

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

Version 3.0 (September 2025)

Unit Pack

Qualification at a glance

Subject area	Mechanical
City & Guilds number	4608
Age group approved	16-19, 19+
Entry requirements	None
Assessment types	Portfolio
Approvals	Automatic approval
Registration and certification	Consult the Walled Garden/Online Catalogue for last dates

Title and level	GLH	TQT	City & Guilds qualification number	Ofqual accreditation number
Level 3 Diploma in Aviation Maintenance (Military Development Competence) - Aircraft Mechanical Maintenance	831	3329	4608-60	603/2068/0

Version	Amendment	Section
1.1 November 2018	Various typographical errors	Units
2.0 July 2019	Additions and corrections to unit 378,379,380. Footer updated.	Units Footer
2.1 November 2022	Page number corrections to contents page	Contents page
2.2 November 2024	Correction to units 381, 383, 384, 385 and 386	Major/Minor components
3.0 September 2025	Addition of unit 457	Introduction, Units

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

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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, 457.

City & Guilds unit number	Unit title	GLH
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Mandatory

301	Complying with statutory regulations and organisational safety requirements	35
302	Using and interpreting engineering data and documentation	25
304	Reinstating the work area on completion of activities	25
375	Carrying out fault diagnosis on aircraft airframe, mechanical components and systems	119
376	Undertaking scheduled maintenance of aircraft airframe and mechanical equipment	91
455	Working efficiently and effectively in engineering	25

Optional

377	Repairing airframes and structures	133
378	Modifying airframes	126
379	Removing and replacing aircraft power plant and components	175
380	Removing and replacing components of aircraft control systems	175
381	Removing and replacing components of aircraft fuel and lubrication systems	175
382	Removing and replacing components of aircraft hydraulic systems	175
383	Removing and replacing components of aircraft pneumatic and vacuum systems	175
384	Removing and replacing components of aircraft environmental systems	175
385	Removing and replacing components of aircraft power transmission systems	175
386	Removing and replacing components of aircraft cabin systems	161

Optional

387	Removing and replacing major assemblies of aircraft airframes	175
388	Modifying aircraft propulsion equipment and systems	175
389	Carrying out tests on aircraft engines and systems	133
390	Carrying out tests on aircraft control systems	126
391	Carrying out tests on aircraft fuel and storage systems	133
392	Carrying out tests on aircraft hydraulic systems	133
393	Carrying out tests on aircraft pneumatic and vacuum systems	133
394	Carrying out tests on aircraft environmental systems	133
395	Carrying out tests on aircraft power transmission systems	133
396	Carrying out checks and tests on replaced airframe major assemblies	126
457	Preparing and applying coatings/finishes to aircraft components by hand	150

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.

Carrying out fault diagnosis on aircraft airframe and 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 airframes 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 or 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 of the work they carry out. They must ensure that all tools, equipment, and materials used in the maintenance activities are removed from the work area on completion of the activities and that all necessary job/task documentation is completed, accurately and legibly.

The 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 and 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 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.

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 'lifer' consumables (such as oils, grease, belts, gaskets, seals and filters)
 - 3.4 replacing 'lifer' 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
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- 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 aircraftmanufacturers' 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 'lived' 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.

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/manufacturers' 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.

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 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 manufacturers' 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 378

Modifying 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.

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
-

Group B: **Other engine components**: Remove and replace **two** of the following:

- 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 manufacturers' 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 'lifer' 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 379

Removing and replacing aircraft power plant and components

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.

