.5 compressors
3.6 cylinders/actuating mechanisms
3.7 motors
3.8 accumulators
3.9 control valves
3.10 air coolers
3.11 air filters
3.12 pressure reducing valves
3.13 non-return valves
3.14 sensors
3.15 regulators
3.16 gauges
3.17 pipes, ducting and hoses
3.18 sealing devices

---

**Learning outcome**

The learner will:

4. Carry out **all** of the following removal and replacement activities as applicable to

4.1 chocking and supporting components
4.2 replacing all 'lifed' items (seals, filters, gaskets)
4.3 releasing stored pressure
4.4 positioning and aligning replaced components
4.5 disconnecting electrical connections
4.6 making mechanical connections
4.7 disconnecting/removing hoses and pipes
4.8 making electrical connections
4.9 applying and removing covering/protection to exposed components, wires, pipework or vents
4.10 checking components for serviceability
4.11 replacing damaged/defective components
4.12 tightening fastenings to the required torque
4.13 applying bolt locking methods (such as split pins, wire locking, lock nuts)
4.14 making 'off-load' checks before re-pressurising
4.15 setting, and adjusting replaced components (such as travel, working clearance)
4.16 re-pressurising the system
4.17 labelling (and storing in the correct location) components that require repair or overhaul
Learning outcome

The learner will:
5 Remove and replace aircraft pneumatic and vacuum system components in compliance with one of the following:

5.1 Civil Aviation Authority (CAA)/European Aviation Safety Authority (EASA)
5.2 extended twin operations procedures (ETOpS) (where appropriate)
5.3 Military Aviation Authority (MAA)
5.4 Aerospace Quality Management Standards (AS)
5.5 Federal Aviation Authority (FAA)
5.6 BS, ISO or BSEN standards and procedures
5.7 customer standards and requirements
5.8 organisation standards and procedures
5.9 aircraft manufacturer’s requirements

Learning outcome

The learner will:
6 Complete the relevant paperwork, to include one from the following and pass it to the appropriate people:

6.1 job cards
6.2 computer records
6.3 aircraft service/flight log
6.4 aircraft log book
6.5 permit to work/formal risk assessment

Learning outcome

Knowledge and understanding

Assessment criteria

The learner must know and understand:

K1 the specific safety practices and procedures that they need to observe when working on aircraft pneumatic and vacuum systems (including any specific legislation, regulations/codes of practice for the activities, equipment or materials)

K2 the importance of maintenance on, and impact upon (extended twin operations procedures) ETOpS systems, legislation and local procedures

K3 the hazards associated with removing and replacing aircraft pneumatic and vacuum system components, and with the tools and equipment used (such as the need to support the aircraft and/or its components, the use of cylinder chocks and wedges, safe release of pressurised systems, misuse of tools) and how to minimise them and reduce any risks
K4 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the organisation if these are not adhered to
K5 the requirements and importance of understanding and applying human factors as defined by the regulatory requirements and the potential impact if these are not adhered to
K6 the protective equipment that they need to use for both personal protection (PPE) and protection of the aircraft
K7 how to extract and use information from aircraft manuals, history/maintenance reports, flight logs, charts, circuit and physical layouts, specifications, symbols used in aircraft pneumatic and vacuum systems and other documents needed in the removal and replacement process
K8 how to carry out currency/issue checks on the specifications they are working with
K9 terminology used in aircraft pneumatic and vacuum systems and the use of fluid power diagrams and symbols
K10 the various types of pipe and component that make up the aircraft pneumatic or vacuum system (such as rigid pipes, flexible hoses, pipe connectors, pipe sealing and supporting devices, valves used for pressure, flow and directional control, double and single action cylinders/actuators, pumps, pressure intensifiers, mechanical and electrical control devices)
K11 the basic principles of operation of the pneumatic or vacuum system being worked on and the performance characteristics and function of the valves, cylinders/actuators within the circuit
K12 the techniques used to remove components from aircraft pneumatic and vacuum systems, without damage to the components or surrounding structure (such as release of pressures/force, proof marking, extraction of components) and the need to protect the circuit integrity by fitting blanking plugs and labelling exposed circuits
K13 the various mechanical fasteners that will need to be removed and replaced and their method of removal and replacement (such as threaded fasteners, special securing devices)
K14 the various types of electrical connectors that are used, methods of unlocking, orientation indicators and locating and locking in of the connections
K15 the importance of applying electrostatic discharge (ESD) procedures when working on sensitive equipment/device
K16 methods of lifting and supporting the components/equipment during the removal and replacement activities
K17 the importance of ensuring that the work area is free from dirt, swarf and foreign object damage and of ensuring that any exposed components or pipe ends are correctly covered/protected
K18 recognition of contaminants and the problems they can create; the effects and likely symptoms of contamination in the pneumatic or vacuum system
K19 the need to correctly label and store components that require repair or overhaul, and to check that replacement components have the correct part/identification markings
K20 how to reconnect components into the circuit (such as the use of gaskets/seals and jointing/sealing compounds; ensuring correct tightness of pipe fittings and valve connections; eliminating stress on pipework/connections; ensuring that pipework is supported at suitable intervals; carrying out visual checks of all components; checking the security of joints and that the system is safe to re-pressurise)
K21 how to make adjustments to components/assemblies to ensure that they function correctly (such as pressure settings and their effect on the system, travel and working clearance)
K22 why electrical bonding is critical and why it must be both mechanically and electrically secure
K23 why securing devices need to be tightened to the correct torque, locked and labelled and the different methods that are used
K24 the tools and equipment used in the removal and replacement activities, and their calibration/care and control procedures
K25 the need to control and account for all tools and equipment used during the removal and replacement activity
K26 the problems that can occur with the removal/replacing operations and how these can be overcome
K27 the recording documentation 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
K28 the procedure for the safe disposal of waste materials, scrap components and fluids
K29 the extent of their own authority and to whom they should report if they have a problem that they cannot resolve
Unit 383  Removing and replacing components of aircraft pneumatic and vacuum systems

Supporting Information

**Unit guidance**
Assessment requirements for this have been developed by employers for the occupational competency units and qualifications for the Aerospace and Aviation Sector. These assessment requirements are set down in the Aerospace Engineering Employer Occupational Unit Assessment Strategy.

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems.

This will allow each organisation to develop their own specific and tailored apprentice training programme whilst meeting their own requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers.
Unit 384 Removing and replacing components of aircraft environmental systems
Unit aim:

This Employer Unit of Competence (EUC) has been developed by employers in the Aerospace and Aviation Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief.

This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to carry out the removal and replacement of components of aircraft environmental systems, in accordance with approved procedures. It covers both fixed wing and rotary winged aircraft, and includes a range of equipment associated with oxygen equipment, cabin pressurisation equipment, therapeutic masks, air conditioning and heating systems, anti-g, pressurisation of bulkheads, pressure domes, door, canopy and window seals and demisting equipment, avionic cooling, water and waste, ice and rain protection, as applicable to the aircraft type.

They will be required to select the appropriate tools and equipment to use, based on the operations to be performed and the components to be removed. The removal and replacement activities will include taking all necessary safeguards to isolate the system, drain fluids, support and lift removed and replaced parts, and will also include replacing faulty equipment at component or unit level, replenishing fluids, setting and adjusting replaced components, and leaving the system in a safe condition and ready for testing. Their responsibilities will require them to comply with organisational policy and procedures for the removal and replacement 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. They 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, accurately and legibly. They 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.

Their underpinning knowledge will provide a good understanding of their work and will provide an informed approach to applying the appropriate removal and replacement techniques and procedures to aircraft environmental equipment and systems. They will understand the removal and replacement methods and procedures, and their application, along with the systems maintenance requirements. They will know how the environmental system and 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 removal and replacement activities, and for ensuring that the equipment is replaced to the required standard. In addition, they will have sufficient knowledge of these components to ensure that they are fit for purpose and meet the specifications, thus providing a sound basis for carrying out the replacement.

They will understand the safety precautions required when working on the aircraft environmental system, especially those for isolating the system. They 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.

They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall objectives of the organisation, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity, motivation and commitment.

Notes To display competence in this standard, it is necessary to both remove and replace components from aircraft environmental systems. They must remove components; however, they may fit a replacement component where the original was previously removed by another person.
Learning outcome

Performance Requirements

Assessment criteria

The learner can:

P1 work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines
P2 demonstrate the required behaviours in line with the job role and organisational objectives
P3 follow the relevant aircraft manuals and publications to carry out the required work
P4 establish and where appropriate, mark component orientation for re-assembly
P5 ensure that any stored energy or substances are released safely and correctly
P6 carry out the removal and replacement activities, within the limits of their personal authority
P7 remove and replace the required components, using approved tools and techniques
P8 take suitable precautions to prevent damage to components and the surrounding structure
P9 complete the relevant documentation, in accordance with organisational requirements
P10 label and store (in an appropriate location) components that require repair or overhaul
P11 dispose of waste materials and scrap components in accordance with safe working practices and approved procedures

Learning outcome

The learner will:

1 Carry out all of the following during the removal and replacement activity:

1.1. obtain clearance to work on the aircraft and observe all relevant safety procedures
1.2. obtain and use the appropriate documentation (such as job instructions, aircraft manuals, technical instructions, and other relevant maintenance documentation)
1.3. 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
1.4. obtain the correct tools and equipment for the activity, and check that they are in a safe, tested and usable condition and within current certification/calibration date
1.5. ensure the safe isolation and draining/depressurisation of the environmental equipment before breaking into the system
1.6. ensure that all relevant safety devices and mechanical/physical locks are in place (where appropriate)
1.7. where appropriate, apply electrostatic discharge (ESD) protection procedures
1.8. use approved removal and replacement techniques and procedures at all times
1.9. ensure that components and surrounding structures are maintained free from damage and foreign objects
1.10. return all tools and equipment to the correct location on completion of the activities
1.11. leave the aircraft and the environmental system in a safe and appropriate condition, free from foreign object debris and in a condition ready for testing

Learning outcome
The learner will:

2 Remove components from three of the following aircraft environmental systems and replace components from three of the following aircraft environmental systems:

2.1 oxygen systems
2.2 cabin pressurisation systems
2.3 ice protection
2.4 air conditioning systems
2.5 pressurised bulkheads
2.6 rain protection
2.7 cabin heating and cooling
2.8 pressure domes
2.9 anti-g
2.10 avionic cooling systems
2.11 demisting equipment
2.12 oxygen and inert gas generation
2.13 aircrew liquid cooling
2.14 other aircraft environmental specific systems

Learning outcome
The learner will:

3 During the activities identified in scope 2 above, the learner must cover the removal and replacement of the following:

Major environmental system components: Remove and replace two of the following:

3.1 reservoirs/supply tanks
3.2 air receivers
3.3 compressor
3.4 regulators
3.5 accumulators
3.6 diffusers
3.7 pumps
3.8 cylinders
3.9 pressure intensifiers
3.10 charging bottles
3.11 water extractors
3.12 humidifier
3.13 cold air units/air cycle machines
3.14 heat exchangers
3.15 pressure controllers
3.16 safety devices
3.17 air-conditioning packs
3.18 actuating mechanisms
3.19 sensors
3.20 oxygen generation components
3.21 valves (such as by-pass, shut-off, check, relief, temperature control, outflow, anti-g) pressure
3.22 face mask and allied equipment
3.23 environmental seals and sealants
3.24 ozone converters
3.25 door, window and canopy seals
3.26 liquid cooling unit
3.27 other specific components
3.28 filters
3.29 hoses
3.30 gauges
3.31 strainers including water separator
3.32 gaskets and seals
3.33 electrical controls (solenoids, motors, switches)
3.34 earthing straps/jumper braids
3.35 unions and couplings
3.36 rigid pipework/ducting

Learning outcome

The learner will:

4 Carry out all of the following removal and replacement activities as applicable to the equipment:

4.1 releasing stored pressure (where applicable)
4.2 replacing all 'lifed' items (seals, filters, gaskets)
4.3 disconnecting electrical connections
4.4 positioning and aligning replaced components
4.5 disconnecting/removing hoses and pipes
4.6 making mechanical connections
4.7 ensuring that any part-dismantled components are secure/supported
4.8 making electrical connections
4.9 tightening fastenings to the required torque
4.10 applying and removing covering/protection to exposed components, wires, pipework or vents
4.11 use of ground support equipment
4.12 checking components for serviceability
4.13 replacing damaged/defective components
4.14 labelling (and storing in the correct location) components that require repair or overhaul
4.15 applying bolt locking methods (such as split pins, wire locking, lock nuts)
4.16 fitting blanks to open systems to prevent entry of contaminating debris
4.17 securing components using mechanical fasteners and threaded devices
4.18 re-pressurising the system (where applicable)
4.19 applying bolt locking methods (such as split pins, wire locking, lock nuts)

Learning outcome
The learner will:
5 Remove and replace environmental system components in compliance with one of the following:

5.1 Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
5.2 extended twin operations procedures (ETOpS) (where appropriate)
5.3 Military Aviation Authority (MAA)
5.4 Aerospace Quality Management Standards (AS)
5.5 Federal Aviation Authority (FAA)
5.6 BS, ISO or BSEN standards and procedures
5.7 customer standards and requirements
5.8 organisation standards and procedures
5.9 aircraft manufacturer's requirements

Learning outcome
Knowledge and understanding

Assessment criteria
The learner must know and understand:

K1 the specific safety practices and procedures that they need to observe when working on aircraft environmental systems (including any specific legislation, regulations/codes of practice for the activities, equipment or materials)
K2 the importance of maintenance on, and impact upon (extended twin operations procedures) ETOpS systems, legislation and local procedures
K3 the safety procedures that must be carried out before work is started on removing environmental system components (such as displaying warning notices, draining and depressurising systems)
K4 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the organisation if these are not adhered to
the hazards associated with removing aircraft environmental system components, and with the tools and equipment used (such as handling fluids, pressurised systems, misuse of tools) and how to minimise them and reduce any risks

the requirements and importance of understanding and applying human factors as defined by the regulatory requirements and the potential impact if these are not adhered to

the protective equipment that they need to use for both personal protection (PPE) and protection of the aircraft

how to extract and use information from aircraft manuals, history/maintenance reports, flight logs, charts, circuit and physical layouts, specifications, symbols used in aircraft environmental systems and other documents needed in the removal and replacement process

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

terminology used in aircraft environmental systems and the use of diagrams and associated symbols

the various types of pipes and components that make up the aircraft environmental system (such as rigid pipes, flexible hoses, pipe connectors, pipe sealing and supporting devices, compressors, pumps, pressure intensifiers, mechanical and electrical control devices)

the basic principles of operation of the aircraft environmental system being worked on and the performance characteristics and function of the components within the circuit

the techniques used to remove components from aircraft environmental systems without damage to components or surrounding structure (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)

the various mechanical fasteners to be removed and replaced and their method of removal and replacement (such as threaded fasteners, special securing devices)

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

the importance of applying electrostatic discharge (ESD) procedures when working on sensitive equipment/device

methods of lifting, handling and supporting the components/equipment during removal and replacement activities

the importance of ensuring that the work area is free from dirt, swarf and foreign object damage and of ensuring that any exposed components or pipe ends are correctly covered/protected

recognition of contaminants and the problems they can create; the effects and likely symptoms of contamination in the system (especially hydrocarbons in oxygen systems)

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

how to re-connect components into the system (such as the use of gaskets/seals and jointing/sealing compounds; ensuring the correct tightness of pipe fittings and valve connections; eliminating stress on pipework/connections; ensuring that pipework is supported at suitable intervals; carrying out visual checks of all components; checking security of joints and that the system is safe to re-fill/pressurise)
K22 how to make adjustments to components/assemblies to ensure that they function correctly (such as flow and pressure settings) and their effect on the system, travel and working clearance

K23 why electrical bonding is critical and why it must be both mechanically and electrically secure

K24 why securing devices need to be tightened to the correct torque, locked and labelled and the different methods that are used

K25 the tools and equipment used in the removal and replacement activities, and their calibration/care and control procedures

K26 the need to control and account for all tools and equipment used during the removal and replacement activity

K27 the problems that can occur with the removal/replacing operations and how these can be overcome

K28 the recording documentation 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

K29 the procedure for the safe disposal of waste materials, scrap components, oils and fluids

K30 the extent of their own authority and to whom they should report if they have a problem that they cannot resolve
Unit 384  Removing and replacing components of aircraft environmental systems

Supporting Information

Unit guidance
Assessment requirements for this have been developed by employers for the occupational competency units and qualifications for the Aerospace and Aviation Sector. These assessment requirements are set down in the Aerospace Engineering Employer Occupational Unit Assessment Strategy.

