

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

Version 1 (August 2018)

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 Engine Overhaul	411	1540	4608-60	603/2068/0

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

Contents

Qualification at a glance	2
Contents	3
1 Introduction	4
2 Units	5
Unit 397 Dressing Aircraft Engines	6
Unit 398 Carrying out test bed runs on aircraft engines (uninstalled)	13
Unit 399 Overhauling Aircraft Gas Turbine Engines by Module Replacement	20
Unit 400 Overhauling Aircraft Gas Turbine Engine Compressor Assemblies	28
Unit 401 Overhauling Aircraft Gas Turbine Engine Combustion Assemblies	36
Unit 402 Overhauling Aircraft Gas Turbine Engine Turbine Assemblies	44
Unit 403 Overhauling Aircraft Gas Turbine Engine Gearbox Assemblies	52
Unit 404 Overhauling Aircraft Piston Engines	60
Unit 405 Dismantling Aircraft Gas Turbine Engines to Module/Unit Level	68
Unit 406 Rebuilding Aircraft Gas Turbine Engine Assemblies after Overhaul	75
Appendix 1 Useful contacts	83

1 Introduction

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

Structure

Learners must complete 301, 302, 304, 455 plus two from 397- 406.

City & Guilds unit number	Unit title	GLH
---------------------------	------------	-----

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
455	Working efficiently and effectively in engineering	25

Optional

397	Dressing Aircraft Engines	133
398	Carrying Out Test Bed Runs on Aircraft Engines (Uninstalled)	357
399	Overhauling Aircraft Gas Turbine Engines by Module Replacement	357
400	Overhauling Aircraft Gas Turbine Engine Compressor Assemblies	322
401	Overhauling Aircraft Gas Turbine Engine Combustion Assemblies	357
402	Overhauling Aircraft Gas Turbine Engine Turbine Assemblies	315
403	Overhauling Aircraft Gas Turbine Engine Gearbox Assemblies	315
404	Overhauling Aircraft Piston Engines	315
405	Dismantling Aircraft Gas Turbine Engines to Module/Unit Level	168
406	Rebuilding Aircraft Gas Turbine Engines Assemblies after Overhaul	357

2 Units

Structure of the units

These units each have the following:

- City & Guilds reference number
- Level
- 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.

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 carry out assembly operations to dress aircraft engines, in accordance with approved procedures. It covers both fixed wing and rotary winged aircraft engines. They will be required to obtain all the required tools and equipment for the assembly/dressing operations and to check that they are in a safe and usable condition. In carrying out the assembly operations, they will be required to follow laid-down procedures and specific assembly techniques, in order to assemble the various components onto the engine.

The assembly activities will also include making all necessary checks and adjustments to ensure that components are correctly orientated, positioned and aligned, that moving parts have the correct working clearances, that all fasteners are tightened to the correct torque and that the assembled parts function as per the specification.

Their responsibilities will require them to comply with organisational policy and procedures for the assembly activities undertaken and to report any problems with the assembly activities, materials or equipment that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. They will be expected to ensure that all tools, equipment and materials used in the installation are correctly accounted for on completion of the activities and to complete all necessary job/task documentation accurately and legibly. 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 assembly/dressing techniques and procedures. They will understand the aircraft engine being dressed and its application and will know about the equipment, relevant components and fastening devices, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

They will understand the safety precautions required when carrying out the assembly activities. 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 instructions, assembly drawings and any other specifications.
- P4 ensure that the specified components are available and that they are in a usable condition.
- P5 use the appropriate methods and techniques to assemble the components in their correct positions.
- P6 secure the components using the specified connectors and securing devices.
- P7 check the completed assembly to ensure that all operations have been completed and the finished assembly meets the required specification.
- P8 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 assembly activities:
 - 1.1 obtain and use the appropriate documentation (such as job instructions, aircraft engine/module assembly drawings, planning and quality control documentation)
 - 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 safe access and working arrangements for the assembly area
 - 1.4 obtain the correct tools and equipment for the activity and check that they are in a safe and usable condition and within current calibration date
 - 1.5 ensure that all the required components are available and have the correct part numbers
 - 1.6 follow safe practice/approved assembly/fitting techniques and procedures at all times
 - 1.7 ensure that components and surrounding structures are maintained free from damage and foreign objects
 - 1.8 return all tools and equipment to the correct location on completion of the assembly activities
 - 1.9 ensure that all work carried out is correctly documented and recorded
 - 1.10 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 use **five** of the following assembly methods and techniques:
 - 2.1 assembly of components by pressure
 - 2.2 torque setting of fasteners
 - 2.3 assembly of components by expansion or contraction
 - 2.4 applying sealant/adhesives
 - 2.5 aligning components
 - 2.6 drilling and riveting
 - 2.7 setting working clearances
 - 2.8 electrical bonding of components
 - 2.9 securing components using mechanical fasteners and threaded devices
 - 2.10 making connections to electrical components and harnesses
 - 2.11 applying bolt locking methods (split pins, wire locking, lock nuts, stiff nuts).

Learning outcome

The learner will:

- 3 carry out the dressing of the aircraft engine, by fitting **all** of the following:
 - 3.1 fuel pipes
 - 3.2 valves (solenoid, bleed, pressure)
 - 3.3 thermocouples
 - 3.4 manifolds
 - 3.5 coolers (air, oil, fuel)
 - 3.6 electrical modules (if applicable)
 - 3.7 oil pipes
 - 3.8 heat exchangers (oil, fuel)
 - 3.9 electrical harnesses (if applicable)
 - 3.10 pumps
 - 3.11 sensors (vibration, fire)
 - 3.12 filters
 - 3.13 brackets
 - 3.14 air pipes
 - 3.15 engine suspension mounts.

Learning outcome

The learner will:

- 4 carry out **all** of the required checks for accuracy, using the correct inspection testing equipment, to include:
 - 4.1 positional accuracy
 - 4.2 orientation
 - 4.3 freedom of movement
 - 4.4 alignment
 - 4.5 operating/working clearance
 - 4.6 completeness
 - 4.7 torque loadings
 - 4.8 freedom from damage or foreign objects.

Learning outcome

The learner will:

- 5 dress aircraft engine assemblies in compliance with **one** of the following standards:
 - 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 engine manufacturer's requirements.

Learning outcome

The learner will:

- 6 complete the relevant paperwork, to include **one** from the following and pass it to the appropriate people:
 - 6.1 build records
 - 6.2 job cards
 - 6.3 log cards
 - 6.4 aircraft flight log
 - 6.5 other specific recording method.

Learning outcome

Knowledge and understanding

Assessment criteria

The apprentice must know and understand:

- K1 the specific safety precautions to be taken whilst carrying out the dressing of aircraft engines (such as any specific legislation, regulations or codes of practice relating to the activities, equipment or materials).
- K2 the health and safety requirements of the work area in which they are carrying out the engine dressing activities and the responsibility they place on them.
- K3 the hazards associated with the dressing of aircraft engines 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 COSHH regulations with regard to the substances used in the engine dressing process.
- 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 engine dressing activities.
- K8 the various types of drawing and specification that are used during the engine dressing and assembly activities.
- K9 how to identify the components to be used; component identification systems (such as codes and component orientation indicators).
- K10 preparations and inspections to be undertaken on the components, prior to fitting them into the assembly.
- K11 the assembly methods and procedures to be used and the importance of adhering to the procedures.
- K12 how the components are to be aligned and positioned prior to securing, and the tools and equipment that are used (such as jigs and fixtures).
- 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 assembly and why they must not use substitutes.
- K15 how to complete basic fitting practices, meeting regulatory and organisational requirements (such as torque tightening, wire locking, fitting wire thread inserts, fitting O-ring seals, fitting lock nuts, blue bedding, seals, tab washers, cup washers and swage nuts).
- K16 dealing with components or fastening devices incorrectly assembled, damaged or having other faults.
- K17 the application of sealants and adhesives within the assembly activities and the precautions that must be taken when working with them.
- K18 the quality control procedures to be followed during the assembly operations.

- K19 how to conduct any necessary checks to ensure the accuracy and quality of the assemblies produced.
- K20 how to detect assembly defects and what to do to rectify them (such as ineffective fasteners, foreign object damage).
- K21 how to move large components and assemblies, the methods and equipment used to transport, handle and lift the components into position and how to check that the equipment is within its current certification dates.
- K22 how to check that the tools and equipment to be used are correctly calibrated and are in a safe, tested and serviceable condition.
- K23 the importance of ensuring that all tools are used correctly and within their permitted operating range.
- K24 the importance of ensuring that the completed assembly is free from dirt, swarf and foreign objects.
- K25 the importance of ensuring that all tools, equipment and components are accounted for and returned to their correct location on completion of the assembly activities.
- K26 the problems that can occur with the engine dressing activities and how they can be avoided.
- K27 the importance of informing appropriate people of non-conformances.
- K28 the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 397 Dressing Aircraft Engines

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

357

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 test bed runs on aircraft engines, as appropriate to the engine type, in accordance with approved procedures. The engines to be tested will include turbo prop, turbo jet, turbo fan, ducted fan, turbo shaft, piston engines, auxiliary power units (APU), and ground turbine start units (GTS). They will be required to carry out all necessary preparations to the engine, in readiness for the tests to be carried out and these will include ensuring that the engine is correctly mounted to the test bed/pylon, that all ancillary equipment is fitted to the engine, appropriate blanking plates are fitted, test instrumentation is correctly connected and that all necessary electrical checks are carried out. In carrying out the tests, they will be required to follow laid-down procedures to ensure that the working area is clear, appropriate guards and notices are displayed, engine runs/tests are carried out in accordance with the appropriate schedule, monitoring procedures are complied with, analysis of results is made, and that test documentation is completed, accurately and legibly.

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 engine test procedures. They will understand the engine being tested, the specific test schedule to be followed and will know what the various instruments and readings mean, in adequate depth to provide a sound basis for carrying out the tests to the required specification. They will understand the safety precautions required when carrying out the testing activities, in particular those involved with fuelling and 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 engine for testing by carrying out **all** of the following, as applicable to the engine type:
 - 1.1 obtain and use the correct issue of engine test schedule, test procedures and quality documentation
 - 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 attach and secure the engine to the test pylon
 - 1.4 fit all the required test instrumentation to the engine
 - 1.5 fit all required ancillary equipment (to include starter motors, control valves, slave oil filters, magnetic chip detectors and strainers)
 - 1.6 fit appropriate blanks (to include bleed off-take, anti-icing, generator and hydraulic)
 - 1.7 make all required connections to the engine (to include fuel connections, electrical and instrumentation)
 - 1.8 carry out all necessary electrical checks and confirm that the engine is ready for testing
 - 1.9 ensure that all personal are clear of the test facility and that safe working distance procedures are maintained.

Learning outcome

The learner will:

- 2 carry out tests to appropriate schedules, on **one** of the following types of engine:
 - 2.1 turbo prop
 - 2.2 ducted fan
 - 2.3 auxiliary power unit (APU)
 - 2.4 turbo jet
 - 2.5 turbo-shaft
 - 2.6 ground turbine start (GTS)
 - 2.7 turbo-fan
 - 2.8 piston engines.

Learning outcome

The learner will:

- 3 carry out tests to appropriate schedules on **one** of the following categories of engines:
 - 3.1 production engines
 - 3.2 repaired/overhauled engines
 - 3.3 development engines.

Learning outcome

The learner will:

- 4 undertake engine tests, as listed in the appropriate engine test schedule, to include **all** of the following:
 - 4.1 visually checking that the engine is free from any damage or obvious defects
 - 4.2 filling the engine with oil
 - 4.3 checking that engine igniter mechanisms operate correctly
 - 4.4 carrying out ground idle checks
 - 4.5 checking that fuel flow is operating correctly
 - 4.6 carrying out running and handling checks
 - 4.7 carrying out performance curves
 - 4.8 carrying out vibration surveys
 - 4.9 checking that engine pressure ratios are within specification
 - 4.10 checking that engine temperature is within specification
 - 4.11 checking that throttle/high pressure fuel flow operates smoothly
 - 4.12 checking that the bleed air system functions correctly
 - 4.13 ensuring that maximum thrust/power is achieved
 - 4.14 checking that fire detection and protection equipment is functioning.