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 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/ailerons
 - 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:
-

Remove and replace **three** of the following major and **four** of the following minor components:

Major components

- 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

Minor components

- 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/desyms
- 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
 - 4.5 setting and adjusting replaced components
 - 4.6 supporting equipment to be removed
 - 4.7 making mechanical connections
 - 4.8 dismantling equipment to an appropriate level
 - 4.9 making electrical connections
 - 4.10 proof marking components to aid reassembly
 - 4.11 tightening fastenings to the required torque
 - 4.12 applying and removing covering/protection to exposed components, wires, pipework or vents
 - 4.13 using lifting operations (manual or automated)
 - 4.14 checking components for serviceability
 - 4.15 replacing all damaged/defective components
 - 4.16 replacing all 'lived' items (such as seals, bearings, gaskets)
 - 4.17 securing components using mechanical fasteners and threaded devices
 - 4.18 applying bolt locking methods (such as split pins, wire locking, lock nuts)
 - 4.19 labelling (and storing in the correct location) components that require repair or overhaul
 - 4.20 protecting and preparing removed components for transportation for overhaul
-

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 manufacturers' requirements
-

Learning outcome

The learner will:

- 6 Complete the relevant paperwork, including **one** from the following and pass it to the appropriate people
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- 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 'lived' 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 380

Removing and replacing components of aircraft control 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.

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 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:

Remove and replace **three** of the following major and **four** of the following minor fuel or lubrication components:

Major components

- 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

Minor fuel or lubrication 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 'lived' 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 manufacturers' 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.

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 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

Other system components: Remove and replace **two** of the following:

- 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 'lived' 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 manufacturers' 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.

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:

Remove and replace **two** of the following major components and **two** minor components:

Major components:

- 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

Minor components:

- 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 'lived' 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 manufacturers' 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.

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 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:

Remove and replace **two** major and **four** minor of the following:

Major environmental system components:

- 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
- Minor environmental system 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 'lived' 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 manufacturers' requirements
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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)
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- 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 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
 - 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 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
 - K9 how to carry out currency/issue checks on the specifications they are working with
 - K10 terminology used in aircraft environmental systems and the use of diagrams and associated symbols
 - K11 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)
 - K12 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
 - K13 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)
 - 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/device
 - K17 methods of lifting, handling and supporting the components/equipment during 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 recognition of contaminants and the problems they can create; the effects and likely symptoms of contamination in the system (especially hydrocarbons in oxygen systems)
 - 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 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.

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 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.

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 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

- 1.10. 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:

Remove and replace **three** major and **four** minor of the following:

Major power transmission components:

- 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

Minor power transmission components:

- 3.14 static seals/gaskets
 - 3.15 gaiters
 - 3.16 sensors
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- 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 'lived' 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
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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 manufacturers' 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
- 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 transmission systems
- K12 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
- K13 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
- 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
- K17 methods of lifting, handling and supporting the components/equipment during removal and replacement activities
- K18 the identification and application, fitting and removal of different types of bearings (such as roller, ball, thrust)
- K19 methods of checking that components are fit for purpose, and how to identify defects and wear characteristics
- K20 the use of measuring equipment (such as micrometers, Verniers, expansion indicators and other devices)
- K21 the need to replace 'lived' items (such as seals and gaskets)
- 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 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)

- K24 how to make adjustments to components/assemblies to ensure that they function correctly (such as setting working clearance, setting travel, preloading bearings)
- K25 why securing devices need to be tightened to the correct torque, locked and labelled, and different methods used
- K26 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.

GLH: 161

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:

Remove and replace **three** major and **four** minor of the following:

Major cabin equipment and furnishings:

- 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
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- 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

Minor cabin equipment and furnishings:

- 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 'lived' 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 manufacturers' 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

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 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/ailerons
- 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 'lifer' 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 manufacturers' 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

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 manufacturers' 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

- K21 the importance of applying electrostatic discharge (ESD) procedures when working on sensitive equipment or devices
- K22 the importance of using the specified fasteners for the modification and why they must not use substitutes
- K23 the application of sealants and adhesives within the modification activities and the precautions that must be taken when working with them
- K24 the quality control procedures to be followed during the modification operations
- K25 how to conduct any necessary checks to ensure the accuracy, position, security, function and completeness of the modification
- K26 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
- K27 how to check that the tools and equipment to be used are correctly calibrated, and are in a safe, tested and serviceable condition
- K28 the importance of ensuring that all tools are used correctly and within their permitted operating range
- K29 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
- K30 the problems associated with carrying out modifications on aircraft propulsion systems and components and the importance of informing the appropriate people of non-conformances
- 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 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.