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems.
This will allow each organisation to develop their own specific and tailored apprentice training programme whilst meeting their own requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers.
Unit 385  Removing and replacing components of aircraft power transmission systems
Unit aim:

This Employer Unit of Competence (EUC) has been developed by employers in the Aerospace and Aviation Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief.

This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to carry out the removal and replacement of components of aircraft power transmission systems, in accordance with approved procedures and it covers rotary winged aircraft. They will be required to select the appropriate tools and equipment to use, based on the operations to be performed and the components to be removed. The aircraft power transmission system components to be removed will include items such as drive shafts, drive shaft supports, gearbox assemblies, couplings, mechanical fasteners, accelerometers, vibration monitoring equipment, and main and tail rotor assemblies. The removal and replacement activities will include taking all necessary safeguards to isolate the system, support and lift removed and replaced parts, replacing faulty equipment at component or unit level, setting and adjusting replaced components and leaving the power transmission system in a safe condition and ready for testing.

Their responsibilities will require them to comply with organisational policy and procedures for the removal and replacement 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. They 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, accurately and legibly. They 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.

Their underpinning knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate removal and replacement techniques and procedures to aircraft power transmission systems. They will understand the removal and replacement methods and procedures, and their application, along with the power transmission maintenance requirements. They will know how the power transmission system 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 removal and replacement activities, and for ensuring that the equipment is replaced to the required standard. In addition, they will have sufficient knowledge of these components to ensure that they are fit for purpose and meet the specifications, thus providing a sound basis for carrying out the replacement.

They will understand the safety precautions required when working on aircraft power transmission systems, especially those for isolating the equipment and for lifting and handling heavy and bulky components. They 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 To display competence in this standard, it is necessary to both remove and replace components from aircraft transmission systems. They must remove components; however, they may fit a replacement component where the original was previously removed by another person.
Learning outcome

Performance Requirements

Assessment criteria

The learner can:

P1 work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines
P2 demonstrate the required behaviours in line with the job role and organisational objectives
P3 follow the relevant aircraft manuals and publications to carry out the required work
P4 establish and where appropriate, mark component orientation for re-assembly
P5 ensure that any stored energy or substances are released safely and correctly
P6 carry out the removal and replacement activities, within the limits of their personal authority
P7 remove and replace the required components, using approved tools and techniques
P8 take suitable precautions to prevent damage to components and the surrounding structure
P9 complete the relevant documentation, in accordance with organisational requirements
P10 label and store (in an appropriate location) components that require repair or overhaul
P11 dispose of waste materials and scrap components, in accordance with safe working practices and approved procedures

Learning outcome

The learner will:

1 Carry out all of the following during the removal and replacement activity

1.1. obtain clearance to work on the aircraft, and observe all relevant safety procedures
1.2. obtain and use the appropriate documentation (such as job instructions, aircraft manuals, technical instructions, and other relevant maintenance documentation)
1.3. 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
1.4. obtain the correct tools and equipment for the activity, and check that they are in a safe, tested and usable condition and within current certification/calibration date
1.5. ensure the safe isolation of the power transmission system before commencing work on the equipment ensure that all relevant safety devices and mechanical/physical locks are in place (where appropriate)
1.6. where appropriate, apply electrostatic discharge (ESD) protection procedures
1.7. use approved removal and replacement techniques and procedures at all times
1.8. ensure that components and surrounding structures are maintained free from spillages, damage and foreign objects
1.9. return all tools and equipment to the correct location on completion of the activities
leave the aircraft and the power transmission systems in a safe and appropriate condition, free from foreign object debris and in a condition ready for testing

Learning outcome

The learner will:

2. Remove components from three of the following aircraft power transmission systems and replace components from three of the following aircraft power transmission systems:

   2.1 intermediate gear box
   2.2 main gear box
   2.3 tail gear box
   2.4 nose/forward gear box
   2.5 main rotor head assembly
   2.6 tail rotor drive train
   2.7 tail rotor assembly

Learning outcome

The learner will:

3. During the activities identified in scope 2 above, the learner must cover the removal and replacement of the following:

   Major power transmission components: Remove and replace three of the following:

   3.1 drive shaft
   3.2 main rotor head
   3.3 flexi couplings
   3.4 drive shaft support
   3.5 tail rotor head
   3.6 rotor brakes
   3.7 bearings
   3.8 dynamic seals
   3.9 swash plate
   3.10 couplings
   3.11 fan bearing support group (FBSG)
   3.12 control valves
   3.13 gearboxes
   3.14 static seals/gaskets
   3.15 gaiters
   3.16 sensors
   3.17 mechanical controls (plungers, springs, rollers)
   3.18 locks and stops
3.19 electrical controls (solenoids, motors, switches)
3.20 control units
3.21 accelerometers
3.22 levers and linkages
3.23 other specific components

**Learning outcome**

The learner will:

4. **Carry out all** of the following removal and replacement activities as applicable to the equipment:

4.1 draining and removing fluids
4.2 use of ground support equipment
4.3 positioning and aligning replaced components
4.4 supporting equipment to be removed
4.5 dismantling equipment to an appropriate level
4.6 disconnecting electrical connections
4.7 disconnecting/removing hoses and pipes
4.8 removing mechanical fasteners and securing devices
4.9 using lifting operations (manual or automated)
4.10 proof marking components to aid reassembly
4.11 checking components for serviceability
4.12 replacing all damaged/defective components
4.13 replacing all ‘lifed’ items (such as seals, bearings, gaskets)
4.14 applying gaskets and sealant/adhesives
4.15 setting and adjusting replaced components
4.16 making mechanical connections
4.17 making electrical connections
4.18 tightening fastenings to the required torque
4.19 securing components using mechanical fasteners and threaded devices
4.20 applying bolt locking methods (such as split pins, wire locking, lock nuts)
4.21 making ‘off-load’ checks before starting up
4.22 applying and removing covering/protection to exposed components, wires, pipework or vents
4.23 labelling (and storing in the correct location) components that require repair or overhaul
4.24 protecting and preparing removed components for transportation for overhaul

**Learning outcome**

The learner will:

5. Remove and replace aircraft power transmission system components in compliance with **one** of the following:
5.1 Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
5.2 extended twin operations procedures (ETOpS) (where appropriate)
5.3 Military Aviation Authority (MAA)
5.4 Aerospace Quality Management Standards (AS)
5.5 Federal Aviation Authority (FAA)
5.6 BS, ISO or BSEN standards and procedures
5.7 customer standards and requirements
5.8 organisation standards and procedures
5.9 aircraft manufacturer's requirements

___

**Learning outcome**

The learner will:

6 Complete the relevant paperwork, to include one from the following and pass it to the appropriate people:

6.1 job cards
6.2 computer records
6.3 aircraft service/flight log
6.4 aircraft log book
6.5 permit to work/formal risk assessment

___

**Learning outcome**

Knowledge and understanding

**Assessment criteria**

The learner must know and understand:

K1 the specific safety practices and procedures that they need to observe when working on aircraft power transmission systems (including any specific legislation, regulations/codes of practice for the activities, equipment or materials)

K2 the importance of maintenance on, and impact upon (extended twin operations procedures) ETOpS systems, legislation and local procedures

K3 hazards associated with removing and replacing aircraft power transmission system components, and with the tools and equipment used (such as handling oils, greases, stored pressure/force, lifting and moving heavy and bulky components, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures), and how to minimise them and reduce any risks

K4 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the organisation if these are not adhered to

K5 the requirements and importance of understanding and applying human factors as defined by the regulatory requirements and the potential impact if these are not adhered to

K6 the protective equipment that they need to use for both personal protection (PPE) and protection of the aircraft
what constitutes a hazardous voltage and how to recognise victims of electric shock
how to reduce the risks of a phase to earth shock (such as insulated tools, rubber matting and isolating transformers)
how to extract and use information from aircraft maintenance manuals, history/maintenance reports, flight logs, and other documents needed in the removal and replacement process
how to carry out currency/issue checks on the specifications they are working with
terminology used in aircraft power transmission systems
the basic principles of how the transmission system and equipment functions, its operating sequence, the working purpose of individual units/components and how they interact
the techniques used to remove components from aircraft power transmission systems, without damage to the components or surrounding structure (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
the various mechanical fasteners to be removed and replaced, and their method of removal and replacement (such as threaded fasteners, special securing devices)
the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking in of the connections
the importance of applying electrostatic discharge (ESD) procedures when working on sensitive equipment
methods of lifting, handling and supporting the components/equipment during removal and replacement activities
the identification and application, fitting and removal of different types of bearings (such as roller, ball, thrust)
methods of checking that components are fit for purpose, and how to identify defects and wear characteristics
the use of measuring equipment (such as micrometers, Verniers, expansion indicators and other devices)
the need to replace ‘lifed’ items (such as seals and gaskets)
the need to correctly label and store components that require repair or overhaul, and to check that replacement components have the correct part/identification markings
how to replace and reconnect components into the system (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)
how to make adjustments to components/assemblies to ensure that they function correctly (such as setting working clearance, setting travel, preloading bearings)
why securing devices need to be tightened to the correct torque, locked and labelled, and different methods used
recognition of contaminants and the problems they can create; the effects and likely symptoms of contamination in the power transmission system
K27 why electrical bonding is critical, and why it must be both mechanically and electrically secure
K28 the importance of making `off-load' checks before running the equipment under power
K29 how to check that tools and equipment are free from damage or defect, are in a safe and usable condition, and are configured correctly for the intended purpose
K30 the need to control and account for all tools and equipment used during the removal and replacement activity
K31 how to use lifting and handling equipment in the maintenance activity
K32 the recording documentation 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
K33 the procedure for the safe disposal of waste materials, scrap components, oils and fluids
K34 the problems associated with removing and replacing power plant components, and how they can be overcome
K35 the extent of their own authority and to whom they should report if they have a problem that they cannot resolve
Unit 385  Removing and replacing components of aircraft power transmission systems

Supporting Information

Unit guidance
Assessment requirements for this have been developed by employers for the occupational competency units and qualifications for the Aerospace and Aviation Sector. These assessment requirements are set down in the Aerospace Engineering Employer Occupational Unit Assessment Strategy.

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems.
This will allow each organisation to develop their own specific and tailored apprentice training programme whilst meeting their own requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers.
Unit 386  Removing and replacing components of aircraft cabin systems
Unit aim:

This Employer Unit of Competence (EUC) has been developed by employers in the Aerospace and Aviation Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief.

This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to carry out the removal and replacement of components of aircraft cabin equipment and furnishings, in accordance with approved procedures. It covers both fixed wing and rotary winged aircraft, and includes a range of equipment associated with seating, standard and executive (VIP) furniture, luggage racks, galley cubicles and equipment, toilet cubicles, panels, soft furnishings, safety equipment, power supplies and in-flight entertainment equipment, as applicable to the aircraft type. They will be required to select the appropriate tools and equipment to use, based on the operations to be performed and the components to be removed. The removal and replacement activities will include taking all necessary safeguards to isolate the equipment, support and lift removed and replaced parts, replacing faulty equipment at component or unit level, setting and adjusting replaced components, and leaving the equipment in a safe condition and ready for testing.

Their responsibilities will require them to comply with organisational policy and procedures for the removal and replacement 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. They 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, accurately and legibly. They 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.

Their underpinning knowledge will provide a good understanding of their work and will provide an informed approach to applying the appropriate removal and replacement techniques and procedures to aircraft cabin equipment and furnishings. They will understand the removal and replacement methods and procedures and their application, along with the systems maintenance requirements. They will know how the cabin 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 removal and replacement activities and for ensuring that the equipment is replaced to the required standard. In addition, they will have sufficient knowledge of these components to ensure that they are fit for purpose and meet the specifications, thus providing a sound basis for carrying out the replacement.

They will understand the safety precautions required when working on the aircraft cabin equipment and furnishings. They 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.

They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall objectives of the organisation, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity, motivation and commitment.