Learning outcome

The learner will:

- 5 deal with **two** of the following complexities during the engine tests:
 - 5.1 engine runs with no faults
 - 5.2 engine runs with faults
 - 5.3 engine with intermittent faults.

Learning outcome

The learner will:

- 6 de-rig the engine on completion of the testing procedures, to include carrying out **all** of the following:
 - 6.1 removing and checking magnetic chip detectors for contamination
 - 6.2 removing and checking slave filters for contamination
 - 6.3 installing the engine's own magnetic chip detectors and filters
 - 6.4 draining all oil and fuel from the engine
 - 6.5 removing all blanks and test instrumentation
 - 6.6 removing the engine from the pylon, safely and correctly
 - 6.7 passing the engine to dispatch (where applicable).

Learning outcome

The learner will:

- 7 review, record and analyse the results of the test run, using **two** of the following:
 - 7.1 engine test schedule
 - 7.2 data sheets
 - 7.3 calibration records
 - 7.4 log cards/history sheet
 - 7.5 fault records
 - 7.6 maintenance manuals and records
 - 7.7 company-specific documentation.

Learning outcome

The learner will:

- 8 carry out tests in compliance with **one** of the following:
 - 8.1 Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
 - 8.2 Military Aviation Authority (MAA)
 - 8.3 Aerospace Quality Management Standards (AS)

- 8.4 Federal Aviation Authority (FAA)
 - 8.5 Joint Airworthiness Authority (JAA)
 - 8.6 extended twin operations procedures (ETOpS)
 - 8.7 BS, ISO or BSEN standards and procedures
 - 8.8 customer standards and requirements
 - 8.9 organisation standards and procedures
 - 8.10 power plant manufacturer's specific requirements.
-

Learning outcome

Knowledge and understanding

Assessment criteria

The apprentice 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 in which 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 tests are started on the engine (such as the lock guard system is functioning, test cell is empty of people, bed doors are closed, all personnel are clear of the test area).
- 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 during the testing activities.
- 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 engine prior to starting the engine tests (such as attaching to the test pylon, fitting test instrumentation, fitting ancillary equipment, fitting blanking plates, filling the engine with oil, making fuel connections, attaching electrical power and making final electrical checks of all systems).
- K10 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.
- K11 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.
- K12 the correct operating procedures for the engines being tested.
- K13 the basic principle of operation of the engines under test and the function of the individual units within the system.
- K14 the methods and procedures to be used to carry out the various engine tests.

- K15 the need to apply engine power in incremental stages and to check all readings, temperatures and pressures at each stage.
- K16 how to record the results of each individual test and the documentation that must be used for this.
- K17 from whom to seek authorisation if they need to alter or change the test procedures.
- K18 how to analyse the test results and how to make valid decisions about the acceptability of the engine.
- K19 the procedures to be followed if the engine or system fails to meet the test specification.
- K20 potential problems that can occur with the testing activities and how they can be overcome.
- K21 problems that may cause errors or discrepancies in/with the test results and how to avoid them.
- K22 any required environmental controls relating to the testing.
- K23 why equipment control is critical and what to do if a piece of equipment is unaccounted for on completion of the activities.
- K24 the documentation to be completed at the end of the testing activities.
- K25 the extent of their own authority and to whom they should report if they have a problem that they cannot resolve.

Unit 398

Carrying out test bed runs on aircraft engines (uninstalled)

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

357

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 a complete overhaul of aircraft gas turbine engines by module replacement, in accordance with approved procedures.

It covers both fixed wing and rotary winged aircraft engines. The engine to be overhauled will have been removed from the aircraft and the overhauling activities may take place in a workshop or hangar. In carrying out the overhauling operations, they will be required to follow laid-down procedures and use specific dismantling and rebuilding techniques. The overhauling activities will involve removing the engine nacelles/outer casing, removing all ancillary equipment and components and dismantling the engine down to the various sub-assembly units, such as fan case, front fan, compressor module, combustor module, turbine module and gearbox.

They will then be expected to rebuild the engine, which will involve fitting replacement or overhauled sub-assembly units (such as compressor, combustor, turbine, and gearbox) and the replacement of all damaged, worn and 'lived' components. The overhauling activities will include making all necessary checks and adjustments to ensure that components are correctly replaced, positioned, aligned, adjusted, torque loaded, locked and fastened, and that the correct sealants are used. Their responsibilities will require them to comply with organisational policy and procedures for the overhaul of the aircraft gas turbine engine, and to report any problems with the overhauling activities or with the tools and equipment used that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. They must ensure that all tools, equipment and materials used in the overhauling activities are removed from the work area on completion of the activities, and that all necessary job/task documentation is completed accurately and legibly.

They will be expected to work with a minimum of supervision, taking personal responsibility for their actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide a good understanding of their work and will provide an informed approach to applying appropriate overhauling techniques and procedures to aircraft gas turbine engines. They will understand the dismantling and reassembly methods and procedures used and their application. They will know how the engine functions, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the overhauling activities to the required specification. In addition, 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 reassembly.

They will understand the safety precautions required when carrying out the overhauling activities associated with aircraft gas turbine engines, especially those for lifting, handling and supporting the equipment being removed and replaced. 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 overhauling schedules to carry out the required work.
- P4 establish the components to be removed and where appropriate, mark components to aid re-assembly.
- P5 ensure that any stored energy or substances are released, safely and correctly.
- P6 carry out the overhaul to the agreed level, using the correct tools and techniques.
- P7 ensure that all removed components are correctly identified and stored in the correct location.
- P8 report any instances where the overhauling activities cannot be fully met, or where there are identified defects outside the planned overhauling schedule.
- P9 complete the relevant documentation, in accordance with organisational requirements.
- P10 dispose of unwanted components, waste materials and substances, in accordance with safe working practices and approved procedures.
- P11 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 overhaul of the aircraft gas turbine engine:
 - 1.1 obtain and use the appropriate documentation (such as job instructions, engine overhaul manuals, engineering drawings, technical instructions and other relevant maintenance documentation)
 - 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 safe access and working arrangements for the overhauling area
 - 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 that all oils, fluids and fuel have been drained/removed before breaking into the system
 - 1.6 ensure that the engine is suitably supported and that appropriate lifting and handling equipment is available
 - 1.7 carry out the overhauling activities, using approved techniques and procedures at all times

- 1.8 ensure that components and surrounding structures are maintained free from damage and foreign objects
 - 1.9 return all tools and equipment to the correct location on completion of the activities
 - 1.10 leave the work area and engine in a safe and appropriate condition, free from foreign object debris and in a condition ready for testing.
-

Learning outcome

The learner will:

- 2 carry out a major overhaul of **one** of the following types of aircraft gas turbine engine:
 - 2.1 turbo prop
 - 2.2 turbo jet
 - 2.3 turbo-fan
 - 2.4 ducted fan
 - 2.5 turbo-shaft
 - 2.6 ground turbine start (GTS).
-

Learning outcome

The learner will:

- 3 dismantle aircraft gas turbine engines, to include removing **four** of the following sub-assemblies:
 - 3.1 fan case
 - 3.2 exhaust/reheat assembly
 - 3.3 combustor module
 - 3.4 turbine
 - 3.5 front fan
 - 3.6 compressor module
 - 3.7 by-pass duct
 - 3.8 gear box.
-

Learning outcome

The learner will:

- 4 carry out **all** of the following activities on the equipment being overhauled
 - 4.1 pre-disassembly checks
 - 4.2 replacing all 'lived' items (such as seals, bearings, gaskets)
 - 4.3 removing engine nacelles/outer casing
 - 4.4 disconnecting and removing wires/cables, and attaching suitable cable identification markers
 - 4.5 applying gaskets and sealant/adhesives
 - 4.6 replacing all damaged or defective sub-assemblies and components
-

- 4.7 disconnecting and removing pipework
 - 4.8 removing all ancillary components
 - 4.9 re-assembling components to sub-assembly level
 - 4.10 dismantling equipment to unit/sub-assembly level
 - 4.11 re-assembling sub-assemblies to unit level
 - 4.12 dismantling units to component level
 - 4.13 setting and adjusting replaced components
 - 4.14 removing and replacing components having interference fits (such as by expansion, contraction, pressure)
 - 4.15 refitting all ancillary components
 - 4.16 reconnecting all pipework
 - 4.17 refitting cable harnesses
 - 4.18 proof-marking/labelling of components to aid reassembly
 - 4.19 refitting electrical units and connecting to cables
 - 4.20 electrical bonding of components
 - 4.21 checking components for wear and serviceability
 - 4.22 tightening fastenings to the required torque
 - 4.23 securing components using mechanical fasteners and threaded devices
 - 4.24 applying bolt locking methods (such as split pins, wire locking, lock nuts, stiff nuts, swage nuts).
-

Learning outcome

The learner will:

5 replace/refit a range of engine components and sub-assemblies, to include: **four** of the following engine modules:

- 5.1 fan case
- 5.2 combustor module
- 5.3 front fan
- 5.4 turbine
- 5.5 compressor module
- 5.6 gear box
- 5.7 exhaust/reheat assembly
- 5.8 by-pass d

plus **eight** of the following types of component:

- 5.9 curvic couplings
- 5.10 wire thread inserts
- 5.11 bearings
- 5.12 pipes and unions
- 5.13 static seals/gaskets
- 5.14 mechanical controls (such as plungers, springs, rollers)

- 5.15 dynamic seals
 - 5.16 shims and packing
 - 5.17 electrical units and controls (such as solenoids, motors, switches)
 - 5.18 mechanical securing devices
 - 5.19 locking devices
 - 5.20 other specific components.
-

Learning outcome

The learner will:

- 6 carry out checks and tests on the overhauled engine, to include **six** of the following:
 - 6.1 positional accuracy
 - 6.2 operating/working clearance
 - 6.3 orientation
 - 6.4 electrical checks (such as continuity and earth bonding)
 - 6.5 alignment
 - 6.6 visual inspection for completeness and freedom from damage or foreign objects
 - 6.7 freedom of movement
 - 6.8 bearing end float
 - 6.9 'special-to-type' test rig checks.
-

Learning outcome

The learner will:

- 7 complete the relevant paperwork, to include **one** of the following and pass it to the appropriate people:
 - 7.1 job cards
 - 7.2 computer records
 - 7.3 aircraft log books
 - 7.4 engine overhaul logs or reports
 - 7.5 work authorisation documents
 - 7.6 permit to work/formal risk assessment and/or sign-on/off procedures
 - 7.7 shift handover documentation.
-

Learning outcome

The learner will:

- 8 overhaul aircraft gas turbine engines in compliance with **one** of the following:
 - 8.1 Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
 - 8.2 extended twin operations procedures (ETOpS) (where appropriate)
 - 8.3 Military Aviation Authority (MAA)
-

- 8.4 Aerospace Quality Management Standards (AS)
 - 8.5 Federal Aviation Authority (FAA)
 - 8.6 BS, ISO or BSEN standards and procedures
 - 8.7 customer standards and requirements
 - 8.8 organisation standards and procedures
 - 8.9 engine manufacturer's requirements.
-

Learning outcome

Knowledge and understanding

Assessment criteria

The apprentice must know and understand:

- K1 the specific safety practices and procedures that they need to observe when dismantling and replacing aircraft gas turbine engine modules (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 area in which the dismantling and module replacement 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 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 hazards associated with dismantling and replacing aircraft gas turbine engine modules (such as handling oils, greases, aviation fuel, stored pressure/force, use of power tools, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down overhauling procedures, lifting and moving large and heavy components) and how to minimise them and reduce any risks.
- K7 the importance of wearing protective clothing (PPE) and other appropriate safety equipment during the dismantling and module replacement activities.
- K8 how to obtain and interpret drawings, specifications, manufacturers' manuals, history/maintenance reports, and other documents needed in the overhauling process.
- K9 how to carry out currency/issue checks on the specifications they are working with.
- K10 the quality control procedures to be followed during the overhauling operations.
- K11 the procedure for obtaining replacement parts, materials and other consumables necessary for the overhaul.
- K12 company policy on the repair/replacement of components during the overhauling process.
- K13 terminology used in aircraft gas turbine engines and engine modules.
- K14 the basic principles of how the engine functions and the working purpose of individual modules/units..
- K15 the extent to which the equipment is to be dismantled for the overhaul

- K16 the sequence to be adopted for the dismantling/reassembling of various types of engine assemblies.
- K17 the techniques used to dismantle the aircraft gas turbine engines without damage to the components or surrounding structure (such as release of pressures/force, draining of fluids, making electrical disconnections, proof marking components to aid reassembly, removing assemblies requiring pressure/force, removing mechanical locking and securing mechanisms/devices).
- K18 the need to protect the system integrity by ensuring that exposed components are correctly covered/protected.
- K19 how to lift and move large components and assemblies; the methods and equipment used to transport, handle and lift the components during the overhauling activities.
- K20 the need to ensure that lifting and handling equipment is within its current certification dates.
- K21 methods of checking that components are fit for purpose, how to identify defects and wear characteristics, and the need to replace 'lived' items (such as seals and gaskets).
- K22 the uses of measuring equipment (such as micrometers, Verniers, expansion indicators and other measuring devices).
- K23 methods of reassembling the aircraft gas turbine engine, using new or previously overhauled modules (such as replacing assemblies requiring pressure/force, ensuring correct orientation and alignment of modules, replacing mechanical locking and securing mechanisms/devices, reconnecting pipes and electrical connectors).
- K24 how to make adjustments to replaced components/assemblies to ensure that they function correctly (such as checking alignment, balancing of rotating components such as turbines, setting working clearance, setting travel, and pre-loading bearings).
- K25 the various mechanical fasteners that are used and their method of removal and replacement (including rivets, threaded fasteners, special securing devices)..
- K26 the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking in of the connections
- K27 the tools and equipment used in the overhauling activities and how to check that they are in a safe, tested and usable 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 overhauling activities.
- K30 the procedure for the safe disposal of waste materials.
- K31 the generation of maintenance documentation and/or reports following the overhauling activity.
- K32 the problems that can occur during the overhauling activity 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 399

Overhauling Aircraft Gas Turbine Engines by Module Replacement

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

322

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 a complete overhaul of aircraft gas turbine engine compressor assemblies, in accordance with approved procedures.

It covers both fixed wing and rotary winged aircraft engines. The compressor assembly to be overhauled will have been removed from the engine assembly and the overhauling activities may take place in a workshop or hangar. In carrying out the overhauling operations, they will be required to follow laid-down procedures and use specific dismantling and rebuilding techniques. The overhauling activities will involve removing all ancillary components and sub-assemblies, removing the compressor blades, stators, bearings and seals, and stripping the compressor housing of all its components.

They will then be expected to inspect the components for damage and wear and to make decisions on which components can be reused and which will need replacing. They will then rebuild the compressor assembly, which will involve fitting replacement or overhauled sub-assembly units (such as compressor housing, stators, compressor blades) and the replacement of all damaged, worn and 'lived' components. The overhauling activities will include making all necessary checks and adjustments to ensure that components are correctly replaced, positioned, aligned, adjusted, torque loaded, locked and fastened, and that the correct sealants are used.

Their responsibilities will require them to comply with organisational policy and procedures for the overhauling of the aircraft gas turbine engine compressor assembly, and to report any problems with the overhauling activities, or with the tools and equipment used that they cannot personally resolve or that is outside their permitted authority, to the relevant people. They must ensure that all tools, equipment and materials used in the overhauling activities are removed from the work area on completion of the activities, and that all necessary job/task documentation is completed accurately and legibly. They will be expected to work with a minimum of supervision, taking personal responsibility for their actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide a good understanding of their work and will provide an informed approach to applying appropriate overhauling techniques and procedures to aircraft gas turbine engine compressor assemblies. They will understand the dismantling and reassembly methods and procedures used and their application.

They will know how the compressor assembly functions, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the overhauling activities to the required specification. In addition, 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 reassembly. They will understand the safety precautions required when carrying out the overhauling activities associated with aircraft gas turbine engine compressor assemblies, especially those for lifting, handling and supporting the equipment being removed and replaced. 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 overhauling schedules to carry out the required work.
- P4 establish the components to be removed and where appropriate, mark components to aid re-assembly.
- P5 ensure that any stored energy or substances are released, safely and correctly.
- P6 carry out the overhaul to the agreed level, using the correct tools and techniques.
- P7 ensure that all removed components are correctly identified and stored in the correct location.
- P8 report any instances where the overhauling activities cannot be fully met, or where there are identified defects outside the planned overhaul schedule.
- P9 complete the relevant documentation, in accordance with organisational requirements.
- P10 dispose of unwanted components, waste materials and substances, in accordance with safe working practices and approved procedures.
- P11 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 overhaul of the aircraft gas turbine engine compressor assembly:
 - 1.1 obtain and use the appropriate documentation (such as job instructions, engine overhaul manuals, engineering drawings, technical instructions, and other relevant maintenance documentation)
 - 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 safe access and working arrangements for the overhauling area
 - 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 that all oils, fluids and fuel have been drained/removed before breaking into the system
 - 1.6 ensure that the compressor assembly is suitably supported and that appropriate lifting and handling equipment is available
 - 1.7 carry out the overhauling activities, using approved techniques and procedures at all times

- 1.8 ensure that components and surrounding structures are maintained free from damage and foreign objects
 - 1.9 return all tools and equipment to the correct location on completion of the activities
 - 1.10 leave the work area and compressor assembly in a safe and appropriate condition, free from foreign object debris on completion of the activities.
-

Learning outcome

The learner will:

- 2 dismantle the aircraft gas turbine engine compressor assembly, to include removing **all** of the following:
 - 2.1 compressor housing
 - 2.2 bearings
 - 2.3 locking devices
 - 2.4 compressor stators
 - 2.5 sub-assemblies
 - 2.6 wire thread inserts
 - 2.7 compressor blades
 - 2.8 seals and gaskets
 - 2.9 pipes and unions
 - 2.10 curvic couplings
 - 2.11 shims and packing.
-

Learning outcome

The learner will:

- 3 carry out **all** of the following activities on the equipment being overhauled:
 - 3.1 cleaning parts prior to dismantling
 - 3.2 replacing all damaged or defective sub-assemblies and components
 - 3.3 pre-disassembly checks and tests
 - 3.4 releasing stored energy (where applicable)
 - 3.5 replacing all 'lived' items (such as seals, bearings, gaskets)
 - 3.6 draining/removing any remaining fluids
 - 3.7 dismantling equipment to unit/sub-assembly level
 - 3.8 reassembling the compressor
 - 3.9 dismantling units to component level
 - 3.10 balancing components (where applicable)
 - 3.11 removing and replacing components having interference fits (such as by expansion, contraction, pressure)
 - 3.12 'blue bedding' components
 - 3.13 making mechanical connections
 - 3.14 setting and adjusting replaced components
-

- 3.15 proof-marking/labelling of components to aid reassembly
 - 3.16 tightening fastenings to the required torque
 - 3.17 electrical bonding of components
 - 3.18 checking components for wear and serviceability (such as visual, measurement, NDT, use of probes/scopes)
 - 3.19 applying gaskets and sealant/adhesives
 - 3.20 securing components using mechanical fasteners and threaded devices
 - 3.21 applying locking and retaining devices (such as circlips, pins, wire locking, lock nuts, stiff nuts, swage nuts)
 - 3.22 applying protection to openings to prevent entry of contaminating debris.
-

Learning outcome

The learner will:

- 4 replace a range of compressor assembly components, to include **ten** of the following:
 - 4.1 compressor housing
 - 4.2 locking devices
 - 4.3 compressor stators
 - 4.4 wire thread inserts
 - 4.5 compressor blades
 - 4.6 pipes and unions
 - 4.7 curvic couplings
 - 4.8 mechanical controls (such as plungers, springs, rollers)
 - 4.9 bearings
 - 4.10 static seals/gaskets
 - 4.11 electrical controls (such as solenoids, motors, switches)
 - 4.12 dynamic seals
 - 4.13 shims and packing
 - 4.14 mechanical securing devices
 - 4.15 other specific component.
-

Learning outcome

The learner will:

- 5 carry out checks and tests on the overhauled equipment, to include **six** of the following:
 - 5.1 positional accuracy
 - 5.2 operating/working clearance
 - 5.3 orientation
 - 5.4 visual inspection for completeness and freedom from damage or foreign objects
 - 5.5 alignment
 - 5.6 freedom of movement
 - 5.7 'special-to-type' test rig checks
-

5.8 bearing end float.

Learning outcome

The learner will:

- 6 overhaul aircraft gas turbine engine compressor assemblies in compliance with **one** of the following:
 - 6.1 Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
 - 6.2 Federal Aviation Authority (FAA)
 - 6.3 Military Aviation Authority (MAA)
 - 6.4 Aerospace Quality Management Standards (AS)
 - 6.5 BS, ISO or BSEN standards and procedures
 - 6.6 customer standards and requirements
 - 6.7 organisation standards and procedures
 - 6.8 engine manufacturer's requirements.
-

Learning outcome

The learner will:

- 7 complete the relevant paperwork, to include **one** of the following and pass it to the appropriate people:
 - 7.1 job cards
 - 7.2 computer records
 - 7.3 aircraft log books
 - 7.4 engine overhaul logs or reports
 - 7.5 work authorisation documents
 - 7.6 permit to work/formal risk assessment and/or sign-on/off procedures.
-

Learning outcome

Knowledge and understanding

Assessment criteria

The apprentice must know and understand:

- K1 the specific safety practices and procedures that they need to observe when overhauling aircraft gas turbine engine compressor assemblies (including any specific legislation, regulations/codes of practice for the activities, equipment or materials).
 - K2 the health and safety requirements of the area in which the overhauling activity is to take place and the responsibility these requirements place on them.
 - K3 the hazards associated with overhauling aircraft gas turbine engine compressor assemblies (such as handling oils, greases, stored pressure/force, use of power tools, misuse of tools, using damaged or badly maintained tools and equipment, not following
-

- laid-down overhauling procedures, lifting and moving large and heavy components) and how to minimise them 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 importance of wearing protective clothing and other appropriate safety equipment (PPE) during the overhaul.
 - K7 how to obtain and interpret drawings, specifications, manufacturers' manuals, history/maintenance reports and other documents needed in the overhauling process.
 - K8 how to carry out currency/issue checks on the specifications they are working with.
 - K9 the quality control procedures to be followed during the overhauling operations.
 - K10 the procedure for obtaining replacement parts, materials and other consumables necessary for the overhaul.
 - K11 company policy on the repair/replacement of components during the overhauling process.
 - K12 terminology used in aircraft gas turbine engine compressor assemblies.
 - K13 the basic principles of how the compressor assembly functions, its operating sequence, the working purpose of individual units/components and how they interact.
 - K14 the extent to which the equipment is to be dismantled for overhaul.
 - K15 the sequence to be adopted for the dismantling/reassembling of the compressor assembly.
 - K16 the techniques used to dismantle the aircraft gas turbine engine compressor assembly, without damage to the components or surrounding structure (such as release of energy/pressures/force; making mechanical disconnections; proof marking components to aid reassembly; removing assemblies having interference fits (such as expansion, contraction, and the use of presses and extractors); removing mechanical locking and securing mechanisms/devices).
 - K17 the need to protect the system integrity by ensuring that exposed components are correctly covered/protected.
 - K18 how to lift and move large components and assemblies; the methods and equipment used to transport, handle and lift the components during the overhauling activities.
 - K19 the need to ensure that lifting and handling equipment is within its current certification dates.
 - K20 methods of checking that components are fit for purpose, how to identify defects and wear characteristics, and the need to replace 'lived' items (such as seals and gaskets).
 - K21 the uses of measuring equipment (such as micrometers, verniers, expansion indicators and other measuring devices).
 - K22 methods of reassembling the aircraft gas turbine engine compressor assembly, using new or previously overhauled components (such as replacing assemblies requiring pressure/force, ensuring correct orientation, bedding in bearings and components, replacing mechanical locking and securing mechanisms/devices, torque setting components).