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 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 manufacturers' 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
- 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 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)
- K7 the protective clothing and equipment (PPE) to be worn
- K8 the hazards associated with testing aircraft engines and how to minimise them and reduce any risks
- K9 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)
- K10 how to ensure that the aircraft is electrically bonded prior to fuelling and de-fuelling and why this is so important
- K11 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
- 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 correct operating procedures of the engines being tested
- K14 the methods and procedures to be used to carry out the various engine tests
- K15 the basic principle of operation of the engines under test and the function of the individual components within the system
- K16 the need to apply engine power in incremental stages and to check all readings, temperatures and pressures at each stage
- K17 why equipment control is critical and what to do if a piece of equipment is unaccounted for on completion of the activities
- K18 how to record the results of each individual test and the documentation that must be used
- K19 from whom to seek authorisation if they need to alter or change the test procedures
- K20 how to analyse the test results and how to make valid decisions about the acceptability of the aircraft
- K21 the procedures to be followed if the engine or system fails to meet the test specification
- K22 potential problems that can occur with the testing activities and how they can be overcome
- K23 the problems that may cause errors or discrepancies in/with the test results and how to avoid these
- K24 any required environmental controls relating to the testing
- K25 the documentation to be completed at the end of the testing activities
- K26 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.

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/ailerons
- 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
 - 3.5 use of safety locks
 - 3.6 measuring equipment.
-

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/manufacturers' 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.

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 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 manufacturers' 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.

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 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
 - 2.1 main undercarriage
 - 2.2 rotor brakes
 - 2.3 ram air turbine
 - 2.4 nose undercarriage
 - 2.5 blade fold
 - 2.6 cargo doors
 - 2.7 tail undercarriage
 - 2.8 main rotor control
 - 2.9 weapon bay doors
 - 2.10 nose wheel steering
 - 2.11 tail rotor control
 - 2.12 emergency systems
 - 2.13 wheel braking system
 - 2.14 spoilers/speed brakes
 - 2.15 utility systems
 - 2.16 damping mechanisms
 - 2.17 outriggers
 - 2.18 flying controls
 - 2.19 main gear steering
 - 2.20 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:
 - 3.1 aircraft hydraulic pumps
 - 3.2 sampling devices
 - 3.3 hydraulic testing rigs
 - 3.4 'special-to-type' test equipment
 - 3.5 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 manufacturers' 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

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 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 manufacturers' 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.

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 manufacturers' 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 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 environmental 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.

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

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 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 manufacturers' 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.

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 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/ailerons
- 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 manufacturers' 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

Unit 457 Preparing and applying coatings/finishes to aircraft components by hand.

GLH: 150

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.

This EUC identifies the training and development required in order that the apprentice can demonstrate competency in removing coatings and surface finishes, carrying out surface preparation and preparing and applying aircraft component coating/finishing materials for application, in accordance with approved procedures and practices.

They will be required to use appropriate job instructions, specifications, tools and equipment to carry out the preparations of the coating/finishing materials. They will be required to check that all coatings have been prepared in accordance with manufacturers' recommendations for the application conditions. They will be required to apply the various coatings/finishes to the components/parts of the aircraft by hand.

They will be expected to use the specified or appropriate processes and techniques to remove existing material, prepare surfaces and apply the coatings. This will include degreasing, priming, colouring or protecting/masking the various parts, as applicable to the task.