Notes To display competence in this standard, it is necessary to both remove and replace components of aircraft cabin equipment and furnishings. They must remove components; however, they may fit a replacement component where the original was previously removed by another person.
Learning outcome

Performance Requirements

Assessment criteria

The learner can:

P1 work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines
P2 demonstrate the required behaviours in line with the job role and organisational objectives
P3 follow the relevant aircraft manuals and publications to carry out the required work
P4 establish and where appropriate, mark component orientation for re-assembly
P5 ensure that any stored energy or substances are released safely and correctly
P6 carry out the removal and replacement activities, within the limits of their personal authority
P7 remove and replace the required components, using approved tools and techniques
P8 take suitable precautions to prevent damage to components and the surrounding structure
P9 complete the relevant documentation, in accordance with organisational requirements
P10 label and store (in an appropriate location) components that require repair or overhaul
P11 dispose of waste materials and scrap components, in accordance with safe working practices and approved procedures

Learning outcome

The learner will:

1 Carry out all of the following during the removal and replacement activity:

1.1 obtain clearance to work on the aircraft and observe all relevant safety procedures
1.2 obtain and use the appropriate documentation (such as job instructions, aircraft manuals, technical instructions and other relevant maintenance documentation)
1.3 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
1.4 obtain the correct tools and equipment for the activity and check that they are in a safe, tested and usable condition and within current certification/calibration date
1.5 ensure the safe isolation and where appropriate, draining of the equipment before removing it
1.6 ensure that all relevant safety devices and mechanical/physical locks are in place (where appropriate)
1.7 where appropriate, apply electrostatic discharge (ESD) protection procedures
1.8 use approved removal and replacement techniques and procedures at all times
1.9 ensure that components and surrounding structures are maintained free from spillages, damage and foreign objects
1.10 return all tools and equipment to the correct location on completion of the activities
1.11 leave the aircraft in a safe and appropriate condition, free from foreign object debris

---

**Learning outcome**

The learner will:

2 Remove components from three of the following aircraft cabin equipment and furnishing systems and replace components from three of the following aircraft cabin equipment and furnishing systems:

2.1 cabin furniture
2.2 cockpit furniture
2.3 luggage and storage systems
2.4 toilet equipment
2.5 panel systems
2.6 auxiliary equipment
2.7 galley equipment
2.8 decorative trim and covering
2.9 safety equipment
2.10 fresh water
2.11 waste/foul water

---

**Learning outcome**

The learner will:

3 During the activities identified in scope 2 above, they must cover the removal and replacement of the following:

Major cabin equipment and furnishings: Remove and replace three of the following:

3.1 seating (such as crew and passenger)
3.2 water compressors
3.3 window panels
3.4 cabin furniture (such as standard and executive (VIP))
3.5 galley equipment
3.6 entertainment equipment
3.7 flooring (such as carpets, vinyl)
3.8 food preparation equipment
3.9 water heaters
3.10 panels (such as ceiling, side, floor, soft panels)
3.11 beverage machines
3.12 fresh water storage
3.13 power support units
3.14 waste water storage
3.15 cabin dividers/removable bulkheads
3.16 freight rollers/power drives
3.17 sanitary units and fittings
3.18 equipment consoles
3.19 static line cables
3.20 storage units (such as luggage racks, overhead storage, dog boxes)
3.21 other specific components
3.22 fire extinguishers/blankets
3.23 galley storage boxes
3.24 seat covers
3.25 passenger restraint kits
3.26 oxygen bottles
3.27 hard trim
3.28 emergency escape/survival equipment
3.29 pipes and hoses
3.30 curtains/blinds
3.31 aero medical equipment (such as first aid boxes, stretchers)
3.32 specialist life saving equipment (such as defibrillator, airway kits)

Learning outcome
The learner will:

4 Carry out all of the following removal and replacement activities as applicable to the equipment:

4.1 disconnecting electrical connections (where appropriate)
4.2 replacing all `lifed' items (seals, filters, gaskets)
4.3 ensuring that any part dismantled components are secure/supported
4.4 positioning and aligning replaced components
4.5 applying and removing covering/protection to exposed components, wires, pipework or vents
4.6 making mechanical connections
4.7 making electrical connections (where appropriate)
4.8 checking components for serviceability
4.9 replacing damaged/defective components
4.10 tightening fastenings to the required torque
4.11 labelling (and storing in the correct location) components that require repair or overhaul
4.12 setting, and adjusting replaced components (such as travel, working clearance)
4.13 applying bolt locking methods (such as split pins, wire locking, lock nuts)
4.14 securing components using mechanical fasteners and threaded devices
4.15 applying bolt locking methods (such as split pins, wire locking, lock nuts)
Learning outcome
The learner will:

5  Remove and replace aircraft cabin equipment and furnishings in compliance with one of the following:

5.1 Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
5.2 extended twin operations procedures (ETOpS) (where appropriate)
5.3 Military Aviation Authority (MAA)
5.4 Aerospace Quality Management Standards (AS)
5.5 Federal Aviation Authority (FAA)
5.6 BS, ISO or BSEN standards and procedures
5.7 customer standards and requirements
5.8 organisation standards and procedures
5.9 aircraft manufacturer’s requirements

Learning outcome
The learner will:

6  Complete the relevant paperwork, to include one from the following and pass it to the appropriate people:

6.1 job cards
6.2 computer records
6.3 aircraft service/flight log
6.4 aircraft log book
6.5 permit to work/formal risk assessment

Learning outcome
Knowledge and understanding

Assessment criteria
The learner must know and understand:

K1 the specific safety practices and procedures that they need to observe when working on aircraft cabin equipment and furnishings (including any specific legislation, regulations/codes of practice for the activities, equipment or materials)
K2 the importance of maintenance on, and impact upon (extended twin operations procedures) ETOpS systems, legislation and local procedures
K3 the safety procedures that must be carried out before work is started on removing cabin equipment and furnishing components (such as displaying warning notices, isolating systems, draining and depressurising systems)
K4 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the organisation if these are not adhered to
K5 the hazards associated with removing aircraft cabin equipment and furnishings, and with the tools and equipment used (such as lifting and handling, misuse of tools) and how to minimise them and reduce any risks
K6 the requirements and importance of understanding and applying human factors as defined by the regulatory requirements and the potential impact if these are not adhered to
K7 the protective equipment that they need to use for both personal protection (PPE) and protection of the aircraft
K8 what constitutes a hazardous voltage and how to recognise victims of electric shock
K9 how to reduce the risks of a phase to earth shock (such as insulated tools, rubber matting and isolating transformers)
K10 how to extract and use information from aircraft manuals, history/maintenance reports, flight logs, physical layouts, specifications and other documents needed in the removal and replacement process
K11 how to carry out currency/issue checks on the specifications they are working with
K12 terminology used in aircraft cabin equipment and furnishings and the use of diagrams and associated symbols
K13 the techniques used to remove cabin equipment and furnishing components from the aircraft, without damage to the components or surrounding structure
K14 the importance of applying electrostatic discharge (ESD) procedures when working on sensitive equipment or devices
K15 the various mechanical fasteners that will need to be removed and replaced and their method of removal and replacement (such as threaded fasteners, special securing devices)
K16 the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking in of the connections
K17 methods of lifting, handling and supporting the components/equipment during the removal and replacement activities
K18 the importance of ensuring that the work area is free from dirt, swarf and foreign object damage, and of ensuring that any exposed components or pipe ends are correctly covered/protected
K19 the need to correctly label and store components that require repair or overhaul and to check that replacement components have the correct part/identification markings
Unit 386 Removing and replacing components of aircraft cabin systems

Supporting Information

Unit guidance
Assessment requirements for this have been developed by employers for the occupational competency units and qualifications for the Aerospace and Aviation Sector. These assessment requirements are set down in the Aerospace Engineering Employer Occupational Unit Assessment Strategy.

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems. This will allow each organisation to develop their own specific and tailored apprentice training programme whilst meeting their own requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers.
Unit 387 Removing and replacing major assemblies of aircraft airframes
Unit aim:

This Employer Unit of Competence (EUC) has been developed by employers in the Aerospace and Aviation Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief.

This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to carry out the removal and replacement of major assemblies of aircraft airframes, in accordance with approved procedures. It covers both fixed wing and rotary winged aircraft, and includes a range of assemblies such as landing gear, flying control surfaces, main and tail rotor assemblies, tail pylon, transmission systems, cabin, cargo and weapon bay doors, and other aircraft specific equipment. The removal and replacement activities will include making all necessary checks to support and chock pistons/moving parts, lifting and handling components, removing and replacing faulty equipment at component or unit level, setting and adjusting the completed system, and leaving the components in a safe condition and ready for testing.

Their responsibilities will require them to comply with organisational policy and procedures for the removal and replacement 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. They 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, accurately and legibly. They 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.

Their underpinning knowledge will provide a good understanding of their work and will provide an informed approach to applying the appropriate removal and replacement techniques and procedures to major components of the aircraft airframe. They will understand the removal and replacement methods and procedures and their application, along with the system maintenance requirements. They 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 removal and replacement activities and for ensuring that the equipment is replaced to the required standard. In addition, they will have sufficient knowledge of these components to ensure that they are fit for purpose and meet the specifications, thus providing a sound basis for carrying out the replacement.

They will understand the safety precautions required when removing and replacing major airframe components, especially those for isolating the equipment and lifting and moving the components. They 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.

They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall objectives of the organisation, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity, motivation and commitment.

Notes To display competence in this standard, it is necessary to both remove and replace major components from aircraft airframes. They must remove components; however, they may fit a replacement component where the original was previously removed by another person.
Learning outcome

Performance Requirements

Assessment criteria

The learner can:

P1 work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines
P2 demonstrate the required behaviours in line with the job role and organisational objectives
P3 follow the relevant aircraft manuals and publications to carry out the required work
P4 establish and where appropriate, mark component orientation for re-assembly
P5 ensure that any stored energy or substances are released safely and correctly
P6 carry out the removal and replacement activities, within the limits of their personal authority
P7 remove and replace the required components, using approved tools and techniques
P8 take suitable precautions to prevent damage to components and the surrounding structure
P9 complete the relevant documentation, in accordance with organisational requirements
P10 label and store (in an appropriate location) components that require repair or overhaul
P11 dispose of waste materials and scrap components in accordance with safe working practices and approved procedures

Learning outcome

The learner will:

1 Carry out all of the following during the removal and replacement activity:

1.1 obtain clearance to work on the aircraft and observe all relevant safety procedures
1.2 obtain and use the appropriate documentation (such as job instructions, aircraft manuals, technical instructions, and other relevant maintenance documentation)
1.3 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
1.4 obtain the correct tools and equipment for the activity, and check that they are in a safe, tested and usable condition and within current certification/calibration date
1.5 ensure the safe isolation and depressurisation of equipment before breaking into the system
1.6 ensure that all relevant safety devices and mechanical/physical locks are in place (where appropriate)
1.7 where appropriate, apply electrostatic discharge (ESD) protection procedures
1.8 use approved removal and replacement techniques and procedures at all times
1.9 ensure that components and surrounding structures are free from spillages, damage and foreign objects
1.10 return all tools and equipment to the correct location on completion of the activities
1.11 leave the aircraft in a safe and appropriate condition, free from foreign object debris and ready for testing

Learning outcome
The learner will:

21 Remove three of the following major airframe components and replace three of the following major airframe components:

2.1 main undercarriage
2.2 propeller
2.3 flaperons
2.4 weapon bay doors
2.5 nose undercarriage
2.6 rudders
2.7 flaps/slats
2.8 cabin doors
2.9 tail undercarriage
2.10 ailerons/tailerons
2.11 outriggers
2.12 main gear box
2.13 wing
2.14 main rotor assembly
2.15 canards/foreplanes
2.16 intermediate gear box
2.17 spoilers/speed brakes
2.18 tail rotor assembly
2.19 elevators
2.20 vertical stabiliser
2.21 tail gear box
2.22 air brakes
2.23 canopy
2.24 stabilisers
2.25 nose gear box
2.26 horizontal stabiliser/tailplane
2.27 tail pylon
2.28 cargo doors
2.29 other specific major assembly
Learning outcome

The learner will:

3 Carry out all of the following removal and replacement activities as applicable to the equipment:

3.1 isolation of the components to be removed (such as electrical, fluid power)
3.2 chocking and supporting components
3.3 disconnecting electrical connections (where applicable)
3.4 disconnecting mechanical fastening devices
3.5 disconnecting/removing hoses/pipes (where applicable)
3.6 replacing damaged/defective components
3.7 replacing 'lifed' items (seals, filters, gaskets)
3.8 releasing stored pressure (where applicable)
3.9 draining and removing fluids (where applicable)
3.10 lifting and moving components
3.11 checking components for serviceability
3.12 positioning and aligning replaced components
3.13 making mechanical connections
3.14 making electrical connections (where applicable)
3.15 tightening fastenings to the required torque
3.16 replacing fluids and bleeding the system (where applicable)
3.17 setting, and adjusting replaced components (such as travel, working clearance)
3.18 making ‘off-load’ checks before re-pressurising (where applicable)
3.19 applying and removing covering/protection to exposed components, wires, pipework or vents
3.20 re-pressurising the system (where applicable)
3.21 labelling (and storing in the correct location) components that require repair or overhaul
3.22 applying bolt locking methods (such as split pins, wire locking, lock nuts)

Learning outcome

The learner will:

41 Remove and replace aircraft major assemblies in compliance with one of the following:

4.1 Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
4.2 extended twin operations procedures (ETOpS) (where appropriate)
4.3 Military Aviation Authority (MAA)
4.4 Aerospace Quality Management Standards (AS)
4.5 Federal Aviation Authority (FAA)
4.6 BS, ISO or BSEN standards and procedures
4.7 customer standards and requirements
4.8 organisation standards and procedures
4.9 aircraft manufacturer’s requirements

---

**Learning outcome**

The learner will:

5. Complete the relevant paperwork, to include **one** from the following and pass it to the appropriate people

5.1 job cards
5.2 computer records
5.3 aircraft service/flight log
5.4 aircraft log book
5.5 permit to work/formal risk assessment

---

**Learning outcome**

Knowledge and understanding

**Assessment criteria**

The learner must know and understand:

K1 the specific safety practices and procedures that they need to observe when working on major airframe components (including any specific legislation, regulations/codes of practice for the activities, equipment or materials)

K2 the importance of maintenance on and impact upon (extended twin operations procedures) ETOpS systems, legislation and local procedures

K3 the hazards associated with removing and replacing major airframe components and with the tools and equipment used (such as the need to support the aircraft and/or its components, lifting and moving heavy and bulky components, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures) and how to minimise them and reduce any risks

K4 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the organisation if these are not adhered to

K5 the requirements and importance of understanding and applying human factors as defined by the regulatory requirements and the potential impact if these are not adhered to

K6 the protective equipment that they need to use for both personal protection (PPE) and protection of the aircraft

K7 what constitutes a hazardous voltage and how to recognise victims of electric shock

K8 how to reduce the risks of a phase to earth shock (such as insulated tools, rubber matting and isolating transformers)

K9 how to extract and use information from aircraft maintenance manuals, history/maintenance reports, flight logs and other documents needed in the removal and replacement process

K10 how to carry out currency/issue checks on the specifications they are working with

K11 terminology used for major airframe components

K12 the requirement to place the aircraft in to a specific position prior to the removal of major assemblies (such as on trestles)
K13 the basic principles of how the major airframe components and equipment functions, its operating sequence, the working purpose of individual units/components and how they interact

K14 the techniques used to remove the major airframe components from the aircraft, without damage to the components or surrounding structure (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 ensuring that exposed components are correctly covered/protected)

K15 the various mechanical fasteners to be removed and replaced, and their method of removal and replacement (such as threaded fasteners, special securing devices)

K16 the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking in of the connections

K17 the importance of applying electrostatic discharge (ESD) procedures when working on sensitive equipment or devices

K18 methods of lifting, handling and supporting the components/equipment during the removal and replacement activities

K19 methods of checking that components are fit for purpose and how to identify defects and wear characteristics

K20 the need to correctly label and store components that require repair or overhaul and to check that replacement components have the correct part/identification markings

K21 how to replace and reconnect the major airframe components onto the aircraft (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)

K22 how to make adjustments to components/assemblies to ensure that they function correctly (such as setting working clearance, setting travel)

K23 why electrical bonding is critical and why it must be both mechanically and electrically secure

K24 why securing devices need to be tightened to the correct torque, locked and labelled, and the different methods that are used

K25 how to check that tools and equipment are free from damage or defect, are in a safe, tested and usable condition, and are configured correctly for the intended purpose

K26 the need to control and account for all tools and equipment used during the removal and replacement activity

K27 how to use lifting and handling equipment in the maintenance activity

K28 the problems that can occur with the removal/replacing operations and how these can be overcome

K29 the recording documentation 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

K30 the procedure for the safe disposal of waste materials, scrap components, oils and fluids

K31 the extent of their own authority and to whom they should report if they have a problem that they cannot resolve
Unit 387  Removing and replacing major assemblies of aircraft airframes

Supporting Information

Unit guidance
Assessment requirements for this have been developed by employers for the occupational competency units and qualifications for the Aerospace and Aviation Sector. These assessment requirements are set down in the Aerospace Engineering Employer Occupational Unit Assessment Strategy.