- K23 how to make adjustments to replaced components/assemblies to ensure that they function correctly (such as checking alignment, balancing of rotating components such as turbines, setting working clearance, setting travel, and pre-loading bearings).
- K24 the various mechanical fasteners that are used, and their method of removal and replacement (including rivets, threaded fasteners, special securing devices).
- K25 the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking-in of the connections.
- K26 the tools/equipment used in the overhauling activities and how to check that they are in a safe/usable condition.
- K27 the importance of ensuring that all tools are used correctly and within their permitted operating range.
- K28 the importance of ensuring that all tools, equipment and components are accounted for and returned to their correct location on completion of the overhauling activities.
- K29 the procedure for the safe disposal of waste materials.
- K30 the generation of maintenance documentation and/or reports following the overhauling activity.
- K31 the problems that can occur during the overhauling activity and how they can be overcome.
- K32 the extent of their own authority and to whom they should report if they have a problem that they cannot resolve.

Unit 400

Overhauling Aircraft Gas Turbine Engine Compressor 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 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 a complete overhaul of aircraft gas turbine engine combustion assemblies, in accordance with approved procedures. It covers both fixed wing and rotary winged aircraft engines.

The combustion assembly to be overhauled will have been removed from the engine and the overhauling activities may take place in a workshop or hangar. In carrying out the overhauling operations, they will be required to follow laid-down procedures and use specific dismantling and rebuilding techniques. The overhauling activities will involve removing all ancillary components and sub-assemblies, removing the combustion cans/chambers, nozzle guide vanes, outer guide vanes, bearings and seals, and stripping the combustion housing of all its components.

They will be required to inspect the components for damage and wear, and to make decisions on which components can be reused and which will need replacing. They will then rebuild the combustion assembly, which will involve fitting replacement or overhauled sub-assembly units (such as combustion housing, combustion cans/chambers, nozzle guide vanes) and the replacement of all damaged, worn and 'lived' components. The overhauling activities will include making all necessary checks and adjustments to ensure that components are correctly replaced, positioned, aligned, adjusted, torque loaded, locked and fastened, and that the correct sealants are used. Their responsibilities will require them to comply with organisational policy and procedures for the overhaul of the aircraft gas turbine engine combustion assembly, and to report any problems with the overhauling activities, or with the tools and equipment used that they cannot personally resolve or that is outside their permitted authority, to the relevant people.

They must ensure that all tools, equipment and materials used in the overhauling activities are removed from the work area on completion of the activities, and that all necessary job/task documentation is completed accurately and legibly. 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 appropriate overhauling techniques and procedures to aircraft gas turbine engine combustion assemblies. They will understand the dismantling and reassembly methods and procedures used, and their application. They will know how the combustion assembly functions, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the overhauling activities to the required specification. In addition, 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 reassembly.

They will understand the safety precautions required when carrying out the overhauling activities associated with aircraft gas turbine engine combustion assemblies, especially those for lifting, handling and supporting the equipment being removed and replaced. 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 overhauling schedules to carry out the required work.
- P4 establish the components to be removed and where appropriate, mark components to aid re-assembly.
- P5 ensure that any stored energy or substances are released safely and correctly.
- P6 carry out the overhaul to the agreed level, using the correct tools and techniques.
- P7 ensure that all removed components are correctly identified and stored in the correct location.
- P8 report any instances where the overhauling activities cannot be fully met or where there are identified defects outside the planned overhauling schedule.
- P9 complete the relevant documentation, in accordance with organisational requirements.
- P10 dispose of unwanted components, waste materials and substances, in accordance with safe working practices and approved procedures.
- P11 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 overhaul of the aircraft gas turbine engine combustion assembly:
 - 1.1 obtain and use the appropriate documentation (such as job instructions, engine overhaul manuals, engineering drawings, technical instructions and other relevant maintenance documentation)
 - 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 safe access and working arrangements for the overhaul area
 - 1.4 obtain the correct tools and equipment for the activity, and check that they are in a safe and usable condition and within current certification/calibration date
 - 1.5 ensure that all oils, fluids and fuel have been drained/removed before breaking into the system
 - 1.6 ensure that the combustion assembly is suitably supported and that appropriate lifting and handling equipment is available
 - 1.7 carry out the overhauling activities, using approved techniques and procedures at all times

- 1.8 ensure that components and surrounding structures are maintained free from damage and foreign objects
 - 1.9 return all tools and equipment to the correct location on completion of the activities
 - 1.10 leave the work area and combustion assembly in a safe and appropriate condition, free from foreign object debris on completion of the activities.
-

Learning outcome

The learner will:

- 2 dismantle the aircraft gas turbine engine combustion assembly, to include removing **all** of the following:
 - 2.1 combustion case
 - 2.2 outer guide vanes
 - 2.3 locking devices
 - 2.4 combustion cans/chambers
 - 2.5 seals and gaskets
 - 2.6 wire thread inserts
 - 2.7 annular combustion chambers
 - 2.8 shims and packing
 - 2.9 pipes and unions
 - 2.10 nozzle guide vanes.
-

Learning outcome

The learner will:

- 3 carry out **all** of the following activities on the equipment being overhauled:
 - 3.1 cleaning parts prior to dismantling
 - 3.2 replacing all damaged or defective sub-assemblies and components
 - 3.3 pre-disassembly checks and tests
 - 3.4 releasing stored energy (where applicable)
 - 3.5 replacing all 'lived' items (such as seals, bearings, gaskets)
 - 3.6 draining/removing any remaining fluids
 - 3.7 dismantling equipment to unit/sub-assembly level
 - 3.8 reassembling the combustion unit
 - 3.9 dismantling units to component level
 - 3.10 'blue bedding' components
 - 3.11 removing and replacing components having
 - 3.12 making mechanical connections interference fits (such as by expansion, contraction, pressure)
 - 3.13 setting and adjusting replaced components
 - 3.14 tightening fastenings to the required torque
 - 3.15 proof-marking/labelling of components to aid reassembly
-

- 3.16 electrical bonding of components
 - 3.17 applying gaskets and sealant/adhesives
 - 3.18 checking components for wear and serviceability (such as visual, measurement, NDT, use of probes/scopes)
 - 3.19 securing components using mechanical fasteners and threaded devices
 - 3.20 applying locking and retaining devices (such as circlips, pins, wire locking, lock nuts, stiff nuts, swage nuts)
 - 3.21 applying protection to openings to prevent entry of contaminating debris.
-

Learning outcome

The learner will:

- 4 replace a range of combustion assembly components, to include **ten** of the following:
 - 4.1 combustion case
 - 4.2 locking devices
 - 4.3 combustion cans/chambers
 - 4.4 wire thread inserts
 - 4.5 annular combustion chambers
 - 4.6 pipes and unions
 - 4.7 nozzle guide vanes
 - 4.8 mechanical controls (such as plungers, springs, rollers)
 - 4.9 outer guide vanes
 - 4.10 locks and stops
 - 4.11 electrical controls (such as solenoids, motors, switches)
 - 4.12 static seals/gaskets
 - 4.13 dynamic seals
 - 4.14 shims and packing
 - 4.15 other specific components.
-

Learning outcome

The learner will:

- 5 carry out checks and tests on the overhauled equipment, to include **six** of the following:
 - 5.1 positional accuracy
 - 5.2 operating/working clearance
 - 5.3 orientation
 - 5.4 visual inspection for completeness and freedom from damage or foreign objects
 - 5.5 alignment
 - 5.6 freedom of movement
 - 5.7 'special-to-type' test rig checks.
-

Learning outcome

The learner will:

- 6 overhaul aircraft gas turbine engine combustion assemblies in compliance with **one** of the following:
 - 6.1 Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
 - 6.2 Federal Aviation Authority (FAA)
 - 6.3 Military Aviation Authority (MAA)
 - 6.4 Aerospace Quality Management Standards (AS)
 - 6.5 BS, ISO or BSEN standards and procedures
 - 6.6 customer standards and requirements
 - 6.7 organisation standards and procedures
 - 6.8 engine manufacturer's requirements.

Learning outcome

The learner will:

- 7 complete the relevant paperwork, to include **one** of the following and pass it to the appropriate people:
 - 7.1 job cards
 - 7.2 computer records
 - 7.3 aircraft log books
 - 7.4 engine overhaul logs or reports
 - 7.5 work authorisation documents
 - 7.6 permit to work/formal risk assessment.

Learning outcome

Knowledge and understanding

Assessment criteria

The apprentice must know and understand:

- K1 the specific safety practices and procedures that they need to observe when overhauling aircraft gas turbine engine combustion assemblies (including any specific legislation, regulations/codes of practice for the activities, equipment or materials).
- K2 the health and safety requirements of the area in which the overhauling activity is to take place and the responsibility these requirements place on them.
- K3 the hazards associated with overhauling aircraft gas turbine engine combustion assemblies (such as handling oils, greases, stored pressure/force, use of power tools, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down overhauling procedures, lifting and moving large and heavy components), and how to minimise them and reduce any risks.

- 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 and other appropriate safety equipment (PPE) during the overhaul.
- K7 how to obtain and interpret drawings, specifications, manufacturers' manuals, history/maintenance reports, and other documents needed in the overhauling process.
- K8 how to carry out currency/issue checks on the specifications they are working with.
- K9 the quality control procedures to be followed during the overhauling operations.
- K10 the procedure for obtaining replacement parts, materials and other consumables necessary for the overhaul.
- K11 company policy on the repair/replacement of components during the overhauling process.
- K12 terminology used in aircraft gas turbine engine combustion assemblies.
- K13 the basic principles of how the combustion assembly functions, its operating sequence, the working purpose of individual units/components and how they interact.
- K14 the extent to which the equipment is to be dismantled for overhaul.
- K15 the sequence to be adopted for the dismantling/reassembling of the combustion assembly.
- K16 the techniques used to dismantle the aircraft gas turbine engine combustion assembly, without damage to the components or surrounding structure (such as release of energy/pressures/force; making mechanical disconnections; proof marking components to aid reassembly; removing assemblies having interference fits (such as expansion, contraction, and the use of presses and extractors); removing mechanical locking and securing mechanisms/devices).
- K17 the need to protect the system integrity by ensuring that exposed components are correctly covered/protected.
- K18 how to lift and move large components and assemblies; the methods and equipment used to transport, handle and lift the components during the overhauling activities.
- K19 the need to ensure that lifting and handling equipment is within its current certification dates.
- K20 methods of checking that components are fit for purpose, how to identify defects and wear characteristics, and the need to replace 'lived' items (such as seals and gaskets).
- K21 the uses of measuring equipment (such as micrometers, Verniers, expansion indicators and other measuring devices).
- K22 methods of reassembling the aircraft gas turbine engine combustion assembly, using new or previously overhauled components (such as replacing assemblies requiring pressure/force, ensuring correct orientation, bedding in bearings and components, replacing mechanical locking and securing mechanisms/devices, torque setting components).
- K23 how to make adjustments to replaced components/assemblies to ensure that they function correctly (such as checking alignment, balancing of rotating components such as turbines, setting working clearance, setting travel, and pre-loading bearings).