Their responsibilities will require them to comply with organisational policy and procedures for the preparation of the coating materials, the coating/finishing activities undertaken, and for the disposal of surplus product, arisings, and contaminated solvents. They will be required to report any problems with the activities, equipment or materials that they cannot personally resolve – or are outside their permitted authority – to the relevant people. They will need to ensure that all tools, equipment and materials used are correctly accounted for on completion of the activities, and they must complete all necessary job/task documentation accurately and legibly.

They will be expected to work either with a minimum level of supervision or as a member of a team, and to take personal responsibility for their own actions and for the quality and accuracy of the work that they carry out. Where team working is involved, they must demonstrate a significant personal contribution during the team activities to satisfy the requirements of this standard, and they must demonstrate competence in all the areas required by the standard.

Their underpinning knowledge will provide a good understanding of their work and will provide an informed approach to the preparation and application of aircraft coating/finishing materials. They will understand the properties of the aircraft coatings and the applications for which they are intended. They will know about expiry dates, induction times, viscosity and temperature conditioning requirements in sufficient depth to provide a sound basis for carrying out the activities, and for ensuring that the coatings are prepared and applied to the required standards.

They will understand the safety precautions required when carrying out the coating/finishing 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 occupational behaviours required in the workplace to meet the job profile and overall company objectives, including being able to demonstrate: personal responsibility and resilience; working effectively in teams; effective communication and interpersonal skills; focus on quality and problem solving; and continuous development.

Learning outcome

Performance Requirements

Assessment criteria

The learner can:

- P1 work safely at all times, complying with health and safety and environmental legislation, regulations and other relevant guidelines
- P2 obtain the required materials and check them for quantity, quality, and 'in date'
- P3 determine how the materials need to be prepared
- P4 carry out the preparations using suitable equipment
- P5 ensure the material surfaces to be coated/finished are suitably prepared including old material removal, cleanliness and any masking for the finishing operations to be carried out
- P6 check that the finishing equipment and coating solutions are set up and maintained at satisfactory operating conditions and levels
- P7 carry out the coating/finishing process in accordance with operating procedures and the component specification
- P8 ensure that the coated/finished workpiece achieves the required characteristics and meets the finishing specification
- P9 deal promptly and effectively with problems within your control and report those that cannot be solved
- P10 dispose of waste and excess materials in line with agreed organisational policy and procedures
- P11 complete relevant paperwork and submit to appropriate people

Learning outcome

The learner will:

- 1 Carry out **all** of the following during the coating/finishing activities:
 - 1.1 ensure that the correct documentation for the coating operations (such as coating manufacturer's specifications, job instructions, aircraft standards) is followed

- 1.2 adhere to procedures or systems in place for risk assessment, COSHH, Chemical Hazard Information and Packaging for Supply (CHIPs) data, personal protective equipment and other relevant safety regulations
 - 1.3 obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition
 - 1.4 apply appropriate and safe preparation, ensuring underlying layers/structure remain free from damage where applicable
 - 1.5 apply a suitable level of protection and masking to the surrounding area of the repair
 - 1.6 apply appropriate coating/finishing techniques and procedures at all times
 - 1.7 dispose of waste items and materials in a safe and environmentally acceptable manner, in line with company procedures
 - 1.8 clean and return all tools and equipment to the correct location on completion of the activities
 - 1.9 leave the work area in a safe condition and free from any spillages, excess materials and foreign object debris
-

Learning outcome

The learner will:

- 2 Obtain an estimate of the volume of coating/finishing material to be prepared for the complete coating of bare substrate or for the overcoating of previously coated substrate, to include **two** of the following:
 - 2.1 aircraft detail components
 - 2.2 major assemblies
 - 2.3 sub-assemblies
 - 2.4 complete aircraft
 - 2.5 other specific components
-

Learning outcome

The learner will:

- 3 Prepare aircraft coatings for application, by carrying out **all** the following activities:
 - 3.1 obtain the correct type and quantities of materials
 - 3.2 ensure that the correct mixing ratios are adhered to (where applicable)
 - 3.3 mix correct quantities of primer (where applicable)
 - 3.4 mix correct quantities of colour (where applicable)
 - 3.5 check the prepared coating material is of the correct viscosity
 - 3.6 ensure the prepared material has been in the container for the induction period (where applicable)
 - 3.7 ensure the prepared material is at the recommended temperature and humidity for application
-

Learning outcome

The learner will:

- 4 Prepare and apply **two** of the following types for application:
 - 4.1 one-part finishes
 - 4.2 two-part finishes
 - 4.3 solvent based
 - 4.4 adhesive based
 - 4.5 water based

Learning outcome

The learner will:

- 5 Prepare and apply **three** of the following types of aircraft coatings/finishes for application:
 - 5.1 surface sealers
 - 5.2 top-coats
 - 5.3 UV coatings
 - 5.4 temporary protective coatings
 - 5.5 primers
 - 5.6 flexible coatings
 - 5.7 heatproof coatings
 - 5.8 specialty coatings

Learning outcome

The learner will:

- 6 Apply coatings/finishes to **two** of the following:
 - 6.1 aircraft detail components
 - 6.2 major assemblies
 - 6.3 sub-assemblies
 - 6.4 complete aircraft
 - 6.5 other specific components

Learning outcome

The learner will:

- 7 Apply coatings/finishes to parent materials, to include **two** of the following:
 - 7.1 bare metal (ferrous)
 - 7.2 bare metal (non-ferrous)
 - 7.3 composite
 - 7.4 previously painted surfaces

Learning outcome

The learner will:

- 8 Apply coating/finishing materials using **two** of the following:
 - 8.1 brushes
 - 8.2 rollers
 - 8.3 pads
 - 8.4 dipping
 - 8.5 other specific method

Learning outcome

The learner will:

- 9 Apply coatings/finishes, using appropriate techniques to achieve **three** of the following:
 - 9.1 correct thickness
 - 9.2 colour match
 - 9.3 uniform and complete coverage of the surface to be coated
 - 9.4 gloss levels
 - 9.5 smooth surface free from runs or drips
 - 9.6 repair Integration/Integration of the repair

Learning outcome

The learner will:

- 10 Reinststate the work area on completion of the preparation activities, to include carrying out **all** of the following:
 - 10.1 dispose of excess or unused coatings/finishes, in accordance with approved policy and procedures

- 10.2 clean containers to be reused, and dispose of arisings and used solvents, in accordance with approved policy and procedures
 - 10.3 dispose of non-reusable containers, equipment, materials in accordance with approved policy and procedures
 - 10.4 clean and return all tools and excess materials
 - 10.5 contribute to the completion of all required records (including consumption of paint and solvents)
-

Learning outcome

The learner will:

- 11 Prepare and apply coatings/finishes which comply with **one** of the following standards:
 - 11.1 Civil Aviation Authority (CAA)
 - 11.2 customer standards and requirements
 - 11.3 Ministry of Defence (MoD)
 - 11.4 organisation standards and procedures
 - 11.5 Federal Aviation Authority (FAA)
 - 11.6 coating finishes manufacturer's recommendations
-

Learning outcome

The learner will:

- 12 Complete the relevant paperwork, to include **one** from the following, and pass it to the appropriate people:
 - 12.1 build/production records
 - 12.2 quality control documentation
 - 12.3 aircraft log
 - 12.4 other specific records
-

Learning outcome

Knowledge and understanding

Assessment criteria

The learner must know and understand:

- K1 the safe working practices and procedures to be observed when working with aircraft component coating/finishing materials and equipment (including items such as general workshop and site safety, protecting other workers from the effects of the work, cordoning and atmospheric controls)
-