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems.
This will allow each organisation to develop their own specific and tailored apprentice training programme whilst meeting their own requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers.
Unit 388  Modifying aircraft propulsion equipment and systems

GLH:  175

Unit aim:

This Employer Unit of Competence (EUC) has been developed by employers in the Aerospace and Aviation Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief.

This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to modify aircraft propulsion equipment and systems, in accordance with approved procedures. It covers both fixed wing and rotary winged aircraft, where the systems and components may have to be modified for a number of reasons, which could include performance being out of specification, inherent design problems, changes to customer specification, or assembly problems. They will be required to prepare the work area, ensuring that it is safe and free from hazards, to check that the correct component parts requiring modification are available, to obtain all relevant and current documentation, and to obtain the tools and equipment required for the modification, checking that they are in a safe and usable condition. In carrying out the modification operations, they will be required to follow laid-down procedures and to use specific modification leaflets or service bulletins. The modification requirements will include such items as blade set changes and component upgrades. The modification activities will also include making all necessary checks, including functional checks of systems that have been disturbed during the modification.

Their responsibilities will require them to comply with organisational policy and procedures for the modification 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. They 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.

Their underpinning knowledge will provide a good understanding of their work and will provide an informed approach to applying the appropriate modification techniques and procedures. They will understand the propulsion equipment being modified, and its application, and will know about the components, systems and fastening devices of systems disturbed during the modification operation, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

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

They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall objectives of the organisation, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity, motivation and commitment.
Learning outcome
Performance Requirements

Assessment criteria

The learner can:
P1 work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines
P2 demonstrate the required behaviours in line with the job role and organisational objectives
P3 obtain and follow the relevant modification specifications and job instructions
P4 confirm and agree what modifications are to be carried out to meet the specification
P5 prepare the propulsion equipment/system for the required modification
P6 carry out the modification using approved materials, methods and procedures
P7 complete the modification within the agreed timescale
P8 ensure that the modified propulsion equipment/system meets the specified operating conditions
P9 produce accurate and complete records of all modification work carried out
P10 deal promptly and effectively with problems within their control and report those that cannot be solved

Learning outcome
The learner will:
1 Carry out all of the following during the modification activities:

1.1. obtain and use the appropriate documentation (such as job instructions, aircraft modification drawings, technical instructions, planning and quality control documentation, aircraft standards and specifications)
1.2. 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
1.3. provide and maintain a safe working environment for the modification activities
1.4. obtain the correct tools and equipment for the activity, and check that they are in a safe, tested and usable condition and within current calibration date
1.5. obtain clearance to work on the aircraft and observe the power isolation and safety procedures
1.6. use safe and approved modification techniques and procedures at all times
1.7. ensure that correct part numbers are used, including (where appropriate) left or right handed parts
1.8. where appropriate, apply electrostatic discharge (ESD) protection procedures
1.9. return all tools and equipment to the correct location on completion of the activities
1.10. dispose of waste items in a safe and environmentally acceptable manner
1.11. leave the work area in a safe and appropriate condition, free from foreign object debris on completion of the activities

---

**Learning outcome**

The learner will:

2 Modify propulsion equipment/systems from **one** of the following type of aircraft:

- 2.1 commercial aircraft
- 2.2 light aircraft
- 2.3 military aircraft
- 2.4 helicopters

---

**Learning outcome**

The learner will:

3 Modify aircraft propulsion equipment/systems, to include **three** from:

- 3.1 pumps
- 3.2 engine nacelle
- 3.3 exhaust system
- 3.4 thermocouples
- 3.5 filters
- 3.6 control mechanisms
- 3.7 combustion chamber
- 3.8 electrical modules
- 3.9 pipework
- 3.10 compressor blades
- 3.11 heat exchangers (such as oil, fuel)
- 3.12 electrical harnesses
- 3.13 bearings
- 3.14 turbine blades
- 3.15 sensors (such as vibration, fire)
- 3.16 ancillary equipment
- 3.17 engine suspension mounts
- 3.18 engine starting equipment
- 3.19 engine monitoring equipment
- 3.20 re-heat/afterburner
- 3.21 airflow control
Learning outcome

The learner will:

4 Carry out the modification, using two of the following methods:

4.1 adjustment
4.2 modify existing components
4.3 remove and replace with new components
4.4 manufacture of new components

Learning outcome

The learner will:

5 Use five of the following methods and techniques during the modification activities:

5.1 dismantling and re-assembling
5.2 hand fitting
5.3 fabricating (such as brackets, clips or covers)
5.4 changing components
5.5 pipe fitting and assembly
5.6 securing and locking components
5.7 repositioning units
5.8 brazing or welding
5.9 electrical fitting and assembly
5.10 adjusting or tuning components
5.11 bonding
5.12 making holes in materials

Learning outcome

The learner will:

6 Use three of the following types of joining method during modifications:

6.1 adhesives/sealants
6.2 locking devices
6.3 rivets
6.4 threaded fasteners
6.5 special fasteners
Learning outcome
The learner will:

7 Modify aircraft propulsion equipment and systems in compliance with one of the following:

7.1 Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
7.2 Extended twin operations procedures (ETOpS) (where appropriate)
7.3 Military Aviation Authority (MAA)/Type Airworthiness Authority (TAA)
7.4 Aerospace Quality Management Standards (AS)
7.5 BS, ISO or BSEN standards and procedures
7.6 Federal Aviation Authority (FAA)
7.7 Customer standards and requirements
7.8 Organisation standards and procedures
7.9 Aircraft manufacturer’s requirements

Learning outcome
The learner will:

8 Complete the relevant paperwork, to include one from the following and pass it to the appropriate people:

8.1 Modification records
8.2 Log cards
8.3 Job cards
8.4 Aircraft flight log
8.5 Aircraft log book
Learning outcome

Knowledge and understanding

Assessment criteria

The learner must know and understand:

K1 the specific safety precautions to be taken while carrying out modifications on aircraft propulsion equipment/systems and components (including any specific legislation, regulations or codes of practice relating to the activities, equipment or materials)
K2 the importance of maintenance on and impact upon (extended twin operations procedures) ETOpS systems, legislation and local procedures
K3 the health and safety requirements of the work area in which they are carrying out the modification activities, and the responsibility these requirements place on them
K4 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the organisation if these are not adhered to
K5 COSHH regulations with regard to substances used in the modification process
K6 the hazards associated with modifying aircraft propulsion equipment/systems, and with the tools and equipment used, and how to minimise them and reduce any risks
K7 the requirements and importance of understanding and applying human factors as defined by the regulatory requirements and the potential impact if these are not adhered to
K8 the personal protective equipment and clothing (PPE) to be worn during the modification activities
K9 what constitutes a hazardous voltage and how to recognise victims of electric shock
K10 how to reduce the risks of a phase to earth shock (such as insulated tools, rubber matting and isolating transformers)
K11 the various types of drawing and specification that are used during the modification
K12 how to carry out currency/issue checks on the specifications they are working with
K13 the reasons why systems and components may require modification
K14 preparations to be undertaken on the propulsion equipment and system, prior to modification
K15 the various methods that could be used to modify assemblies (such as adjust, remove and replace, repair and manufacture)
K16 the techniques that can be used, where appropriate, to modify the propulsion equipment/system (such as fabrication of brackets or covers, mechanical fitting, electrical and electronic or fluid/air/pipe fitting)
K17 how to identify the components to be used; component identification systems (such as codes and component orientation indicators)
K18 the methods and procedures to be used for removing and replacing components, and the importance of adhering to these procedures
K19 the various mechanical fasteners that will be used and their method of installation (including open and blind rivets, threaded fasteners, special securing devices)
K20 the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking in of the connections
the importance of applying electrostatic discharge (ESD) procedures when working on sensitive equipment or devices

the importance of using the specified fasteners for the modification and why they must not use substitutes

the application of sealants and adhesives within the modification activities and the precautions that must be taken when working with them

the quality control procedures to be followed during the modification operations

how to conduct any necessary checks to ensure the accuracy, position, security, function and completeness of the modification

the methods and equipment used to transport, handle and lift the components into position and how to check that the equipment is within its current certification dates

how to check that the tools and equipment to be used are correctly calibrated, and are in a safe, tested and serviceable condition

the importance of ensuring that all tools are used correctly and within their permitted operating range

the importance of ensuring that all tools, equipment and components are accounted for and returned to their correct location on completion of the modification activities

the problems associated with carrying out modifications on aircraft propulsion systems and components and the importance of informing the appropriate people of non-conformances

the recording documentation 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

the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve
Unit 388  
Modifying aircraft propulsion equipment and systems

Supporting Information

*Unit guidance*

Assessment requirements for this have been developed by employers for the occupational competency units and qualifications for the Aerospace and Aviation Sector. These assessment requirements are set down in the Aerospace Engineering Employer Occupational Unit Assessment Strategy.

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems. This will allow each organisation to develop their own specific and tailored apprentice training programme whilst meeting their own requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers.
Unit aim:

This Employer Unit of Competence (EUC) has been developed by employers in the Aerospace and Aviation Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief.

This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to test operational aircraft engines, in accordance with approved procedures. It covers both fixed wing and rotary winged aircraft, and includes testing main and auxiliary engines, as appropriate to the aircraft type. They will be required to carry out all necessary preparations to the aircraft, in readiness for the tests to be carried out, and these will include ensuring that the aircraft is positioned in an appropriate test area, is secured, braked and chocked, and has an appropriate amount of fuel, and that all cockpit/cabin controls are in the appropriate positions. In carrying out the tests, they will be required to follow laid-down procedures, to ensure that the working area is clear, that appropriate guards and notices are displayed, that ground tests and engine runs are carried out in accordance with the appropriate schedule, that monitoring procedures are complied with and analysis of results is undertaken and that test documentation is completed accurately and legibly.

Their responsibilities will require them to comply with organisational policy and procedures for the tests undertaken, and to report any problems with the testing activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. They 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.

Their underpinning knowledge will provide a good understanding of their work and will provide an informed approach to undertaking the appropriate engine test procedures. They will understand the engine being tested, and the specific test schedule to be followed, and they will know what the cabin/cockpit controls do and what the various gauges and indicators mean, in adequate depth to provide a sound basis for carrying out the tests to the required specification.

They will understand the safety precautions required when carrying out the testing activities, in particular those involved with running the engines. They will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall objectives of the organisation, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity, motivation and commitment.
Learning outcome

Performance Requirements

Assessment criteria

The learner can:

P1 work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines
P2 demonstrate the required behaviours in line with the job role and organisational objectives
P3 follow the appropriate procedures for use of tools and equipment to carry out the required tests
P4 set up and carry out the tests using the correct procedures and within agreed timescales
P5 record the results of the tests in the appropriate format
P6 review and analyse the results and carry out further tests if necessary

Learning outcome

The learner will:

1 Prepare the aircraft for testing by carrying out all of the following, as applicable to the aircraft type:

1.1 obtain and use the appropriate documentation (such as technical/job instructions, ground test schedule, test procedures and quality documentations)
1.2 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
1.3 position the aircraft in an appropriate engine test bay
1.4 secure the aircraft by applying brakes, chocking and/or ground anchoring
1.5 ensure that all appropriate engine running guards and ground locks are in position and where applicable, check that ejector seat safety pins are engaged
1.6 ensure that the aircraft is electrically bonded and suitably fuelled for the tests being carried out
1.7 check that all cabin/cockpit controls are set as per the test schedule
1.8 check that electrical power is applied, either internally or by the use of external units
1.9 obtain clearance to undertake the engine test on the aircraft
1.10 ensure that safe working distance procedures are set up (with appropriate warning notices)
1.1. ensure the presence of fire fighting equipment, manual or tender, as appropriate to the situation
1.2. ensure that tests are conducted as per the test procedure for the aircraft/engine type
Learning outcome

The learner will:

2 Carry out tests on one of the following types of powerplant:

2.1 turbo prop
2.2 turbo-shaft
2.3 turbo jet
2.4 piston engines
2.5 turbo-fan
2.6 auxiliary power unit (APU)
2.7 ducted fan
2.8 ground turbine start (GTS)
2.9 pulse detonation engine (PDE)

Learning outcome

The learner will:

3 Carry out four of the following types of test:

3.1 post installation
3.2 functional test of engine driven component (such as generator, hydraulic pump, lubrication pump and air services)
3.3 fault proving/diagnosis
3.4 fluid sampling
3.5 performance testing
3.6 leak test
3.7 other specific tests
3.8 a full system test that incorporates three of the above tests

Learning outcome

The learner will:

4 Test aircraft engines using appropriate tools or test equipment, to include two of the following:

4.1 built in test equipment (BITE)
4.2 sampling devices
4.3 'special-to-type' test equipment
4.4 aircraft instruments and displays
Learning outcome
The learner will:

5   Complete the relevant paperwork, to include one from the following, indicating the results of the tests and pass it to the appropriate people:

      5.1 computer records
      5.2 job cards
      5.3 aircraft log book
      5.4 test records
      5.5 aircraft service/flight log
      5.6 permit to work/formal risk assessment

Learning outcome
The learner will:

6   Carry out tests in compliance with one of the following:

      6.1 Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
      6.2 extended twin operations procedures (ETOpS) (where appropriate)
      6.3 Military Aviation Authority (MAA)
      6.4 Aerospace Quality Management Standards (AS)
      6.5 customer standards and requirements
      6.6 Federal Aviation Authority (FAA)
      6.7 organisation standards and procedures
      6.8 BS, ISO or BSEN standards and procedures
      6.9 manufacturer's specific power plant requirements

Learning outcome
Knowledge and understanding

Assessment criteria
The learner must know and understand:

K1   the specific safety practices and procedures that they need to observe when testing aircraft engines (including any specific legislation, regulations/codes of practice required for the activities, equipment or materials used)
K2   the importance of maintenance on, and impact upon (extended twin operations procedures) ETOpS systems, legislation and local procedures
K3   the health and safety requirements of the work area where they are carrying out the activities and the responsibility these requirements place on them
K4   the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the organisation if these are not adhered to
the requirements and importance of understanding and applying human factors as defined by the regulatory requirements and the potential impact if these are not adhered to

the safety procedures that must be carried out before work is started on the aircraft (such as electrical bonding of the aircraft, checking that ground locks are in position, checking that safety pins are in critical controls (such as ejector seats, undercarriage), erecting warning signs and ensuring all personnel are clear of the test area)

the protective clothing and equipment (PPE) to be worn

the hazards associated with testing aircraft engines and how to minimise them and reduce any risks

the preparations to be carried out on the aircraft prior to starting the engine tests (such as applying brakes, chocking the aircraft, anchoring the aircraft to the ground, positioning cockpit and cabin controls in the correct positions, applying electrical power to the aircraft)

how to ensure that the aircraft is electrically bonded prior to fuelling and de-fuelling and why this is so important

how to obtain the required test schedules and specifications for the aircraft and engine type being tested, and how to check their currency and validity

how to read and interpret the specifications and from whom they can seek assistance if they have problems or issues regarding the test schedules or specifications

the correct operating procedures of the engines being tested

the methods and procedures to be used to carry out the various engine tests

the basic principle of operation of the engines under test and the function of the individual components within the system

the need to apply engine power in incremental stages and to check all readings, temperatures and pressures at each stage

why equipment control is critical and what to do if a piece of equipment is unaccounted for on completion of the activities

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

from whom to seek authorisation if they need to alter or change the test procedures

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

the procedures to be followed if the engine or system fails to meet the test specification

potential problems that can occur with the testing activities and how they can be overcome

the problems that may cause errors or discrepancies in/with the test results and how to avoid these

any required environmental controls relating to the testing

the documentation to be completed at the end of the testing activities

the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve
Unit 389  

**Carrying out tests on aircraft engines and systems**

Supporting Information

**Unit guidance**

Assessment requirements for this have been developed by employers for the occupational competency units and qualifications for the Aerospace and Aviation Sector. These assessment requirements are set down in the Aerospace Engineering Employer Occupational Unit Assessment Strategy.