- K24 the various mechanical fasteners that are used and their method of removal and replacement (including rivets, threaded fasteners, special securing devices).
- K25 the various types of electrical connectors that are used, methods of unlocking, orientation indicators, and locating and locking in of the connections.
- K26 the tools/equipment used in the overhauling activities and how to check that they are in a safe, tested and usable condition.
- K27 the importance of ensuring that all tools are used correctly and within their permitted operating range.
- K28 the importance of ensuring that all tools, equipment and components are accounted for and returned to their correct location on completion of the overhauling activities.
- K29 the procedure for the safe disposal of waste materials.
- K30 the generation of maintenance documentation and/or reports following the overhauling activity.
- K31 the problems that can occur during the overhauling activity and how they can be overcome.
- K32 the extent of their own authority and to whom they should report if they have a problem that they cannot resolve.

Unit 401

Overhauling Aircraft Gas Turbine Engine Combustion 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 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 a complete overhaul of aircraft gas turbine engine turbine assemblies, in accordance with approved procedures. It covers both fixed wing and rotary winged aircraft engines.

The turbine assembly to be overhauled will have been removed from the engine and the overhauling activities may take place in a workshop or hangar. In carrying out the overhauling operations, they will be required to follow laid-down procedures and use specific dismantling and rebuilding techniques. The overhauling activities will involve removing all ancillary components and subassemblies, removing the low, intermediate and high pressure turbines; turbine shafts, discs, bearings and seals; and stripping the turbine housing of all its components.

They will be required to inspect the components for damage and wear, and to make decisions on which components can be reused and which will need replacing. They will then rebuild the turbine assembly, which will involve fitting replacement or overhauled sub-assembly units (such as turbine housing, low, intermediate and high pressure turbines; turbine shafts, bearings and seals), and the replacement of all damaged, worn and 'lived' components. The overhauling activities will include making all necessary checks and adjustments to ensure that components are correctly replaced, positioned, aligned, adjusted, torque loaded, locked and fastened, and that the correct sealants are used.

Their responsibilities will require them to comply with organisational policy and procedures for the overhaul of the aircraft gas turbine engine turbine assembly, and to report any problems with the overhauling activities, or with the tools and equipment used that they cannot personally resolve or that is outside their permitted authority, to the relevant people. They must ensure that all tools, equipment and materials used in the overhauling activities are removed from the work area on completion of the activities, and that all necessary job/task documentation is completed accurately and legibly. 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 appropriate overhauling techniques and procedures to aircraft gas turbine engine turbine assemblies. They will understand the dismantling and reassembly methods and procedures used, and their application. They will know how the turbine assembly functions, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the overhauling activities to the required specification. In addition, 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 reassembly. They will understand the safety precautions required when carrying out the overhauling activities associated with aircraft gas turbine engine turbine assemblies, especially those for lifting, handling and supporting the equipment being removed and replaced. 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

The learner will:

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 overhauling schedules to carry out the required work.
- P4 establish the components to be removed and where appropriate, mark components to aid re-assembly.
- P5 ensure that any stored energy or substances are released, safely and correctly.
- P6 carry out the overhaul to the agreed level, using the correct tools and techniques.
- P7 ensure that all removed components are correctly identified and stored in the correct location.
- P8 report any instances where the overhauling activities cannot be fully met or where there are identified defects outside the planned overhauling schedule.
- P9 complete the relevant documentation, in accordance with organisational requirements.
- P10 dispose of unwanted components, waste materials and substances, in accordance with safe working practices and approved procedures.
- P11 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 overhaul of the aircraft gas turbine engine turbine assembly:
 - 1.1 obtain and use the appropriate documentation (such as job instructions, engine overhaul manuals, engineering drawings, technical instructions and other relevant maintenance documentation)
 - 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 safe access and working arrangements for the overhauling area
 - 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 that all oils, fluids and fuel have been drained/removed before breaking into the system
 - 1.6 ensure that the turbine assembly is suitably supported, and that appropriate lifting and handling equipment is available

- 1.7 carry out the overhauling activities, using approved techniques and procedures at all times
 - 1.8 ensure that components and surrounding structures are maintained free from damage and foreign objects
 - 1.9 return all tools and equipment to the correct location on completion of the activities
 - 1.10 leave the work area and turbine assembly in a safe and appropriate condition, free from foreign object debris on completion of the activities.
-

Learning outcome

The learner will:

- 2 dismantle the aircraft gas turbine engine turbine assembly, to include removing **all** of the following:
 - 2.1 low pressure turbine
 - 2.2 turbine blades
 - 2.3 wire thread inserts
 - 2.4 intermediate pressure turbine
 - 2.5 bearing races
 - 2.6 locking devices
 - 2.7 high pressure turbine
 - 2.8 bearings
 - 2.9 pipes and unions
 - 2.10 turbine shafts
 - 2.11 seals and gaskets
 - 2.12 turbine discs
 - 2.13 shims and packing.
-

Learning outcome

The learner will:

- 3 carry out **all** of the following activities on the equipment being overhauled:
 - 3.1 cleaning parts prior to dismantling
 - 3.2 replacing all damaged or defective sub-assemblies and components
 - 3.3 pre-disassembly checks and tests
 - 3.4 releasing stored energy (where applicable)
 - 3.5 replacing all 'lived' items (such as seals, bearings, gaskets)
 - 3.6 draining/removing any remaining fluids
 - 3.7 dismantling equipment to unit/sub-assembly level
 - 3.8 reassembling the turbine unit
 - 3.9 dismantling units to component level
 - 3.10 applying protection to openings to prevent entry of contaminating debris
 - 3.11 balancing components (where applicable)
-

- 3.12 removing and replacing components having interference fits (such as by expansion, contraction, pressure)
 - 3.13 'blue bedding' components (where applicable)
 - 3.14 making mechanical connections
 - 3.15 setting and adjusting replaced components
 - 3.16 proof-marking/labelling of components to aid reassembly
 - 3.17 tightening fastenings to the required torque
 - 3.18 electrical bonding of components
 - 3.19 checking components for wear and serviceability (such as visual, measurement, NDT, use of probes/scopes)
 - 3.20 applying gaskets and sealant/adhesives
 - 3.21 securing components using mechanical fasteners and threaded devices
 - 3.22 applying locking and retaining devices (such as circlips, pins, wire locking, lock nuts, stiff nuts, swage nuts).
-

Learning outcome

The learner will:

4 replace a range of turbine assembly components, to include **ten** of the following:

- 4.1 low pressure turbine
 - 4.2 dynamic seals
 - 4.3 intermediate pressure turbine
 - 4.4 shims and packing
 - 4.5 high pressure turbine
 - 4.6 locking devices
 - 4.7 turbine shafts
 - 4.8 wire thread inserts
 - 4.9 turbine discs
 - 4.10 pipes and unions
 - 4.11 turbine blades
 - 4.12 mechanical controls (such as plungers, springs, rollers)
 - 4.13 bearing races
 - 4.14 electrical controls (such as solenoids, motors, switches)
 - 4.15 bearings locks and stops
 - 4.16 static seals /gaskets
 - 4.17 other specific components.
-

Learning outcome

The learner will:

5 carry out checks and tests on the overhauled equipment, to include **six** of the following:

- 5.1 positional accuracy
-

- 5.2 operating/working clearance
 - 5.3 orientation
 - 5.4 visual inspection for completeness and freedom from damage or foreign objects
 - 5.5 alignment
 - 5.6 freedom of movement
 - 5.7 'special-to-type' test rig checks
 - 5.8 bearing end float.
-

Learning outcome

The learner will:

- 6 overhaul aircraft gas turbine engine turbine assemblies in compliance with **one** of the following:
 - 6.1 Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
 - 6.2 Federal Aviation Authority (FAA)
 - 6.3 Military Aviation Authority (MAA)
 - 6.4 Aerospace Quality Management Standards (AS)
 - 6.5 BS, ISO or BSEN standards and procedures
 - 6.6 customer standards and requirements
 - 6.7 organisation standards and procedures
 - 6.8 engine manufacturer's requirements.
-

Learning outcome

The learner will:

- 7 complete the relevant paperwork, to include **one** of the following and pass it to the appropriate people:
 - 7.1 job cards
 - 7.2 computer records
 - 7.3 aircraft log books
 - 7.4 engine overhaul logs or reports
 - 7.5 work authorisation documents
 - 7.6 permit to work/formal risk assessment.

Learning outcome

Knowledge and understanding

Assessment criteria

The apprentice must know and understand:

- K1 the specific safety practices and procedures that they need to observe when overhauling aircraft gas turbine engine turbine assemblies (including any specific legislation, regulations/codes of practice for the activities, equipment or materials).
- K2 the health and safety requirements of the area in which the overhauling activity is to take place and the responsibility these requirements place on them.
- K3 the hazards associated with overhauling aircraft gas turbine engine turbine assemblies (such as handling oils, greases, stored energy/pressure/force; use of power tools, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down overhauling procedures, lifting and moving large and heavy components) and how to minimise them and reduce any risks.
- 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 and other appropriate safety equipment (PPE) during the overhaul.
- K7 how to obtain and interpret drawings, specifications, manufacturers' manuals, history/maintenance reports and other documents needed in the overhauling process.
- K8 how to carry out currency/issue checks on the specifications they are working with.
- K9 the quality control procedures to be followed during the overhauling operations.
- K10 the procedure for obtaining replacement parts, materials and other consumables necessary for the overhaul.
- K11 company policy on the repair/replacement of components during the overhauling process.
- K12 terminology used in aircraft gas turbine engine turbine assemblies.
- K13 the basic principles of how the turbine assembly functions, its operating sequence, the working purpose of individual units/components and how they interact.
- K14 the extent to which the equipment is to be dismantled for overhaul.
- K15 the sequence to be adopted for the dismantling/reassembling of the turbine assembly.
- K16 the techniques used to dismantle the aircraft gas turbine engine turbine assembly, without damage to the components or surrounding structure (such as release of energy/pressures/force; making mechanical disconnections; proof marking components to aid reassembly; removing assemblies having interference fits (such as expansion, contraction and the use of presses and extractors); removing mechanical locking and securing mechanisms/devices).
- K17 the need to protect the system integrity by ensuring that exposed components are correctly covered/protected.

- K18 how to lift and move large components and assemblies; the methods and equipment used to transport, handle and lift the components during the overhauling activities.
- K19 the need to ensure that lifting and handling equipment is within its current certification dates.
- K20 methods of checking that components are fit for purpose, how to identify defects and wear characteristics and the need to replace 'lived' items (such as seals and gaskets).
- K21 the uses of measuring equipment (such as micrometers, Verniers, expansion indicators, other measuring devices).
- K22 methods of reassembling the aircraft gas turbine engine turbine assembly, using new or previously overhauled components (such as replacing assemblies requiring pressure/force, ensuring correct orientation, bedding in bearings and components, replacing mechanical locking and securing mechanisms/devices, torque setting of components).
- K23 how to make adjustments to replaced components/assemblies to ensure that they function correctly (such as checking alignment, balancing of rotating components such as turbines, setting working clearance, setting travel, and pre-loading bearings).
- K24 the various mechanical fasteners that are used, and their method of removal and replacement (including rivets, threaded fasteners, special securing devices).
- K25 the various types of electrical connectors that are used, methods of unlocking, orientation indicators, and locating and locking in of the connections.
- K26 the tools/equipment used in the overhauling activities, and how to check that they are in a safe, tested and usable condition.
- K27 the importance of ensuring that all tools are used correctly and within their permitted operating range.
- K28 the importance of ensuring that all tools, equipment and components are accounted for and returned to their correct location on completion of the overhauling activities.
- K29 the procedure for the safe disposal of waste materials.
- K30 the generation of maintenance documentation and/or reports following the overhauling activity.
- K31 the problems that can occur during the overhauling activity and how they can be overcome.
- K32 the extent of their own authority and to whom they should report if they have a problem that they cannot resolve.

Unit 402

Overhauling Aircraft Gas Turbine Engine Turbine 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 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 carry out a complete overhaul of aircraft gas turbine engine gearbox assemblies, in accordance with approved procedures. It covers both fixed wing and rotary winged aircraft engines. The gearbox assembly to be overhauled will have been removed from the engine and the overhauling activities may take place in a workshop or hangar. In carrying out the overhauling operations, they will be required to follow laid-down procedures and use specific dismantling and rebuilding techniques.