- K2 the importance of applying the appropriate occupational behaviours in the workplace and the implications for both the apprentice and the business if these are not adhered to, how to present themselves in the workplace suitably dressed for the activities to be undertaken (such as being neat, clean and dressed in clothes appropriate to the area of activity)
- K3 the hazards associated with carrying out coating/finishing activities on aircraft components, and with the materials and equipment used (including hazards such as the storage, preparation and disposal of aircraft component coating products and solvents, inhalation of fumes, fire and explosion, contact with solvents and other chemicals), and how these hazards can be minimised
- K4 the information found in manufacturers' data sheets, COSHH and in Chemical Hazard Information and Packaging for Supply (CHIPS) data sheets
- K5 the personal protective equipment (PPE) and respiratory protective equipment (RPE) to be worn during the coating/finishing activity, and its care and correct use
- K6 the importance of emergency procedures and safe systems of work (including permits to work, required air quantities (RAQs) and local exhaust ventilation (LEV)) to maintain safe conditions, the provision of adequate and safe lighting and avoidance of sources of ignition
- K7 the environmental impact of the operations being carried out, and with the materials that will be used, and the minimisation of this impact
- K8 the characteristics and applications of various aircraft component coating/finishing products (including items such as sealers, primers, topcoats, and specialised protective coatings)
- K9 the manual material removal techniques including the use of sandpaper and scrapers, to ensure the underlying structure is not damaged
- K10 the need to ensure that the substrates have been prepared correctly for the coatings/finishes to be applied
- K11 product expiry, stock control and the use of batch numbers
- K12 the storage requirements (including environmental controls and containment arrangements) for aircraft component coating/finishing products and solvents (including items such as thinners, cleaners)
- K13 the procedures for transportation, storage and safe use of the coating/finishing materials and solvents
- K14 how to obtain an estimate of the product volume to be prepared for a defined usage (including estimation of areas to be covered, practical paint consumption and loss factors)
- K15 the use of appropriate containers for defined products and usages
- K16 the preparation requirements (including expiry dates, induction times and temperature conditioning requirements)
- K17 the requirements and the process of ensuring adequate protection, including masking the surrounding areas of the repair.
- K18 the importance of mixing ratios (such as use of whole packs) for 'multi-part' products
- K19 the importance of maintaining appropriate environmental conditions for the application and curing of the aircraft coating products
- K20 the time intervals that are required between coats, and why these must be adhered to

- K21 the application equipment to be used and its selection to suit the materials and the coating/finish required (such as brushes, rollers, suitable containers)
- K22 the uses of appropriate containers, hand tools and electro-mechanical/pneumatic equipment
- K23 the equipment care and control procedures (including fume extraction systems and RPE)
- K24 the importance of repair blending/integration techniques
- K25 cleaning and maintenance procedures for aircraft component coating/finishing equipment
- K26 how to recognise defects including the need to reject wrongly mixed coatings and items such as bubbles, foreign object damage, contamination, and surface defects
- K27 problems that can occur with the coating/finishing operations, and how these can be overcome
- K28 the disposal procedures for redundant materials and non-returnable containers
- K29 the procedures to contain and to clear away spillages, and the appropriate disposal of the arisings
- K30 the procedure for the safe disposal and correct separation of waste materials
- K31 the quality control requirements and techniques to be followed
- K32 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
- K33 the importance of the maintenance records and the recording documentation to be completed for the coating/finishing activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation.
- K34 the extent of their own authority and to whom they should report if they have a problem that they cannot resolve.

Unit 457

Preparing and applying coatings/finishes to aircraft components by hand.

Supporting Information

Unit guidance

Assessment Requirements

Assessment requirements have been developed by employers for the occupational competency units and qualifications for Aerospace and Aviation Sector. 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.

Useful contacts

Please visit the [contact us](#) section of the City & Guilds website.

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We partner with our customers to deliver work-based learning programmes that build competency to support better prospects for people, organisations and wider society. We create flexible learning pathways that support lifelong employability because we believe that people deserve the opportunity to (re)train and (re)learn again and again – gaining new skills at every stage of life, regardless of where they start.

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