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems. This will allow each organisation to develop their own specific and tailored apprentice training programme whilst meeting their own requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers.
Unit 390

Carrying out tests on aircraft control systems

GLH: 126

Unit aim:

This Employer Unit of Competence (EUC) has been developed by employers in the Aerospace and Aviation Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief.

This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to test aircraft control systems, in accordance with approved procedures. It covers both fixed wing and rotary winged aircraft, and includes control systems associated with flying controls and powerplant. They will be required to select the appropriate tools and equipment to use, based on the operations to be performed and the systems to be tested. Testing activities will include making all necessary checks and adjustments to ensure that components are correctly positioned and aligned, and making rigging and function tests, range of movement and ground running activities.

Their responsibilities will require them to comply with organisational policy and procedures for the aircraft control system testing 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. They will ensure that all tools, equipment and materials used are correctly accounted for on completion of the testing activities, and that all necessary documentation is completed, accurately and legibly. They 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.

Their underpinning knowledge will provide a good understanding of their work and will provide an informed approach to applying the appropriate aircraft control system test procedures. They will understand the aircraft control system under test, and its application, and will know about the tools and equipment used, and the testing requirements, in adequate depth to provide a sound basis for carrying out the activities, and for ensuring that the tested system performs to the required specification.

They will understand the safety precautions required when carrying out the testing activities and when using the associated tools and equipment. They will be required to demonstrate safe working practices throughout and will understand the responsibility they owe to themselves and others in the workplace.

They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall objectives of the organisation, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity, motivation and commitment.
Learning outcome

Performance Requirements

Assessment criteria

The learner can:

P1 work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines

P2 demonstrate the required behaviours in line with the job role and organisational objectives

P3 follow the appropriate procedures for use of tools and equipment to carry out the required tests

P4 set up and carry out the tests using the correct procedures and within agreed timescales

P5 record the results of the tests in the appropriate format

P6 review the results and carry out further tests if necessary

Learning outcome

The learner will:

1 Carry out all of the following during the testing of the aircraft control systems:

1.1. obtain and use the appropriate documentation (such as job instructions, aircraft control system test procedures, quality control documentation, history sheets, flight logbook, aircraft standards and specifications)

1.2. 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

1.3. provide and maintain a safe working environment for the testing activities

1.4. obtain the correct tools and equipment for the activity and check that they are in a safe, tested and usable condition and within current calibration date

1.5. obtain clearance to work on the aircraft, and observe all relevant isolation and safety procedures

1.6. ensure that safe working distance procedures are set up (where appropriate)

1.7. carry out the tests using the specified techniques and procedures

1.8. make any permitted adjustments to components and equipment to bring the system to the specification requirements

1.9. return all tools and equipment to the correct location on completion of the testing activities

1.10. leave the aircraft and work area in a safe and appropriate condition, free from foreign object debris on completion of the activities
Learning outcome

The learner will:

2. Carry out testing on three of the following aircraft control systems

2.1 air brakes
2.2 ailerons/tailerons
2.3 elevators
2.4 main rotor blades
2.5 spoilers/speed brakes
2.6 cyclic
2.7 trim tabs
2.8 horizontal stabilisers
2.9 flaps/slats
2.10 reaction control
2.11 powerplant
2.12 tail rotor blades/yaw
2.13 tail plane
2.14 wing sweep
2.15 collective
2.16 power augmentation
2.17 propeller
2.18 auxiliary transmission
2.19 auxiliary power
2.20 vectored thrust
2.21 rudders/yaw
2.22 canards
2.23 thrust reverse
2.24 nose wheel steering
2.25 flaperons
2.26 main gear steering
2.27 other specific control system

Learning outcome

The learner will:

3. Test aircraft control systems, using appropriate tools or test equipment, to include two of the following

3.1 built in test equipment (BITE)
3.2 ground support equipment
3.3 "special-to-type' test equipment
3.4 aircraft displays and gauges
Learning outcome
The learner will:

4 Carry out four of the following types of test:

4.1 functional
4.2 built in test equipment (BITE)
4.3 ground run tests
4.4 rigging check
4.5 timings
4.6 freedom and range of movement
4.7 static friction check
4.8 cable tension check
4.9 leak test
4.10 safety interlock test
4.11 'special-to-type' tests
4.12 other specific tests
4.13 a full system test that incorporates three of the above tests

Learning outcome
The learner will:

5 Carry out tests in compliance with one of the following:

5.1 Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
5.2 extended twin operations procedures (ETOpS) (where appropriate)
5.3 Military Aviation Authority (MAA)
5.4 Aerospace Quality Management Standards (AS)
5.5 customer standards and requirements
5.6 Federal Aviation Authority (FAA)
5.7 organisation standards and procedures
5.8 BS, ISO or BSEN standards and procedures
5.9 specific system requirements
5.10 Aircraft/Manufacturer's requirements

Learning outcome
The learner will:

6 Complete the relevant paperwork, to include one from the following, indicating the results of the tests and pass it to the appropriate people:
6.1 computer records
6.2 job cards
6.3 aircraft log book
6.4 test records
6.5 aircraft service/flight log
6.6 permit to work/formal risk assessment

Learning outcome
Knowledge and understanding

Assessment criteria

The learner must know and understand:

K1 the specific safety practices and procedures that they need to observe when testing aircraft control systems (including any specific legislation, regulations/codes of practice for the activities, equipment or materials)

K2 the importance of maintenance on, and impact upon (extended twin operations procedures) ETOpS systems, legislation and local procedures

K3 the health and safety requirements of the work area where they are carrying out the activities and the responsibility these requirements place on them

K4 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the organisation if these are not adhered to

K5 the safety procedures that must be carried out before work is started on the aircraft

K6 the requirements and importance of understanding and applying human factors as defined by the regulatory requirements and the potential impact if these are not adhered to

K7 the protective clothing and equipment (PPE) to be worn and where it can be obtained

K8 hazards associated with testing aircraft control systems, and with the tools, materials and equipment used (such as working on pressurised systems, traps from moving parts), and how to minimise them and reduce any risks

K9 the correct operating procedures of the control system being tested

K10 electrical bonding specifications and their importance

K11 how to obtain the required test schedules and specifications for the aircraft and controls being tested, and how to check their currency and validity

K12 how to read and interpret test schedules and specifications and from whom they can seek assistance if they have problems or issues regarding the test schedules or specifications

K13 the types of test to be carried out on the aircraft control systems (such as functional checks, rigging checks, safety interlock tests, freedom and range of movement checks, ground run tests, leak checks)

K14 the methods and procedures to be used to carry out the various tests on the control systems
K15 test equipment to be used and its selection for particular tests; calibration of test equipment (where applicable); and the currency and issue checks to be made
K16 the techniques, methods and procedures to be used during the tests
K17 why equipment control is critical and what to do if a piece of equipment is unaccounted for on completion of the testing activities
K18 the basic principle of operation of the control system under test and the function of the individual components within the system
K19 the importance of carrying out the tests in the specified sequence and of checking all readings, movements and pressures at each stage
K20 the importance of ensuring that pressure is maintained and the methods used to detect leaks and faults within the system
K21 how to record the results of each individual test and the documentation that must be used
K22 from whom to seek authorisation if they need to alter or change the test procedures
K23 how to analyse the test results and how to make valid decisions about the acceptability of the aircraft
K24 the procedures to be followed if the equipment or system fails to meet the test specification
K25 problems that can occur with the testing activities and how they can be overcome
K26 the problems that may cause errors or discrepancies in/with the test results and how to avoid these
K27 any required environmental controls relating to the testing
K28 the documentation to be completed at the end of the testing activities
K29 the extent of their own authority and to whom they should report if they have a problem that they cannot resolve
Unit 390  Carrying out tests on aircraft control systems

Supporting Information

Assessment requirements for this have been developed by employers for the occupational competency units and qualifications for the Aerospace and Aviation Sector. These assessment requirements are set down in the Aerospace Engineering Employer Occupational Unit Assessment Strategy.

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems. This will allow each organisation to develop their own specific and tailored apprentice training programme whilst meeting their own requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers.
Unit 391  

**Carrying out tests on aircraft fuel and storage systems**

**Unit aim:**
This Employer Unit of Competence (EUC) has been developed by employers in the Aerospace and Aviation Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief.

This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able test aircraft fuel and storage systems, in accordance with approved procedures. It covers both fixed wing and rotary winged aircraft, and includes fuel and storage systems such as main fuel tanks, auxiliary fuel tanks, fuel transmission systems, in-flight refuelling, and fuel drain and fuel jettison systems.

They will be required to select the appropriate tools and equipment to use, based on the operations to be performed and the systems to be tested. The testing activities will include making all necessary checks and adjustments to ensure that components and systems are leak free and are operating correctly, that fuel levels are displayed correctly and that fuel transfer systems are operating correctly. Their responsibilities will require them to comply with organisational policy and procedures for the aircraft fuel system testing 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. They will ensure that all tools, equipment and materials used are correctly accounted for on completion of the testing activities, and that all necessary documentation is completed, accurately and legibly. They 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.

Their underpinning knowledge will provide a good understanding of their work and will provide an informed approach to applying the appropriate aircraft fuel system test procedures. They will understand the aircraft fuel system under test, and its application, and will know about the tools and equipment used, and the testing requirements, in adequate depth to provide a sound basis for carrying out the activities, and for ensuring that the tested system performs to the required specification.

They will understand the safety precautions required when carrying out the testing activities and when using the associated tools and equipment. They will be required to demonstrate safe working practices throughout and will understand the responsibility they owe to themselves and others in the workplace.

They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall objectives of the organisation, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity, motivation and commitment.
Learning outcome

Performance Requirements

Assessment criteria

The learner can:

P1 work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines
P2 demonstrate the required behaviours in line with the job role and organisational objectives
P3 follow the appropriate procedures for use of tools and equipment to carry out the required tests
P4 set up and carry out the tests using the correct procedures and within agreed timescales
P5 record the results of the tests in the appropriate format
P6 review the results and carry out further tests if necessary

Learning outcome

The learner will:

1 Carry out all of the following during the testing of the aircraft fuel and storage systems:

1.1 obtain and use the appropriate documentation (such as job instructions, aircraft fuel and storage system test procedures, quality control documentation, history sheets, flight logbook, aircraft standards and specifications)
1.2 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
1.3 provide and maintain a safe working environment for the testing activities
1.4 obtain the correct tools and equipment for the activity and check that they are in a safe, tested and usable condition and within current calibration date
1.5 obtain clearance to work on the aircraft, and observe all relevant isolation and safety procedures
1.6 ensure that safe working distance procedures are set up (where appropriate)
1.7 carry out the tests using the specified techniques and procedures
1.8 make any permitted adjustments to components and equipment to bring the system to the specification requirements
1.9 return all tools and equipment to the correct location on completion of the testing activities
1.10 leave the aircraft and work area in a safe and appropriate condition, free from foreign object debris on completion of the activities
Learning outcome

The learner will:

2  Carry out testing on **three** of the following aircraft fuel and fuel storage systems/components:

2.1 full system fuel flow  
2.2 bleed valve  
2.3 fuel and de-fuel connections  
2.4 reduced system fuel flow  
2.5 fuel filters  
2.6 auxiliary fuel tank  
2.7 cross-over/change-over tanks  
2.8 fuel drain systems  
2.9 external/drop down fuel tanks  
2.10 in-flight refuelling system  
2.11 fuel jettison system  
2.12 feed valves and systems  
2.13 fuel transmission systems  
2.14 main fuel tanks  
2.15 other specific fuel/fuel storage system

Learning outcome

The learner will:

3  Test aircraft fuel and fuel storage systems/components, using appropriate tools or test equipment, to include **two** of the following:

3.1 fuel pumps  
3.2 blanking equipment  
3.3 fuel testing rigs  
3.4 flushing pipes  
3.5 sampling devices  
3.6 flushing blocks  
3.7 bleeding equipment  
3.8 pressure devices  
3.9 connecting equipment  
3.10 built-in test equipment (BITE)  
3.11 testing rigs  
3.12 "special-to-type" test equipment
Learning outcome
The learner will:

4 Carry out four of the following types of test:

4.1 return line pressure test
4.2 reduced system flush
4.3 system fuel flow functional test
4.4 pressure line pressure test
4.5 system flush
4.6 fuel sampling/taking results
4.7 leak test
4.8 ‘special-to-type’ tests
4.9 BITE test
4.10 fuel level/contents check
4.11 fuel transfer tests
4.12 other specific test
4.13 a full system test that incorporates three of the above tests

Learning outcome
The learner will:

5 Carry out tests in compliance with one of the following:

5.1 Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
5.2 extended twin operations procedures (ETOpS) (where appropriate)
5.3 Military Aviation Authority (MAA)
5.4 Aerospace Quality Management Standards (AS)
5.5 customer standards and requirements
5.6 Federal Aviation Authority (FAA)
5.7 organisation standards and procedures
5.8 BS, ISO or BSEN standards and procedures
5.9 specific system requirements
5.10 aircraft manufacturer’s requirements

Learning outcome
The learner will:

6 Complete the relevant paperwork, to include one from the following, indicating the results of the tests and pass it to the appropriate people:

6.1 computer records
6.2 job cards
6.3 aircraft log book
6.4 test records
6.5 aircraft service/flight log
6.6 permit to work/formal risk assessment

Learning outcome
Knowledge and understanding

Assessment criteria

The learner must know and understand:

K1 the specific safety practices and procedures that they need to observe when testing aircraft fuel systems (including any specific legislation, regulations/codes of practice for the activities, equipment or materials)
K2 the importance of maintenance on, and impact upon (extended twin operations procedures) ETOPS systems, legislation and local procedures
K3 the health and safety requirements of the work area where they are carrying out the activities and the responsibility these requirements place on them
K4 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the organisation if these are not adhered to
K5 the safety procedures that must be carried out before work is started on the aircraft
K6 the requirements and importance of understanding and applying human factors as defined by the regulatory requirements and the potential impact if these are not adhered to
K7 the protective clothing and equipment (PPE) to be worn and where it can be obtained
K8 hazards associated with testing aircraft fuel systems, and with the tools and equipment used, and how to minimise them and reduce any risks
K9 what constitutes a hazardous voltage and how to recognise victims of electric shock
K10 how to reduce the risks of a phase to earth shock (such as insulated tools, rubber matting and isolating transformers)
K11 the correct operating procedures of the aircraft fuel system being tested
K12 electrical bonding specifications and their importance
K13 how to obtain the required test schedules and specifications for the aircraft fuel and fuel storage system being tested, and how to check their currency and validity
K14 how to read and interpret the specifications and from whom they can seek assistance if they have problems or issues regarding the test schedules or specifications
K15 the methods and procedures to be used to carry out the various tests on the fuel systems
K16 test equipment to be used and its selection for particular tests; calibration of test equipment (where applicable); and the currency and issue checks that need to be made
K17 the techniques, methods and procedures to be used during the tests
K18 the importance of applying electrostatic discharge (ESD) procedures when working on sensitive equipment or devices
K19 why equipment control is critical and what to do if a piece of equipment is unaccounted for on completion of the activities
K20 the basic principle of operation of the aircraft fuel and fuel storage system under test and the function of the individual components within the system
K21 the need to apply tests in the specified stages and to check all readings, pressures and contents at each stage
K22 how to record the results of each individual test and the documentation that must be used
K23 from whom to seek authorisation if they need to alter or change the test procedures
K24 how to analyse the test results and how to make valid decisions about the acceptability of the aircraft
K25 the procedures to be followed if the equipment or system fails to meet the test specification
K26 problems that can occur with the testing activities and how they can be overcome
K27 the problems that may cause errors or discrepancies in/with the test results and how to avoid these
K28 any required environmental controls relating to the testing of the fuel systems
K29 the documentation to be completed at the end of the testing activities
K30 the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve
Unit 391 Carrying out tests on aircraft fuel and storage systems

Supporting Information

Unit guidance
Assessment requirements for this have been developed by employers for the occupational competency units and qualifications for the Aerospace and Aviation Sector. These assessment requirements are set down in the Aerospace Engineering Employer Occupational Unit Assessment Strategy.