The overhauling activities will involve removing all ancillary components and sub-assemblies (such as torque converters and starter units); removing the gearbox drive shafts, lay shafts and gear train assemblies; removing bearings and seals; and stripping the gearbox housing of all its components. They will be required to inspect the components for damage and wear, and to make decisions on which components can be reused and which will need replacing. They will then rebuild the gearbox assembly, which will involve fitting replacement or overhauled sub-assembly units (such as gearbox housing, gearbox shafts, gear train assemblies, bearings and seals) and the replacement of all damaged, worn and 'lived' components.

The overhauling activities will include making all necessary checks and adjustments to ensure that components are correctly replaced, positioned, aligned, adjusted, torque loaded, locked and fastened, and that the correct sealants are used. Their responsibilities will require them to comply with organisational policy and procedures for the overhaul of the aircraft gas turbine engine gearbox assembly, and to report any problems with the overhauling activities, or with the tools and equipment used that they cannot personally resolve or that is outside their permitted authority, to the relevant people. They must ensure that all tools, equipment and materials used in the overhauling activities are removed from the work area on completion of the activities, and that all necessary job/task documentation is completed accurately and legibly.

They will be expected to work with a minimum of supervision, taking personal responsibility for their actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide a good understanding of their work and will provide an informed approach to applying appropriate overhauling techniques and procedures to aircraft gas turbine engine gearbox assemblies. They will understand the dismantling and reassembly methods and procedures used, and their application. They will know how the gearbox assembly functions, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the overhauling activities to the required specification. In addition, 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 reassembly. They will understand the safety precautions required when carrying out the overhauling activities associated with aircraft gas turbine engine gearbox assemblies, especially those for lifting, handling and supporting the equipment being removed and replaced.

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 overhauling schedules to carry out the required work.
- P4 establish the components to be removed and where appropriate, mark components to aid re-assembly.
- P5 ensure that any stored energy or substances are released safely and correctly.
- P6 carry out the overhaul to the agreed level, using the correct tools and techniques.
- P7 ensure that all removed components are correctly identified and stored in the correct location.
- P8 report any instances where the overhauling activities cannot be fully met, or where there are identified defects outside the planned overhauling schedule.
- P9 complete the relevant documentation, in accordance with organisational requirements.
- P10 dispose of unwanted components, waste materials and substances, in accordance with safe working practices and approved procedures.
- P11 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 overhaul of the aircraft gas turbine engine gearbox assembly:
 - 1.1 obtain and use the appropriate documentation (such as job instructions, engine overhauling manuals, engineering drawings, technical instructions and other relevant maintenance documentation)
 - 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 safe access and working arrangements for the overhauling area
 - 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 that all oils, fluids and fuel have been drained/removed before breaking into the system
 - 1.6 ensure that the gearbox assembly is suitably supported and that appropriate lifting and handling equipment is available

- 1.7 carry out the overhauling activities, using approved techniques and procedures at all times
 - 1.8 ensure that components and surrounding structures are maintained free from damage and foreign objects
 - 1.9 return all tools and equipment to the correct location on completion of the activities
 - 1.10 leave the work area and gearbox assembly in a safe and appropriate condition, free from foreign object debris on completion of the activities.
-

Learning outcome

The learner will:

- 2 dismantle the aircraft gas turbine engine gearbox assembly, to include removing **all** of the following:
 - 2.1 gear housings
 - 2.2 gear trains/sub-assemblies
 - 2.3 shims and packing
 - 2.4 bearings
 - 2.5 torque converters
 - 2.6 wire thread inserts
 - 2.7 seals and gaskets
 - 2.8 starter units
 - 2.9 locking devices
 - 2.10 drive shafts
 - 2.11 temperature sensors
 - 2.12 pipes and unions
 - 2.13 lay shafts
 - 2.14 levers and linkages.
-

Learning outcome

The learner will:

- 3 carry out **all** of the following activities on the equipment being overhauled:
 - 3.1 cleaning parts prior to dismantling
 - 3.2 replacing all damaged or defective sub-assemblies and components
 - 3.3 pre-disassembly checks and tests
 - 3.4 releasing stored energy (where applicable)
 - 3.5 replacing all 'lifer' items (such as seals, bearings, gaskets)
 - 3.6 draining/removing any remaining fluids
 - 3.7 dismantling equipment to unit/sub-assembly level
 - 3.8 dismantling units to component level
 - 3.9 applying protection to openings to prevent entry of contaminating debris
 - 3.10 balancing components (where applicable)
-

- 3.11 removing and replacing components having interference fits (such as by expansion, contraction, pressure)
 - 3.12 'blue bedding' components
 - 3.13 reassembling the gearbox unit
 - 3.14 making mechanical connections
 - 3.15 setting and adjusting replaced components
 - 3.16 proof-marking/labelling of components to aid reassembly
 - 3.17 tightening fastenings to the required torque
 - 3.18 electrical bonding of components
 - 3.19 checking components for wear and serviceability (such as visual, measurement, NDT, use of probes/scopes)
 - 3.20 applying gaskets and sealant/adhesives
 - 3.21 securing components using mechanical fasteners and threaded devices
 - 3.22 applying locking and retaining devices (such as circlips, pins, wire locking, lock nuts, stiff nuts, swage nuts).
-

Learning outcome

The learner will:

- 4 replace a range of gearbox assembly components, to include **ten** of the following:
 - 4.1 gear housings
 - 4.2 dynamic seals
 - 4.3 bearings
 - 4.4 shims and packing
 - 4.5 seals and gaskets
 - 4.6 levers and linkages
 - 4.7 drive shafts
 - 4.8 locking devices
 - 4.9 lay shafts locks and stops
 - 4.10 wire thread inserts
 - 4.11 gear trains/sub-assemblies
 - 4.12 pipes and unions
 - 4.13 static seals/gaskets
 - 4.14 mechanical controls (such as plungers, springs, rollers)
 - 4.15 torque converter
 - 4.16 electrical controls (such as solenoids, motors, switches)
 - 4.17 starter units
 - 4.18 temperature sensors
 - 4.19 other specific components.

Learning outcome

The learner will:

- 5 carry out checks and tests on the overhauled equipment, to include **six** of the following:
 - 5.1 positional accuracy
 - 5.2 bearing end float
 - 5.3 orientation
 - 5.4 operating/working clearance
 - 5.5 alignment
 - 5.6 visual inspection for completeness and freedom from damage or foreign objects
 - 5.7 freedom of movement
 - 5.8 gear backlash
 - 5.9 'special-to-type' test rig checks.
-

Learning outcome

The learner will:

- 6 overhaul aircraft gas turbine engine gearbox assemblies in compliance with **one** of the following:
 - 6.1 Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
 - 6.2 Federal Aviation Authority (FAA)
 - 6.3 Military Aviation Authority (MAA)
 - 6.4 Aerospace Quality Management Standards (AS)
 - 6.5 BS, ISO or BSEN standards and procedures
 - 6.6 customer standards and requirements
 - 6.7 company standards and procedures
 - 6.8 engine manufacturer's requirements.
-

Learning outcome

The learner will:

- 7 complete the relevant paperwork, to include **one** of the following and pass it to the appropriate people:
 - 7.1 job cards
 - 7.2 computer records
 - 7.3 aircraft log books
 - 7.4 engine overhaul logs or reports
 - 7.5 work authorisation documents
 - 7.6 permit to work/formal risk assessment.
-

Learning outcome

Knowledge and understanding

Assessment criteria

The apprentice must know and understand:

- K1 the specific safety practices and procedures that they need to observe when overhauling aircraft gas turbine engine gearbox assemblies (including any specific legislation, regulations/codes of practice for the activities, equipment or materials).
- K2 the health and safety requirements of the area in which the overhauling activity is to take place and the responsibility these requirements place on them.
- K3 the hazards associated with overhauling aircraft gas turbine engine gearbox assemblies (such as handling oils, greases, stored energy/pressure/force; use of power tools, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down overhauling procedures, lifting and moving large and heavy components) and how to minimise them and reduce any risks.
- 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 and other appropriate safety equipment (PPE) during the overhaul.
- K7 how to obtain and interpret drawings, specifications, manufacturers' manuals, history/maintenance reports and other documents needed in the overhauling process.
- K8 how to carry out currency/issue checks on the specifications they are working with.
- K9 the quality control procedures to be followed during the overhauling operations.
- K10 the procedure for obtaining replacement parts, materials and other consumables necessary for the overhaul.
- K11 company policy on the repair/replacement of components during the overhauling process.
- K12 terminology used in aircraft gas turbine engine gearbox assemblies.
- K13 the basic principles of how the gearbox assembly functions, its operating sequence, the working purpose of individual units/components and how they interact.
- K14 the extent to which the equipment is to be dismantled for overhaul.
- K15 the sequence to be adopted for the dismantling/reassembling of the gearbox assembly.
- K16 the techniques used to dismantle the aircraft gas turbine engine gearbox assembly, without damage to the components or surrounding structure (such as release of energy/pressures/force; making mechanical disconnections; proof marking components to aid reassembly; removing assemblies having interference fits (such as expansion, contraction, and the use of presses and extractors); removing mechanical locking and securing mechanisms/devices.
- K17 the need to protect the system integrity by ensuring that exposed components are correctly covered/protected.

- K18 how to lift and move large components and assemblies; the methods and equipment used to transport, handle and lift the components during the overhauling activities.
- K19 the need to ensure that lifting and handling equipment is within its current certification dates.
- K20 methods of checking that components are fit for purpose, how to identify defects and wear characteristics, and the need to replace 'lived' items (such as seals and gaskets).
- K21 the uses of measuring equipment (such as micrometers, Verniers, expansion indicators, other measuring devices).
- K22 methods of reassembling the aircraft gas gearbox engine gearbox, using new or previously overhauled components (such as replacing assemblies requiring pressure/force, ensuring correct orientation, bedding in bearings and components, replacing locking/securing mechanisms/devices, torque setting of components).
- K23 how to make adjustments to replaced components/assemblies to ensure that they function correctly (such as checking alignment, balancing of rotating components such as torque converters, setting working clearance, setting travel, setting backlash in gears and pre-loading bearings).
- K24 the various mechanical fasteners that are used, and their method of removal and replacement (including rivets, threaded fasteners, special securing devices).
- K25 the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking in of the connections.
- K26 the tools/equipment used in the overhauling activities and how to check that they are in a safe/usable condition.
- K27 the importance of ensuring that all tools are used correctly and within their permitted operating range.
- K28 the importance of ensuring that all tools, equipment and components are accounted for and returned to their correct location on completion of the overhauling activities.
- K29 the procedure for the safe disposal of waste materials.
- K30 the generation of maintenance documentation and/or reports following the overhauling activity.
- K31 the problems that can occur during the overhauling activity and how they can be overcome.
- K32 the extent of their own authority and to whom they should report if they have a problem that they cannot resolve.

Unit 403

Overhauling Aircraft Gas Turbine Engine Gearbox 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.

GLH

315

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 a complete overhaul of aircraft piston engines, in accordance with approved procedures. The engine to be overhauled will have been removed from the aircraft and the overhauling activities may take place in a workshop or hangar. In carrying out the overhauling operations, they will be required to follow laid-down procedures and use specific dismantling and rebuilding techniques. The overhauling activities will involve removing the engine nacelles/outer casing, removing all ancillary equipment and components and dismantling the engine down to the various sub-assembly units, such as cylinder block and cylinder heads. They will be expected to strip the various sub-assemblies down to their component parts. They will then rebuild the engine, which will involve fitting replacement or overhauled sub-assembly units (such as cylinder block, cylinder heads, torque converters, oil pumps) and the replacement of all damaged, worn and 'lived' components. The overhauling activities will include making all necessary checks and adjustments to ensure that components are correctly replaced, positioned, aligned, adjusted, torque loaded, locked and fastened, and that the correct sealants are used.