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems. This will allow each organisation to develop their own specific and tailored apprentice training programme whilst meeting their own requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers.
**Unit 392**  
**Carrying out tests on aircraft hydraulic systems**

<table>
<thead>
<tr>
<th>GLH: 133</th>
</tr>
</thead>
</table>

**Unit aim:**  
This Employer Unit of Competence (EUC) has been developed by employers in the Aerospace and Aviation Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief.

This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to test aircraft hydraulic systems, in accordance with approved procedures. It covers both fixed wing and rotary winged aircraft, and includes hydraulic systems associated with landing gear, flying controls, main and tail rotor control, blade fold, rotor brakes, nose wheel steering, cargo and weapon bay doors, emergency and utility systems. They will be required to select the appropriate tools and equipment to use, based on the operations to be performed and the systems to be tested. The testing activities will include making all necessary checks and adjustments to ensure that components and systems are leak free, are operating at the correct pressure, and have the required range of movement, sequencing and timings.

Their responsibilities will require them to comply with organisational policy and procedures for the aircraft hydraulic testing 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. They will ensure that all tools, equipment and materials used are correctly accounted for on completion of the testing activities and that all necessary documentation is completed, accurately and legibly. They 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.

Their underpinning knowledge will provide a good understanding of their work and will provide an informed approach to applying the appropriate aircraft hydraulic test procedures. They will understand the aircraft hydraulic system under test, and its application, and will know about the tools and equipment used, and the testing requirements, in adequate depth to provide a sound basis for carrying out the activities, and for ensuring that the tested system performs to the required specification.

They will understand the safety precautions required when carrying out the testing activities and when using the associated tools and equipment. They will be required to demonstrate safe working practices throughout and will understand the responsibility they owe to themselves and others in the workplace.

They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall objectives of the organisation, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity, motivation and commitment.
Learning outcome

Performance Requirements

Assessment criteria

The learner can:

P1 work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines

P2 demonstrate the required behaviours in line with the job role and organisational objectives

P3 follow the appropriate procedures for use of tools and equipment to carry out the required tests

P4 set up and carry out the tests using the correct procedures and within agreed timescales

P5 record the results of the tests in the appropriate format

P6 review the results and carry out further tests if necessary

Learning outcome

The learner will:

1 Carry out all of the following during the testing of the aircraft hydraulic systems

1.1 obtain and use the appropriate documentation (such as job instructions, aircraft hydraulic system test procedures, quality control documentation, history sheets, flight logbook, aircraft standards and specifications)

1.2 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

1.3 provide and maintain a safe working environment for the testing activities

1.4 obtain the correct tools and equipment for the activity and check that they are in a safe, tested and usable condition and within current calibration date

1.5 obtain clearance to work on the aircraft and observe all relevant isolation and safety procedures

1.6 ensure that safe working distance procedures are set up (where appropriate)

1.7 carry out the tests using the specified techniques and procedures

1.8 make any permitted adjustments to components and equipment to bring the system to the specification requirements

1.9 return all tools and equipment to the correct location on completion of the testing activities

1.10 leave the aircraft and work area in a safe and appropriate condition, free from foreign object debris on completion of the activities
Learning outcome

The learner will:

2  Carry out testing on three of the following aircraft hydraulic systems

- main undercarriage
- rotor brakes
- ram air turbine
- nose undercarriage
- blade fold
- cargo doors
- tail undercarriage
- main rotor control
- weapon bay doors
- nose wheel steering
- tail rotor control
- emergency systems
- wheel braking system
- spoilers/speed brakes
- utility systems
- damping mechanisms
- outriggers
- flying controls
- main gear steering
- other specific hydraulic systems (such as hoists)

Learning outcome

The learner will:

3  Test aircraft hydraulic systems, using appropriate tools or test equipment, to include two of the following:

- aircraft hydraulic pumps
- sampling devices
- hydraulic testing rigs
- ‘special-to-type’ test equipment
- built-in test equipment (BITE)

Learning outcome

The learner will:

4  Carry out four of the following types of test:
4.1 leak test  
4.2 fluid sampling  
4.3 timings  
4.4 functional test  
4.5 pressure test  
4.6 sequencing  
4.7 'special-to-type' tests  
4.8 range of movement  
4.9 other specific tests  
4.10 BITE test  
1.11 a full system test that incorporates three of the above tests

---

Learning outcome

The learner will:

5 Carry out tests in compliance with one of the following:

5.1 Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)  
5.2 extended twin operations procedures (ETOpS) (where appropriate)  
5.3 Military Aviation Authority (MAA)  
5.4 Aerospace Quality Management Standards (AS)  
5.5 customer standards and requirements  
5.6 Federal Aviation Authority (FAA)  
5.7 organisation standards and procedures  
5.8 BS, ISO or BSEN standards and procedures  
5.9 specific system requirements  
5.10 aircraft manufacturer’s requirements

---

Learning outcome

The learner will:

6 Complete the relevant paperwork, to include one from the following, indicating the results of the tests and pass it to the appropriate people:

6.1 computer records  
6.2 job cards  
6.3 aircraft log book  
6.4 test records  
6.5 aircraft service/flight log  
6.6 permit to work/formal risk assessment
Learning outcome

Knowledge and understanding

Assessment criteria

The learner must know and understand:

K1 the specific safety practices and procedures that they need to observe when testing hydraulic systems (including any specific legislation, regulations/codes of practice for the activities, equipment or materials)
K2 the importance of maintenance on and impact upon (extended twin operations procedures) ETOpS systems, legislation and local procedures
K3 the health and safety requirements of the work area where they are carrying out the activities and the responsibility these requirements place on them
K4 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the organisation if these are not adhered to
K5 the safety procedures that must be carried out before work is started on the aircraft
K6 the requirements and importance of understanding and applying human factors as defined by the regulatory requirements and the potential impact if these are not adhered to
K7 the protective clothing and equipment (PPE) to be worn and where it can be obtained
K8 hazards associated with testing aircraft hydraulic systems, and with the tools, materials and equipment used (such as handling hydraulic fluids, working on pressurised systems, traps from moving parts) and how to minimise them and reduce any risks
K9 what constitutes a hazardous voltage and how to recognise victims of electric shock
K10 how to reduce the risks of a phase to earth shock (such as insulated tools, rubber matting and isolating transformers)
K11 the correct operating procedures of the system being tested
K12 electrical bonding specifications and their importance
K13 how to obtain the required test schedules and specifications for the aircraft and hydraulic system being tested, and how to check their currency and validity
K14 how to read and interpret the specifications and from whom they can seek assistance if they have problems or issues regarding the test schedules or specifications
K15 the methods and procedures to be used to carry out the various tests on the hydraulic systems
K16 test equipment to be used and its selection for particular tests; calibration of test equipment (where applicable); and the currency and issue checks to be made
K17 the techniques, methods and procedures to be used during the tests
K18 why equipment control is critical and what to do if a piece of equipment is unaccounted for on completion of the activities
K19 the basic principle of operation of the hydraulic system under test and the function of the individual components within the system
K20 the need to apply test pressures in incremental stages and to check all readings and pressures at each stage.
K21 how to record the results of each individual test and the documentation that must be used
K22 from whom to seek authorisation if they need to alter or change the test procedures
K23 how to analyse the test results and how to make valid decisions about the acceptability of the aircraft
K24 the procedures to be followed if the equipment or system fails to meet the test specification
K25 problems that can occur with the testing activities and how they can be overcome
K26 the problems that may cause errors or discrepancies in/with the test results and how to avoid these
K27 any required environmental controls relating to the testing
K28 the documentation to be completed at the end of the testing activities
K29 the extent of their own authority and to whom they should report if they have a problem that they cannot resolve
Unit 392  

Carrying out tests on aircraft hydraulic systems

Supporting Information

**Unit guidance**
Assessment requirements for this have been developed by employers for the occupational competency units and qualifications for the Aerospace and Aviation Sector. These assessment requirements are set down in the Aerospace Engineering Employer Occupational Unit Assessment Strategy.

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems. This will allow each organisation to develop their own specific and tailored apprentice training programme whilst meeting their own requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers.
Unit 393  
Carrying out tests on aircraft pneumatic and vacuum systems

This Employer Unit of Competence (EUC) has been developed by employers in the Aerospace and Aviation Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief.

This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to test aircraft pneumatic and vacuum systems, in accordance with approved procedures. It covers both fixed wing and rotary winged aircraft, and includes pneumatic and vacuum systems associated with emergency blow-down systems, de-icing systems, air stairs, sanitary and waste disposal systems, arrestor mechanisms, deck locks, air start systems, weapons systems, flying controls and other aircraft specific equipment, as applicable to the aircraft type. They will be required to select the appropriate tools and equipment to use, based on the operations to be performed and the systems to be tested. The testing activities will include making all necessary checks and adjustments to ensure that components and systems are leak free, are operating at the correct pressure and have the required range of movement, sequencing and timings.

Their responsibilities will require them to comply with organisational policy and procedures for the aircraft pneumatic or vacuum testing 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. They will ensure that all tools, equipment and materials used are correctly accounted for on completion of the testing activities, and that all necessary documentation is completed, accurately and legibly. They 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.

Their underpinning knowledge will provide a good understanding of their work, and will provide an informed approach to applying the appropriate test procedures for aircraft pneumatic or vacuum systems. They will understand the aircraft hydraulic or vacuum system under test, and its application, and will know about the tools and equipment used, and the testing requirements, in adequate depth to provide a sound basis for carrying out the activities, and for ensuring that the tested system performs to the required specification.

They will understand the safety precautions required when carrying out the testing activities and when using the associated tools and equipment. They will be required to demonstrate safe working practices throughout and will understand the responsibility they owe to themselves and others in the workplace.

They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall objectives of the organisation, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity, motivation and commitment.
Learning outcome

Performance Requirements

Assessment criteria

The learner can:

P1 work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines

P2 demonstrate the required behaviours in line with the job role and organisational objectives

P3 follow the appropriate procedures for use of tools and equipment to carry out the required tests

P4 set up and carry out the tests using the correct procedures and within agreed timescales

P5 record the results of the tests in the appropriate format

P6 review the results and carry out further tests if necessary

Learning outcome

The learner will:

1 Carry out all of the following during the testing of the aircraft pneumatic or vacuum systems:

1.1 obtain and use the appropriate documentation (such as job instructions, aircraft pneumatic and vacuum system test procedures, quality control documentation, history sheets, flight logbook, aircraft standards and specifications)

1.2 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

1.3 provide and maintain a safe working environment for the testing activities

1.4 obtain the correct tools and equipment for the activity and check that they are in a safe, tested and usable condition and within current calibration date

1.5 obtain clearance to work on the aircraft and observe all relevant isolation and safety procedures

1.6 ensure that safe working distance procedures are set up (where appropriate)

1.7 carry out the tests using the specified techniques and procedures

1.8 make any permitted adjustments to components and equipment to bring the system to the specification requirements

1.9 return all tools and equipment to the correct location on completion of the testing activities

1.10 leave the aircraft and work area in a safe and appropriate condition, free from foreign object debris on completion of the activities
Learning outcome

The learner will:

2. Carry out testing on three of the following aircraft pneumatic or vacuum systems

2.1 emergency blow-down systems
2.2 de-icing systems
2.3 wheel braking
2.4 air driven gyros
2.5 air stairs
2.6 damping mechanisms
2.7 spoilers
2.8 engine air start
2.9 deck locks
2.10 slats
2.11 waste disposal systems
2.12 arrester mechanisms
2.13 flaps
2.14 air intake shutters
2.15 gun cocking
2.16 flying controls
2.17 sanitary systems
2.18 weapon bay doors
2.19 nose wheel steering
2.20 waste disposal/utility systems
2.21 other specific systems

Learning outcome

The learner will:

3. Test aircraft pneumatic and vacuum systems, using appropriate tools or test equipment, to include two of the following:

3.1 air pumps
3.2 priming equipment
3.3 connecting equipment
3.4 pressure gauges/devices
3.5 blanking equipment
3.6 leak detection medium
3.7 pneumatic test rigs
3.8 bleeding equipment
3.9 built-in test equipment (BITE)
3.10 vacuum pumps
3.11 other specific test devices
Learning outcome

The learner will:

4  Carry out **four** of the following types of test:

4.1 leak test
4.2 system charging
4.3 air line vapour tests
4.4 timings
4.5 functional test
4.6 pressure test
4.7 system components tests
4.8 sequencing
4.9 'special-to-type' tests
4.10 range of movement
4.11 reduced system test
4.12 BITE test
4.13 other specific tests
4.14 system priming and bleeding
4.15 a full system test that incorporates three of the above tests

Learning outcome

The learner will:

5  Carry out tests in compliance with **one** of the following:

5.1 Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
5.2 extended twin operations procedures (ETOpS) (where appropriate)
5.3 Military Aviation Authority (MAA)
5.4 Aerospace Quality Management Standards (AS)
5.5 customer standards and requirements
5.6 Federal Aviation Authority (FAA)
5.7 organisation standards and procedures
5.8 BS, ISO or BSEN standards and procedures
5.9 specific system requirements
5.10 aircraft manufacturer’s requirements
Learning outcome

The learner will:

6 Complete the relevant paperwork, to include one from the following, indicating the results of the tests and pass it to the appropriate people:

6.1 computer records
6.2 test records
6.3 job cards
6.4 aircraft service/flight log
6.5 aircraft log book
6.6 permit to work/formal risk assessment

Learning outcome
Knowledge and understanding

Assessment criteria

The learner must know and understand:

K1 the specific safety practices and procedures that they need to observe when testing aircraft pneumatic and vacuum systems (including any specific legislation, regulations/codes of practice for the activities, equipment or materials)
K2 the importance of maintenance on, and impact upon (extended twin operations procedures) ETOPs systems, legislation and local procedures
K3 the health and safety requirements of the work area where they are carrying out the activities and the responsibility these requirements place on them
K4 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the organisation if these are not adhered to
K5 the safety procedures that must be carried out before work is started on the aircraft
K6 the requirements and importance of understanding and applying human factors as defined by the regulatory requirements and the potential impact if these are not adhered to
K7 the protective clothing and equipment (PPE) to be worn and where it can be obtained
K8 hazards associated with testing aircraft pneumatic and vacuum systems, and with the tools, materials and equipment used (such as handling working on pressurised systems, traps from moving parts) and how to minimise them and reduce any risks
K9 the correct operating procedures of the system being tested
K10 electrical bonding specifications and their importance
K11 how to obtain the required test schedules and specifications for the aircraft pneumatic or vacuum system being tested and how to check their currency and validity
K12 how to read and interpret the specifications and from whom they can seek assistance if they have problems or issues regarding the test schedules or specifications
K13 the methods and procedures to be used to carry out the various tests on the pneumatic or vacuum systems
K14 test equipment to be used and its selection for particular tests; calibration of test equipment (where applicable); and the currency and issue checks to be made
K15 the techniques, methods and procedures to be used during the tests
K16 why equipment control is critical and what to do if a piece of equipment is unaccounted for on completion of the activities
K17 the basic principle of operation of the pneumatic or vacuum system under test and the function of the individual components within the system
K18 the need to apply test pressures in incremental stages and to check all readings and pressures at each stage
K19 how to record the results of each individual test and the documentation that must be used
K20 from whom to seek authorisation if they need to alter or change the test procedures
K21 how to analyse the test results and how to make valid decisions about the acceptability of the aircraft
K22 the procedures to be followed if the equipment or system fails to meet the test specification
K23 problems that can occur with the testing activities and how they can be overcome
K24 the problems that may cause errors or discrepancies in/with the test results and how to avoid these
K25 any required environmental controls relating to the testing
K26 the documentation to be completed at the end of the testing activities
K27 the extent of their own authority and to whom they should report if they have a problem that they cannot resolve
Unit 393  Carrying out tests on aircraft pneumatic and vacuum systems

Supporting Information

**Unit guidance**
Assessment requirements for this have been developed by employers for the occupational competency units and qualifications for the Aerospace and Aviation Sector. These assessment requirements are set down in the Aerospace Engineering Employer Occupational Unit Assessment Strategy.

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems.

This will allow each organisation to develop their own specific and tailored apprentice training programme whilst meeting their own requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers.
Unit 394  

Carrying out tests on aircraft environmental systems

GLH: 133

Unit aim:

This Employer Unit of Competence (EUC) has been developed by employers in the Aerospace and Aviation Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief.

This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to test aircraft environmental equipment and systems, in accordance with approved procedures. It covers both fixed wing and rotary winged aircraft, and includes oxygen equipment, cabin pressurisation equipment, therapeutic masks, air conditioning and heating systems, anti-g, pressurisation of bulkheads, pressure domes, door, canopy and window seals and demisting equipment, avionic cooling, water and waste, ice and rain protection, as applicable to the aircraft type. They will be required to select the appropriate tools and equipment to use, based on the operations to be performed and the systems to be tested. Testing activities will include making all necessary checks and adjustments to ensure that components are correctly positioned and aligned. Functional testing, to prove system integrity and correct operation of system components, will be carried out using pumps, pressure gauges/devices, test rigs, blanking equipment, connecting equipment, air compressors, and other test devices.

Their responsibilities will require them to comply with organisational policy and procedures for the aircraft system testing 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. They will ensure that all tools, equipment and materials used are correctly accounted for on completion of the testing activities, and that all necessary documentation is completed, accurately and legibly. They 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.

Their underpinning knowledge will provide a good understanding of their work and will provide an informed approach to applying the appropriate aircraft environmental system test procedures. They will understand the aircraft environmental system under test, and its application, and will know about the tools and equipment used, and the testing requirements, in adequate depth to provide a sound basis for carrying out the activities, and for ensuring that the tested system performs to the required specification.

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

They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall objectives of the organisation, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity, motivation and commitment.
Learning outcome
Performance Requirements
Assessment criteria

The learner can:

P1 work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines
P2 demonstrate the required behaviours in line with the job role and organisational objectives
P3 follow the appropriate procedures for use of tools and equipment to carry out the required tests
P4 set up and carry out the tests using the correct procedures and within agreed timescales
P5 record the results of the tests in the appropriate format
P6 review the results and carry out further tests if necessary

Learning outcome
The learner will:

1. Carry out all of the following during the testing of the aircraft environmental systems

1.1. obtain and use the appropriate documentation (such as job instructions, aircraft environmental system test procedures, quality control documentation, history sheets, flight logbook, aircraft standards and specifications)
1.2. 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
1.3. provide and maintain a safe working environment for the testing activities
1.4. obtain the correct tools and equipment for the activity and check that they are in a safe, tested and usable condition and within current calibration date
1.5. obtain clearance to work on the aircraft and observe all relevant isolation and safety procedures
1.6. ensure that safe working distance procedures are set up (where appropriate)
1.7. carry out the tests using the specified techniques and procedures
1.8. make any permitted adjustments to components and equipment to bring the system to the specification requirements
1.9. return all tools and equipment to the correct location on completion of the testing activities
1.10. leave the aircraft and work area in a safe and appropriate condition, free from foreign object debris on completion of the activities
Learning outcome

The learner will:

2  Carry out testing on three of the following aircraft environmental systems:

2.1 oxygen systems
2.2 cabin pressurisation systems
2.3 anti-g
2.4 air conditioning systems
2.5 pressurised bulkheads
2.6 ice protection
2.7 cabin heating and cooling
2.8 pressure domes
2.9 rain protection
2.10 avionic cooling systems
2.11 demisting equipment
2.12 other specific environmental systems

Learning outcome

The learner will:

3  Test aircraft environmental systems, using appropriate tools or test equipment, to include two of the following:

3.1 built-in test equipment (BITE)
3.2 use of safety locks
3.3 ‘special-to-type’ test equipment
3.4 pumps
3.5 air compressors
3.6 pressure gauges/devices
3.7 blanking equipment
3.8 aircraft engines/GTS/APU
3.9 test rigs
3.10 connecting equipment
3.11 other specific test devices
Learning outcome

The learner will:

4 Carry out **four** of the following types of test:

4.1 built-in test equipment (BITE)
4.2 leak test
4.3 air line vapour tests
4.4 line pressure test
4.5 oxygen mask deployment
4.6 bulkhead and dome pressure tests
4.7 flow tests
4.8 air temperature tests
4.9 visual inspection
4.10 cabin pressure test
4.11 equipment functional test
4.12 oxygen concentration test
4.13 pressure balancing
4.14 ‘special-to-type’ tests
4.15 other specific tests
4.16 timings
4.17 a full system test that incorporates three of the above tests

Learning outcome

The learner will:

5 Carry out tests in compliance with **one** of the following:

5.1 Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
5.2 extended twin operations procedures (ETOpS) (where appropriate)
5.3 Military Aviation Authority (MAA)
5.4 Aerospace Quality Management Standards (AS)
5.5 customer standards and requirements
5.6 Federal Aviation Authority (FAA)
5.7 organisation standards and procedures
5.8 BS, ISO or BSEN standards and procedures
5.9 specific system requirements
5.10 aircraft manufacturer’s requirements
Learning outcome

The learner will:

6 Complete the relevant paperwork, to include one from the following, indicating the results of the tests and pass it to the appropriate people:

6.1 computer records
6.2 test records
6.3 job cards
6.4 aircraft service/flight log
6.5 aircraft log book
6.6 permit to work/formal risk assessment

Learning outcome

Knowledge and understanding

Assessment criteria

The learner must know and understand:

K1 the specific safety practices and procedures that they need to observe when testing aircraft environmental systems (including any specific legislation, regulations/codes of practice for the activities, equipment or materials)
K2 the importance of maintenance on, and impact upon (extended twin operations procedures) ETOpS systems, legislation and local procedures
K3 the health and safety requirements of the work area where they are carrying out the activities and the responsibility these requirements place on them
K4 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the organisation if these are not adhered to
K5 the safety procedures that must be carried out before work is started on the aircraft
K6 the requirements and importance of understanding and applying human factors as defined by the regulatory requirements and the potential impact if these are not adhered to
K7 the protective clothing and equipment (PPE) to be worn and where it can be obtained
K8 hazards associated with testing aircraft environmental systems, and with the tools, materials and equipment used (such as working on pressurised systems, moving parts) and how to minimise them and reduce any risks
K9 the correct operating procedures of the environmental system being tested
K10 electrical bonding specifications and their importance
K11 how to obtain the required test schedules and specifications for the aircraft and environmental system being tested, and how to check their currency and validity
K12 how to read and interpret test schedules and specifications and from whom they can seek assistance if they have problems or issues regarding the test schedules or specifications
K13  the types of test to be carried out on the aircraft environmental systems (such as functional checks, pressure tests, pressure balancing, air temperature tests, oxygen mask deployment, oxygen concentration, safety interlock tests, leak checks)

K14  the methods and procedures to be used to carry out the various tests on the environmental systems

K15  the methods and procedures to be used to carry out the various tests on the environmental systems

K16  test equipment to be used and its selection for particular tests; calibration of test equipment (where applicable); and the currency and issue checks to be made

K17  the techniques, methods and procedures to be used during the tests

K18  why equipment control is critical and what to do if a piece of equipment is unaccounted for on completion of the testing activities

K19  the basic principle of operation of the environmental system under test and the function of the individual components within the system

K20  the importance of carrying out the tests in the specified sequence, checking all readings, movements and pressures at each stage

K21  the importance of ensuring that pressure is maintained; and the methods used to detect leaks and faults within the system

K22  how to record the results of each individual test and the documentation that must be used for this

K23  from whom to seek authorisation if they need to alter or change the test procedures
Unit 394  Carrying out tests on aircraft environmental systems

Supporting Information

**Unit guidance**
Assessment requirements for this have been developed by employers for the occupational competency units and qualifications for the Aerospace and Aviation Sector. These assessment requirements are set down in the Aerospace Engineering Employer Occupational Unit Assessment Strategy.

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems. This will allow each organisation to develop their own specific and tailored apprentice training programme whilst meeting their own requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers.
Unit 395  
Carrying out tests on aircraft power transmission systems

GLH: 133

Unit aim:
This Employer Unit of Competence (EUC) has been developed by employers in the Aerospace and Aviation Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief.

This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able test aircraft power transmission systems, in accordance with approved procedures. It covers rotary winged aircraft and includes units and components associated with the aircraft power transmission systems to be tested, such as drive shafts, drive shaft supports, gearbox assemblies, couplings, mechanical fasteners, accelerometers, vibration monitoring equipment, and main and tail rotor assemblies. They will be required to select the appropriate tools and equipment to use, based on the operations to be performed and the systems to be tested. Testing activities will include making all necessary checks and adjustments to ensure that components are correctly positioned and aligned, functional testing of power transmission systems, including rotor heads, drive trains and gear boxes.

Their responsibilities will require them to comply with organisational policy and procedures for the aircraft power transmission testing 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. They will ensure that all tools, equipment and materials used are correctly accounted for on completion of the testing activities, and that all necessary documentation is completed, accurately and legibly. They 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.

Their underpinning knowledge will provide a good understanding of their work and will provide an informed approach to applying the appropriate test procedures to aircraft power transmission systems. They will understand the aircraft power transmission system under test, and its application, and will know about the tools and equipment used, and the testing requirements, in adequate depth to provide a sound basis for carrying out the activities and for ensuring that the tested system performs to the required specification.

They will understand the safety precautions required when carrying out the testing activities and when using the associated tools and equipment. They will be required to demonstrate safe working practices throughout and will understand the responsibility they owe to themselves and others in the workplace.

They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall objectives of the organisation, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity, motivation and commitment.
Learning outcome

Performance Requirements

Assessment criteria

The learner can:
P1 work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines
P2 demonstrate the required behaviours in line with the job role and organisational objectives
P3 follow the appropriate procedures for use of tools and equipment to carry out the required tests
P4 set up and carry out the tests using the correct procedures and within agreed timescales
P5 record the results of the tests in the appropriate format
P6 review the results and carry out further tests if necessary

Learning outcome

The learner will:
1 Carry out all of the following during the testing of the aircraft power transmission systems:

1.1. obtain and use the appropriate documentation (such as job instructions, aircraft power transmission system test procedures, quality control documentation, history sheets, flight logbook, aircraft standards and specifications)
1.2. 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
1.3. provide and maintain a safe working environment for the testing activities
1.4. obtain the correct tools and equipment for the activity and check that they are in a safe, tested and usable condition and within current calibration date
1.5. obtain clearance to work on the aircraft and observe all relevant isolation and safety procedures
1.6. ensure that safe working distance procedures are set up (where appropriate)
1.7. carry out the tests using the specified techniques and procedures
1.8. make any permitted adjustments to components and equipment to bring the system to the specification requirements
1.9. return all tools and equipment to the correct location on completion of the testing activities
1.10. leave the aircraft and work area in a safe and appropriate condition, free from foreign object debris on completion of the activities
Learning outcome
The learner will:

2  Carry out testing on three of the following aircraft power transmission system assemblies/components:

2.1  drive shaft/high speed shaft
2.2  swash plate
2.3  couplings
2.4  intermediate gear box
2.5  tail rotor assembly
2.6  nose/forward gear box
2.7  main gear box
2.8  tail gear box
2.9  accelerometer
2.10  flexi couplings
2.11  drive shaft support
2.12  main rotor assembly
2.13  Other specific power transmission system assembly/components

Learning outcome
The learner will:

3  Test aircraft power transmission system components, using appropriate tools or test equipment, to include three of the following:

3.1  built-in test equipment (BITE)
3.2  use of safety locks
3.3  'special-to-type' test equipment
3.4  dial test indicator
3.5  plumb and bob
3.6  optical site instruments
3.7  laser alignment
3.8  feeler/slip gauges
3.9  jigs/fixture
3.10  clinometers
3.11  'go/no-go' gauge
3.12  lay straight wires
3.13  vibration analysis equipment
Learning outcome

The learner will:

4 Carry out **four** of the following types of test:

4.1 visual inspection
4.2 built-in test equipment (BITE)
4.3 ground run tests
4.4 functional check
4.5 timings
4.6 freedom and range of movement
4.7 gear box alignment (main, tail, intermediate)
4.8 tension adjuster check
4.9 leak test
4.10 safety interlock test
4.11 vibration analysis
4.12 drive shaft/high speed shaft alignment
4.13 main rotor rigging
4.14 phasing check
4.15 tail rotor rigging
4.16 ‘special-to-type’ tests
4.17 static or dynamic balancing
4.18 other specific tests
4.19 a full system test that incorporates three of the above tests

Learning outcome

The learner will:

5 Carry out tests in compliance with **one** of the following:

5.1 Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
5.2 extended twin operations procedures (ETOpS) (where appropriate)
5.3 Military Aviation Authority (MAA)
5.4 Aerospace Quality Management Standards (AS)
5.5 customer standards and requirements
5.6 Federal Aviation Authority (FAA)
5.7 organisation standards and procedures
5.8 BS, ISO or BSEN standards and procedures
5.9 specific system requirements
5.10 aircraft manufacturer’s requirement
Learning outcome

The learner will:

6 Complete the relevant paperwork, to include one from the following, indicating the results of the tests and pass it to the appropriate people:

6.1 computer records
6.2 test records
6.3 job cards
6.4 aircraft service/flight log
6.5 aircraft log book
6.6 permit to work/formal risk assessment

Learning outcome

Knowledge and understanding

Assessment criteria

The learner must know and understand:

K1 the specific safety practices and procedures that they need to observe when testing aircraft power transmission systems (including any specific legislation, regulations/codes of practice for the activities, equipment or materials)
K2 the importance of maintenance on, and impact upon (extended twin operations procedures) ETOpS systems, legislation and local procedures
K3 the health and safety requirements of the work area where they are carrying out the activities and the responsibility these requirements place on them
K4 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the organisation if these are not adhered to
K5 the safety procedures that must be carried out before work is started on the aircraft
K6 the requirements and importance of understanding and applying human factors as defined by the regulatory requirements and the potential impact if these are not adhered to
K7 the protective clothing and equipment (PPE) to be worn and where it can be obtained
K8 hazards associated with testing aircraft power transmission systems, and with the tools, materials and equipment used (such as working with oil and grease, moving/rotating parts) and how to minimise them and reduce any risks
K9 the correct operating procedures of the power transmission system being tested
K10 electrical bonding specifications and their importance
K11 how to obtain the required test schedules and specifications for the aircraft and power transmission system being tested, and how to check their currency and validity
K12 how to read and interpret test schedules and specifications and from whom they can seek assistance if they have problems or issues regarding the test schedules or specifications
K13 the types of test to be carried out on the aircraft power transmission systems (such as alignment checks, balance checks, freedom and range of movement checks, ground run tests, leak checks, safety interlock tests)
K14 the methods and procedures to be used to carry out the various tests on the power transmission systems
K15 test equipment to be used and its selection for particular tests; calibration of test equipment (where applicable); and the currency and issue checks to be made
K16 the techniques, methods and procedures to be used during the tests
K17 why equipment control is critical and what to do if a piece of equipment is unaccounted for on completion of the testing activities
K18 the basic principle of operation of the power transmission system under test and the function of the individual components within the system
K19 the importance of carrying out the tests in the specified sequence, checking all readings, movements and pressures at each stage
K20 the importance of ensuring that pressure is maintained and the methods used to detect leaks and faults within the system
K21 how to record the results of each individual test and the documentation that must be used for this
K22 from whom to seek authorisation if they need to alter or change the test procedures
K23 how to analyse the test results and how to make valid decisions about the acceptability of the aircraft
K24 the procedures to be followed if the equipment or system fails to meet the test specification
K25 problems that can occur with the testing activities and how they can be overcome
K26 the problems that may cause errors or discrepancies in/with the test results and how to avoid these
K27 any required environmental controls relating to the testing
K28 the documentation to be completed at the end of the testing activities
K29 the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve
Unit 395  
Carrying out tests on aircraft power transmission systems

Supporting Information

Unit guidance
Assessment requirements for this have been developed by employers for the occupational competency units and qualifications for the Aerospace and Aviation Sector. These assessment requirements are set down in the Aerospace Engineering Employer Occupational Unit Assessment Strategy.

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems.
This will allow each organisation to develop their own specific and tailored apprentice training programme whilst meeting their own requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers.
Unit 396  

Carrying out checks and tests on replaced airframe major assemblies
Unit aim: This Employer Unit of Competence (EUC) has been developed by employers in the Aerospace and Aviation Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief.

This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to carry out checks and tests on major airframe assemblies, in accordance with approved procedures. It covers both fixed wing and rotary winged aircraft, and includes equipment and components associated with landing gear, flying control surfaces, main and tail rotor assemblies, tail pylon, transmission systems, cabin, cargo and weapon bay doors, and other aircraft specific equipment. They will be required to select the appropriate tools and equipment to use, based on the operations to be performed and the equipment to be checked or tested. The activities will include making all necessary checks and adjustments to ensure that components are correctly positioned and aligned, and functional testing to ensure that correct operation is achieved.

Their responsibilities will require them to comply with organisational policy and procedures for the checking and testing 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. They will ensure that all tools, equipment and materials used are correctly accounted for on completion of the testing activities, and that all necessary documentation is completed, accurately and legibly. They 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.

Their underpinning knowledge will provide a good understanding of their work and will provide an informed approach to applying the appropriate checking and testing procedures for the particular major airframe components. They will understand the components under test, and their application, and will know about the tools and equipment used, and the testing requirements, in adequate depth to provide a sound basis for carrying out the activities and for ensuring that the tested system performs to the required specification.

They will understand the safety precautions required when carrying out the checking and testing activities and when using the associated tools and equipment. They will be required to demonstrate safe working practices throughout and will understand the responsibility they owe to themselves and others in the workplace.

They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall objectives of the organisation, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity, motivation and commitment.
Learning outcome

Performance Requirements

Assessment criteria

The learner can:

P1 work safely at all times, complying with health and safety and other relevant regulations and guidelines
P2 demonstrate the required behaviours in line with the job role and organisational objectives
P3 follow the appropriate procedures for use of tools and equipment to carry out the required tests
P4 set up and carry out the tests using the correct procedures and within agreed timescales
P5 record the results of the tests in the appropriate format
P6 review the results and carry out further tests if necessary

Learning outcome

The learner will:

1 Carry out all of the following during the testing of the major components of the aircraft airframe:

1.1 obtain and use the appropriate documentation (such as job instructions, aircraft airframe component test procedures, quality control documentation, history sheets, flight logbook, aircraft standards and specifications)
1.2 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
1.3 provide and maintain a safe working environment for the testing activities
1.4 obtain the correct tools and equipment for the activity and check that they are in a safe, tested and usable condition and within current calibration date
1.5 obtain clearance to work on the aircraft and observe all relevant isolation and safety procedures
1.6 ensure that safe working distance procedures are set up (where appropriate)
1.7 carry out the tests using the specified techniques and procedures
1.8 make any permitted adjustments to components and equipment to bring the system to the specification requirements
1.9 return all tools and equipment to the correct location on completion of the testing activities
1.10 leave the aircraft and work area in a safe and appropriate condition, free from foreign object debris on completion of the activities
Learning outcome

The learner will:

2 Carry out testing on three of the following major airframe assemblies/components:

2.1 main undercarriage
2.2 rudders
2.3 flaps/slats
2.4 canopy
2.5 nose undercarriage
2.6 ailerons/tailerons
2.7 outriggers
2.8 weapon bay doors
2.9 tail undercarriage
2.10 flaperons
2.11 canards/foreplanes
2.12 main gear box
2.13 spoilers/speed brakes
2.14 main rotor assembly
2.15 elevators
2.16 intermediate gear box
2.17 propeller
2.18 tail rotor assembly
2.19 stabilisers
2.20 tail pylon
2.21 wing
2.22 fin/vertical stabiliser
2.23 cargo doors
2.24 tail gear box
2.25 air brakes
2.26 horizontal stabiliser/tailplane
2.27 cabin doors
2.28 nose gear box
2.29 other specific major assembly

Learning outcome

The learner will:

3 Check/test major components of the aircraft airframe, using appropriate tools or test equipment, to include three of:

3.1 built-in test equipment (BITE)
3.2 use of safety locks
3.3 'special-to-type' test equipment
3.4 aircraft displays and gauges
3.5 ground support equipment
3.6 optical site instruments
3.7 laser alignment
3.8 plumb and bob
3.9 measuring equipment
3.10 inclinometers
3.11 vibration analysis equipment
3.12 lay straight wires

Learning outcome
The learner will:

4 Carry out **four** of the following types of check/test:

4.1 visual inspection
4.2 built-in test equipment (BITE)
4.3 ground run tests
4.4 functional check
4.5 timings
4.6 freedom and range of movement
4.7 gear box alignment (main, tail, intermediate)
4.8 tension adjuster check
4.9 leak test
4.10 safety interlock test
4.11 vibration analysis
4.12 rigging/symmetry check
4.13 main rotor rigging
4.14 phasing check
4.15 static friction check
4.16 tail rotor rigging
4.17 'special-to-type' tests
4.18 other specific tests
4.19 static or dynamic balancing

Including the following:

4.20 a full system test that incorporates **three** of the above tests
Learning outcome

The learner will:

5 Carry out tests in compliance with **one** of the following:

5.1 Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
5.2 extended twin operations procedures (ETOpS) (where appropriate)
5.3 Military Aviation Authority (MAA)
5.4 Aerospace Quality Management Standards (AS)
5.5 customer standards and requirements
5.6 Federal Aviation Authority (FAA)
5.7 organisation standards and procedures
5.8 BS, ISO or BSEN standards and procedures
5.9 specific system requirements
5.10 aircraft manufacturer's requirements

Learning outcome

The learner will:

6 Complete the relevant paperwork, to include **one** from the following, indicating the results of the tests and pass it to the appropriate people:

6.1 computer records
6.2 test records
6.3 job cards
6.4 aircraft service/flight log
6.5 aircraft log book
6.6 permit to work/formal risk assessment

Learning outcome

Knowledge and understanding

Assessment criteria

The learner must know and understand:

K1 the specific safety practices and procedures that they need to observe when checking/testing major components of aircraft airframes (including any specific legislation, regulations/codes of practice for the activities, equipment or materials)

K2 the importance of maintenance on, and impact upon (extended twin operations procedures) ETOpS systems, legislation and local procedures

K3 the health and safety requirements of the work area where they are carrying out the activities and the responsibility these requirements place on them

K4 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the organisation if these are not adhered to
K5 the safety procedures that must be carried out before work is started on the aircraft
K6 the requirements and importance of understanding and applying human factors as defined by the regulatory requirements and the potential impact if these are not adhered to
K7 the protective clothing and equipment (PPE) to be worn and where it can be obtained
K8 hazards associated with checking/testing major components of aircraft airframes, and with the tools, materials and equipment used (such as working with oil and grease, moving/rotating parts) and how to minimise them and reduce any risks
K9 the correct operating procedures of the major airframe components being checked/tested
K10 electrical bonding specifications and their importance
K11 how to obtain the required checking/test schedules and specifications for the airframe components being checked/tested, and how to check their currency and validity
K12 how to read and interpret test schedules and specifications and from whom they can seek assistance if they have problems or issues regarding the test schedules or specifications
K13 the types of check/test to be carried out on the major airframe components (such as alignment checks, balance checks, freedom and range of movement checks, ground run tests, leak checks, safety interlock tests, symmetry and rigging checks)
K14 the methods and procedures to be used to carry out the various checks/tests on the airframe components
K15 checking and test equipment to be used, and its selection for particular tests; calibration of test equipment (where applicable); and the currency and issue checks to be made
K16 why equipment control is critical and what to do if a piece of equipment is unaccounted for on completion of the testing activities
K17 the basic principle of operation of the major airframe components under test and the function of the individual components within the assembly the importance of carrying out the tests in the specified sequence, checking all readings, movements and pressures at each stage
K18 the importance of ensuring that pressure is maintained and the methods used to detect leaks and faults within the system
K19 how to record the results of each individual test and the documentation that must be used
K20 from whom to seek authorisation if they need to alter or change the test procedures
K21 how to analyse the test results and how to make valid decisions about the acceptability of the aircraft
K22 the procedures to be followed if the equipment or system fails to meet the test specification
K23 problems that can occur with the testing activities and how they can be overcome
K24 the problems that may cause errors or discrepancies in/with the test results and how to avoid these
K25 any required environmental controls relating to the testing
K26 the documentation to be completed at the end of the testing activities
K27 the extent of their own authority and to whom they should report if they have a problem that they cannot resolve
Unit 396  Carrying out checks and tests on replaced airframe major assemblies

Supporting Information

**Unit guidance**
Assessment requirements for this have been developed by employers for the occupational competency units and qualifications for the Aerospace and Aviation Sector. These assessment requirements are set down in the Aerospace Engineering Employer Occupational Unit Assessment Strategy.

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems.

This will allow each organisation to develop their own specific and tailored apprentice training programme whilst meeting their own requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers.
Appendix 1  Relationships to other qualifications

Links to other qualifications

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

Literacy, language, numeracy and ICT skills development

This [these] qualification[s] 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:
- 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 on such things as:
- **Walled Garden**: how to register and certificate candidates on line
- **Events**: dates and information on the latest Centre events
- **Online assessment**: how to register for e-assessments.

*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.
Appendix 3  Useful contacts

**UK learners**
General qualification information

**International learners**
General qualification information

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

**Single subject qualifications**
Exam entries, Certificates, Missing or late exam materials, Incorrect exam papers, Forms request (BB, results entry), Exam date and time change

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

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

**Employer**
Employer solutions, Mapping, Accreditation, Development Skills, Consultancy

**Publications**
Logbooks, Centre documents, Forms, Free literature

E: learnersupport@cityandguilds.com
F: +44 (0)20 7294 2413
E: intcg@cityandguilds.com
F: +44 (0)20 7294 2413
E: centresaupport@cityandguilds.com
F: +44 (0)20 7294 2413
F: +44 (0)20 7294 2404 (BB forms)
E: singlesubjects@cityandguilds.com
F: +44 (0)20 7294 2413
E: intops@cityandguilds.com
F: +44 (0)20 7294 2413
E: walledgarden@cityandguilds.com
T: +44 (0)121 503 8993
E: business@cityandguilds.com
F: +44 (0)20 7294 2413

Every effort has been made to ensure that the information contained in this publication is true and correct at the time of going to press. However, City & Guilds’ products and services are subject to continuous development and improvement and the right is reserved to change products and services from time to time. City & Guilds cannot accept liability for loss or damage arising from the use of information in this publication.

If you have a complaint, or any suggestions for improvement about any of the services that we provide, email: feedbackandcomplaints@cityandguilds.com
About City & Guilds

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

City & Guilds Group

The City & Guilds Group is a leader in global skills development. Our purpose is to help people and organisations to develop their skills for personal and economic growth. Made up of City & Guilds, City & Guilds Kineo, The Oxford Group and ILM, we work with education providers, businesses and governments in over 100 countries.

Copyright

The content of this document is, unless otherwise indicated, © The City and Guilds of London Institute and may not be copied, reproduced or distributed without prior written consent. However, approved City & Guilds centres and candidates studying for City & Guilds qualifications may photocopy this document free of charge and/or include a PDF version of it on centre intranets on the following conditions:

- centre staff may copy the material only for the purpose of teaching candidates working towards a City & Guilds qualification, or for internal administration purposes
- candidates may copy the material only for their own use when working towards a City & Guilds qualification

The Standard Copying Conditions (see the City & Guilds website) also apply.

Please note: National Occupational Standards are not © The City and Guilds of London Institute. Please check the conditions upon which they may be copied with the relevant Sector Skills Council.

Published by City & Guilds, a registered charity established to promote education and training

City & Guilds

1 Giltspur Street
London EC1A 9DD
T +44 (0)844 543 0000
F +44 (0)20 7294 2413
www.cityandguilds.com