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

Their underpinning knowledge will provide a good understanding of their work and will provide an informed approach to applying appropriate overhauling techniques and procedures to aircraft piston engines. They will understand the dismantling and reassembly methods and procedures used, and their application. They will know how the engine functions, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the overhauling activities to the required specification. In addition, 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 reassembly.

They will understand the safety precautions required when carrying out the overhauling activities associated with aircraft piston engines, especially those for lifting, handling and supporting the equipment being removed and replaced. 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.

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 overhauling schedules to carry out the required work.
- P4 establish the components to be removed and where appropriate, mark components to aid re-assembly.
- P5 ensure that any stored energy or substances are released safely and correctly.
- P6 carry out the overhaul to the agreed level, using the correct tools and techniques.
- P7 ensure that all removed components are correctly identified and stored in the correct location.
- P8 report any instances where the overhauling activities cannot be fully met, or where there are identified defects outside the planned overhauling schedule.
- P9 complete the relevant documentation, in accordance with organisational requirements.
- P10 dispose of unwanted components, waste materials and substances, in accordance with safe working practices and approved procedures.
- P11 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 overhaul of the aircraft piston engine:
 - 1.1 obtain and use the appropriate documentation (such as job instructions, engine overhauling manuals, engineering drawings, technical instructions, and other relevant maintenance documentation)
 - 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 safe access and working arrangements for the overhauling area
 - 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 that all oils, fluids and fuel have been drained/removed before breaking into the system
 - 1.6 ensure that the piston engine assembly is suitably supported, and that appropriate lifting and handling equipment is available
 - 1.7 carry out the overhauling activities, using approved techniques and procedures at all times

- 1.8 ensure that components and surrounding structures are maintained free from damage and foreign objects
 - 1.9 return all tools and equipment to the correct location on completion of the activities
 - 1.10 leave the work area and piston engine assembly in a safe and appropriate condition, free from foreign object debris and in a condition ready for testing.
-

Learning outcome

The learner will:

- 2 carry out a major overhaul of **one** of the following types of aircraft piston engine:
 - 2.1 in line engine
 - 2.2 'vee' engine
 - 2.3 rotary engine.
-

Learning outcome

The learner will:

- 3 dismantle aircraft piston engines, to include removing **ten** of the following:
 - 3.1 cylinder head
 - 3.2 piston assemblies
 - 3.3 valve mechanisms
 - 3.4 carburettor systems
 - 3.5 crank shaft
 - 3.6 cylinder liners
 - 3.7 oil pumps
 - 3.8 manifolds and exhaust systems
 - 3.9 flywheel
 - 3.10 camshaft assemblies
 - 3.11 fuel/injector pumps and mechanisms
 - 3.12 gearbox
 - 3.13 timing mechanisms
 - 3.14 turbo/supercharger
 - 3.15 torque converter.
-

Learning outcome

The learner will:

- 4 carry out **all** of the following activities on the equipment being overhauled
 - 4.1 pre-disassembly checks
 - 4.2 re-assembling components to sub-assembly level
 - 4.3 removing engine nacelles/outer casing
-

- 4.4 disconnecting and removing wires/cables and attaching suitable cable identification markers
 - 4.5 re-assembling sub-assemblies to unit level
 - 4.6 setting and adjusting replaced components
 - 4.7 removing all ancillary components
 - 4.8 disconnecting and removing pipework
 - 4.9 using specialist tooling
 - 4.10 dismantling equipment to unit/sub-assembly level
 - 4.11 making use of ground support equipment
 - 4.12 dismantling units to component level
 - 4.13 supporting the equipment to be removed
 - 4.14 proof-marking/labelling of components to aid reassembly
 - 4.15 electrical bonding of components
 - 4.16 checking components for wear and serviceability
 - 4.17 replacing all damaged or defective components
 - 4.18 applying gaskets and sealant/adhesives
 - 4.19 replacing all 'lifer' items (such as seals, bearings, gaskets)
 - 4.20 tightening fastenings to the required torque
 - 4.21 securing components using mechanical fasteners and threaded devices
 - 4.22 applying bolt locking methods (such as split pins, wire locking, lock nuts, stiff nuts, swage nuts).
-

Learning outcome

The learner will:

- 5 replace a range of piston engine components, to include **ten** of the following:
 - 5.1 cylinder head
 - 5.2 camshaft assemblies
 - 5.3 fuel pumps
 - 5.4 manifolds
 - 5.5 crank shaft
 - 5.6 timing mechanisms
 - 5.7 seals and gaskets
 - 5.8 sump pans
 - 5.9 flywheel
 - 5.10 valve mechanisms
 - 5.11 pulleys and sprockets
 - 5.12 exhaust systems
 - 5.13 torque converters
 - 5.14 oil pumps
 - 5.15 belts and chains
 - 5.16 pipes and unions
 - 5.17 cylinder liners

- 5.18 bearings
 - 5.19 levers and linkages
 - 5.20 turbo/supercharger
 - 5.21 piston assemblies
 - 5.22 injector mechanisms
 - 5.23 sensing devices.
-

Learning outcome

The learner will:

- 6 carry out checks and tests on the overhauled equipment, to include **six** of the following:
 - 6.1 positional accuracy
 - 6.2 timing (such as valve, ignition fuel injection)
 - 6.3 orientation
 - 6.4 operating/working clearance
 - 6.5 alignment
 - 6.6 visual inspection for completeness and freedom from damage or foreign objects
 - 6.7 freedom of movement
 - 6.8 bearing end float
 - 6.9 boost pressure
 - 6.10 gear backlash
 - 6.11 'special-to-type' test rig checks
 - 6.12 compression.
-

Learning outcome

The learner will:

- 7 overhaul aircraft piston engines in compliance with **one** of the following:
 - 7.1 Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
 - 7.2 Federal Aviation Authority (FAA)
 - 7.3 Military Aviation Authority (MAA)
 - 7.4 Aerospace Quality Management Standards (AS)
 - 7.5 BS, ISO or BSEN standards and procedures
 - 7.6 customer standards and requirements
 - 7.7 company standards and procedures
 - 7.8 engine manufacturer's requirements.
-

Learning outcome

The learner will:

- 8 complete the relevant paperwork, to include **one** of the following and pass it to the appropriate people:
-

- 8.1 job cards
 - 8.2 computer records
 - 8.3 aircraft log books
 - 8.4 engine overhaul logs or reports
 - 8.5 work authorisation documents
 - 8.6 permit to work/formal risk assessment.
-

Learning outcome

Knowledge and understanding:

Assessment criteria

The apprentice must know and understand

- K1 the specific safety practices and procedures that they need to observe when overhauling aircraft piston engines (including any specific legislation, regulations/codes of practice for the activities, equipment or materials).
- K2 the health and safety requirements of the area in which the overhauling activity is to take place, and the responsibility these requirements place on them.
- K3 the hazards associated with overhauling aircraft piston engines (such as such as handling oils, greases, aviation fuel, stored pressure/force, use of power tools, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down overhauling procedures, lifting and moving large and heavy components) and how to minimise them and reduce any risks.
- 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 and other appropriate safety equipment (PPE) during the overhaul.
- K7 how to obtain and interpret drawings, specifications, manufacturers' manuals, history/maintenance reports and other documents needed in the overhauling process.
- K8 how to carry out currency/issue checks on the specifications they are working with.
- K9 the quality control procedures to be followed during the overhauling operations.
- K10 the procedure for obtaining replacement parts, materials and other consumables necessary for the overhaul.
- K11 company policy on the repair/replacement of components during the overhauling process.
- K12 terminology used in aircraft piston engines and engine modules.
- K13 the basic principles of how the engine functions, its operating sequence, the working purpose of individual units/components and how they interact.
- K14 the extent to which the equipment is to be dismantled for overhaul.
- K15 the sequence to be adopted for the dismantling/reassembling of various types of engine assemblies.
- K16 the techniques used to dismantle the aircraft piston engines, without damage to the components or surrounding structure (such as release of energy/pressures/force,

- draining of fluids, making electrical disconnections, proof marking components to aid reassembly, removing assemblies requiring pressure/force, removing mechanical locking and securing mechanisms/devices).
- K17 the need to protect the system integrity by ensuring that exposed components are correctly covered/protected.
- K18 how to lift and move large components and assemblies; the methods and equipment used to transport, handle and lift the components during the overhauling activities.
- K19 the need to ensure that lifting and handling equipment is within its current certification dates.
- K20 methods of checking that components are fit for purpose, how to identify defects and wear characteristics, and the need to replace 'lived' items (such as seals and gaskets).
- K21 the uses of measuring equipment (such as micrometers, verniers, expansion indicators and other measuring devices).
- K22 methods of reassembling the aircraft piston engine, using new or previously overhauled subassemblies (such as replacing assemblies requiring pressure/force, ensuring correct orientation and location of subassemblies, replacing mechanical locking and securing mechanisms/devices, reconnecting pipes and electrical connectors).
- K23 how to make adjustments to replaced components/assemblies to ensure that they function correctly (such as checking alignment, balancing of rotating components such as flywheels and torque converters, setting working clearance, setting travel, and pre-loading bearings).
- K24 the various mechanical fasteners that are used and their method of removal and replacement (including rivets, threaded fasteners, special securing devices).
- K25 the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking in of the connections.
- K26 the tools and equipment used in the overhauling activities and how to check that they are in a safe, tested and usable condition.
- K27 the importance of ensuring that all tools are used correctly and within their permitted operating range.
- K28 the importance of ensuring that all tools, equipment and components are accounted for and returned to their correct location on completion of the overhauling activities.
- K29 the procedure for the safe disposal of waste materials.
- K30 the generation of maintenance documentation and/or reports following the overhauling activity.
- K31 the problems that can occur during the overhauling activity and how they can be overcome.
- K32 the extent of their own authority and to whom they should report if they have a problem that they cannot resolve.

Unit 404 Overhauling Aircraft Piston Engines

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

168

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 dismantle aircraft gas turbine engines to module/unit level, in readiness for overhaul of the individual modules/units, in accordance with approved procedures. It covers both fixed wing and rotary winged aircraft engines. The engine to be dismantled will have been removed from the aircraft. In carrying out the dismantling operations, they will be required to follow laid-down procedures and to use specific engine dismantling techniques. The dismantling activities will involve removing the engine nacelle/outer casing, removing all ancillary equipment and components, and dismantling the engine down to the various sub-assembly units such as fan case, front fan, compressor module, combustor module, turbine module and gear box.

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

Their underpinning knowledge will provide a good understanding of their work and will provide an informed approach to applying appropriate dismantling techniques and procedures to aircraft gas turbine engines. They will understand the dismantling methods and procedures used, and their application. They will know how the engine functions, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the dismantling activities to the required level.

They will understand the safety precautions required when carrying out the dismantling activities associated with aircraft gas turbine engines, especially those for lifting, handling and supporting the equipment being removed. 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 establish and, where appropriate, mark components for re-assembly.
- P4 ensure that any stored energy or substances are released safely and correctly.
- P5 make all isolations and disconnections to the equipment in line with approved procedures.
- P6 carry out the dismantling to the agreed level using correct tools and techniques.
- P7 store components for re-use in approved locations.
- P8 dispose of unwanted components and substances in accordance with approved procedures.
- P9 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 dismantling of the aircraft gas turbine engine:
 - 1.1 obtain and use the correct issue of aircraft manuals and maintenance documentation
 - 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 safe access and working arrangements for the dismantling area
 - 1.4 visually inspect the engine for signs of any damage prior to dismantling it
 - 1.5 ensure that all oils, fluids and fuel have been drained/removed before breaking into the system
 - 1.6 ensure that the engine is suitably supported and that appropriate lifting and handling equipment is available
 - 1.7 carry out the dismantling activities to the appropriate level, using appropriate techniques and procedures
 - 1.8 ensure that components and surrounding structures are maintained free from damage and foreign objects
 - 1.9 return all tools and equipment to the correct location on completion of the activities
 - 1.10 ensure that all work carried out is correctly documented and recorded
 - 1.11 leave the work area and engine in a safe and appropriate condition on completion of the activities.

Learning outcome

The learner will:

- 2 carry out the dismantling of **one** of the following types of aircraft gas turbine engine:
 - 2.1 turbo prop
 - 2.2 turbo jet
 - 2.3 turbo fan
 - 2.4 ducted fan
 - 2.5 turbo shaft
 - 2.6 ground turbine start (GTS).

Learning outcome

The learner will:

- 3 dismantle aircraft gas turbine engines, to include removing **five** of the following sub-assemblies:
 - 3.1 fan case
 - 3.2 exhaust/reheat assembly
 - 3.3 combustor module
 - 3.4 turbine
 - 3.5 front fan
 - 3.6 compressor module
 - 3.7 bypass duct
 - 3.8 gearbox.

Learning outcome

The learner will:

- 4 carry out **all** of the following dismantling activities:
 - 4.1 removing engine nacelle/outer casing
 - 4.2 cleaning parts prior to dismantling
 - 4.3 disconnecting and removing wires/cables, and attaching suitable cable identification markers
 - 4.4 disconnect/removing hoses and pipework
 - 4.5 ensuring that any remaining fluids are drained into suitable containers
 - 4.6 supporting components to be removed
 - 4.7 removing bolt locking devices (such as split pins, wire locking, lock nuts)
 - 4.8 removing mechanical fastening devices
 - 4.9 removing all accessories/line replacement units (LRUs)
 - 4.10 dismantling the engine to module/sub-assembly level

- 4.11 removing components having interference fits (such as by expansion, contraction, pressure)
 - 4.12 carrying out visual inspection of removed parts for any significant defects or damage caused by removal
 - 4.13 applying appropriate part protection techniques and procedures to the removed modules and components
 - 4.14 labelling and storing the modules and components in the correct location ready for inspection and overhaul
 - 4.15 disposing of all items that will be renewed on reassembly (such as seals, locking devices, mechanical fasteners).
-

Learning outcome

The learner will:

- 5 complete the relevant paperwork, to include **one** of the following and pass it to the appropriate people:
 - 5.1 job cards
 - 5.2 work authorisation documents
 - 5.3 computer records
 - 5.4 significant defect reports
 - 5.5 aircraft log books
 - 5.6 shift handover documentation
 - 5.7 engine overhaul logs or reports.
-

Learning outcome

The learner will:

- 6 dismantle aircraft gas turbine engines 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 Federal Aviation Authority (FAA)
 - 6.6 BS, ISO or BSEN standards and procedures
 - 6.7 customer standards and requirements
 - 6.8 organisation standards and procedures
 - 6.9 engine manufacturer's requirements.

Learning outcome

Knowledge and understanding

Assessment criteria

The apprentice must know and understand:

- K1 the specific safety practices and procedures that they need to observe when dismantling aircraft gas turbine engines (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 area in which the dismantling 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 hazards associated with dismantling aircraft gas turbine engines (such as handling oils, greases, aviation fuel, stored pressure/force, use of power tools, misuse of tools, using damaged or badly maintained tools and equipment, lifting and moving large and heavy components) 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 importance of wearing protective clothing and other appropriate safety equipment (PPE) during the dismantling activities.
- K8 how to obtain and interpret drawings, specifications, manufacturers' manuals history/maintenance reports, and other documents needed in the dismantling process.
- K9 how to carry out currency/issue checks on the specifications they are working with
- K10 the quality control procedures to be followed during the dismantling operations.
- K11 company policy on the repair/replacement of components during the dismantling process.
- K12 terminology used in aircraft gas turbine engines and engine modules.
- K13 the basic principles of how the engine functions and the purpose of the individual modules/units.
- K14 the extent to which the equipment is to be dismantled for overhaul.
- K15 the sequence to be adopted for the dismantling of various types of engine assemblies.
- K16 the various mechanical fasteners that are used, and their method of removal (including rivets, threaded fasteners, special securing devices).
- K17 the various types of electrical connector that are used and their methods of unlocking.
- K18 the techniques used to dismantle the aircraft gas turbine engines without damage to the components or surrounding structure (such as release of pressures/force, draining of fluids, making electrical disconnections, proof marking components to aid reassembly, removing assemblies requiring pressure/force, removing mechanical locking and securing mechanisms/devices).

- K19 how to lift and move large components and assemblies; the methods and equipment used to transport, handle and lift the components during the dismantling activities.
- K20 the need to ensure that lifting and handling equipment is within its current certification dates.
- K21 the need to carry out visual inspections of the removed components, checking for any significant defects or damage caused by the dismantling activities.
- K22 the need to carry out part protection techniques and procedures on the removed modules and components, and the protection methods that are used.
- K23 the need to correctly identify, label and store the modules and components ready for overhaul.
- K24 the tools and equipment used in the dismantling activities, and how to check that they are in a safe, tested and usable condition.
- K25 the importance of ensuring that all tools are used correctly and within their permitted operating range.
- K26 the importance of ensuring that all tools and equipment are returned to the correct location on completion of the dismantling activities.
- K27 the procedure for the safe disposal of waste materials.
- K28 the recording documentation to be completed for the dismantling undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation.
- K29 the problems that can occur during the dismantling activity and how they can be overcome.
- K30 the extent of their own authority and to whom they should report if they have a problem that they cannot resolve.

Unit 405

Dismantling Aircraft Gas Turbine Engines to Module/Unit Level

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

357

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 reassembly of aircraft gas turbine engine overhauled modules, into part and final engine assemblies, in accordance with approved procedures. It covers both fixed wing and rotary winged aircraft engines. In carrying out the reassembly operations, they will be required to follow laid-down procedures and specific engine assembly techniques in order to assemble the various sub-assembly units and components.

They will be required to obtain all the required tools and equipment for the assembly operations, and to check that they are in a safe and usable condition. They will then rebuild the gas turbine engine assembly, which will involve fitting new replacement or overhauled sub-assembly units such as fan case, front fan, compressor module, combustor module, turbine module and gearbox. The rebuilding activities will include making all necessary checks and adjustments to ensure that components are correctly replaced, positioned, aligned, adjusted, torque loaded, locked and fastened, and that the correct sealants are used.

Their responsibilities will require them to comply with organisational policy and procedures for the reassembly of the aircraft gas turbine engine, and to report any problems with the reassembly activities or with the tools and equipment used that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. They must ensure that all tools, equipment and materials used in the assembly activities are correctly accounted for and removed from the work area on completion of the activities, and that all necessary job/task documentation is completed accurately and legibly. 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 appropriate reassembly techniques and procedures to aircraft gas turbine engines. They will understand the assembly methods and procedures used, and their application. They will know how the engine functions, the purpose of the individual modules, relevant components and fastening devices, in adequate depth to provide a sound basis for carrying out the reassembly activities to the required specification.

They will understand the safety precautions required when carrying out the reassembly activities associated with aircraft gas turbine engines, especially those for lifting, handling and supporting the equipment being assembled. 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 instructions, assembly drawings and any other specifications.
- P4 ensure that the specified components are available and that they are in a usable condition.
- P5 use the appropriate methods and techniques to assemble the components in their correct positions.
- P6 secure the components using the specified connectors and securing devices.
- P7 check the completed assembly to ensure that all operations have been completed and the finished assembly meets the required specification.
- P8 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 reassembly of the aircraft gas turbine engine:
 - 1.1 obtain and use the correct issue of engine assembly drawings, overhaul manual and planning documentation
 - 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 safe access and working arrangements for the assembly area
 - 1.4 ensure that all the required modules and components are available and have the correct part numbers
 - 1.5 ensure that all tools and measuring instruments to be used are within current calibration dates
 - 1.6 ensure that the engine/modules are suitably supported
 - 1.7 use lifting and slinging equipment in accordance with health and safety guidelines and procedures
 - 1.8 carry out the reassembly activities, using approved techniques and procedures
 - 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 ensure that all work carried out is correctly documented and recorded

- 1.12 leave the work area and engine in a safe and appropriate condition on completion of the activities.
-

Learning outcome

The learner will:

- 2 carry out the reassembly of **one** of the following types of aircraft gas turbine engine:
- 2.1 turbo prop
 - 2.2 turbo jet
 - 2.3 turbo-fan
 - 2.4 ducted fan
 - 2.5 turbo-shaft
 - 2.6 ground turbine start (GTS).
-

Learning outcome

The learner will:

- 3 reassemble aircraft gas turbine engines, to include refitting **five** of the following:
- 3.1 fan case
 - 3.2 compressor module
 - 3.3 turbine
 - 3.4 front fan
 - 3.5 combustor module
 - 3.6 gearbox
 - 3.7 exhaust/reheat assembly
 - 3.8 bypass duc.
-

Learning outcome

The learner will:

- 4 carry out **ten** of the following reassembly methods and techniques on the engine being rebuilt:
- 4.1 cleaning parts/mating faces prior to assembly
 - 4.2 correctly positioning and orienting the modules to be assembled
 - 4.3 fitting gaskets and applying sealant/adhesives
 - 4.4 aligning components
 - 4.5 assembly of components by pressure
 - 4.6 assembly of components by expansion or contraction
 - 4.7 'blue bedding' components (where applicable)
 - 4.8 setting and adjusting replaced components (such as shimming and packing)
 - 4.9 torque setting of bolts, fasteners, clips, sub-assemblies
-

- 4.10 electrical bonding of components
 - 4.11 securing components using mechanical fasteners and threaded devices
 - 4.12 applying locking and retaining devices (such as circlips, pins, wire locking, lock nuts, stiff nuts, swage nuts)
 - 4.13 applying protection to openings to prevent entry of contaminating debris.
-

Learning outcome

The learner will:

- 5 carry out checks for accuracy, using the correct inspection and testing equipment, to include **all** of the following
 - 5.1 dimensions
 - 5.2 alignment
 - 5.3 positional accuracy
 - 5.4 completeness
 - 5.5 freedom of movement
 - 5.6 visual inspection for completeness and freedom from damage or foreign objects
 - 5.7 operating/working clearance
 - 5.8 bearing end float (as applicable)
 - 5.9 `special-to-type' test rig checks
 - 5.10 orientation.
-

Learning outcome

The learner will:

- 6 complete the relevant paperwork, to include **one** of the following and pass it to the appropriate people:
 - 6.1 job cards
 - 6.2 computer records
 - 6.3 aircraft log books
 - 6.4 engine overhaul logs or reports
 - 6.5 work authorisation documents
 - 6.6 shift handover documentation.
-

Learning outcome

The learner will:

- 7 rebuild aircraft gas turbine engine assemblies 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)
-

- 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 organisation standards and procedures
 - 7.9 engine manufacturer's requirements.
-

Learning outcome

Knowledge and understanding:

Assessment criteria

The apprentice must know and understand

- K1 the specific safety precautions to be taken whilst carrying out the aircraft gas turbine engine reassembly (including any specific legislation, regulations or codes of practice relating to the activities, equipment or materials).
- K2 the health and safety requirements of the work area in which they are carrying out the reassembly activities, and the responsibility these requirements place on them.
- K3 COSHH regulations with regard to the substances used in the assembly process.
- 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 producing aircraft gas turbine engine assemblies, 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 reassembly activities.
- K8 the various types of drawing/overhaul manual and specification that are used during the reassembly activities.
- K9 how to identify the modules and components to be used; component identification systems (such as codes and component orientation indicators).
- K10 preparations to be undertaken on the modules and components, prior to fitting them into the assembly.
- K11 the reassembly methods and procedures to be used, and the importance of adhering to these procedures.
- K12 methods of reassembling the aircraft gas turbine engine, using new or previously overhauled components (such as replacing assemblies requiring pressure/force, ensuring correct orientation, bedding in bearings and components, replacing mechanical locking and securing mechanisms/devices, torque setting components).
- K13 how the components are to be positioned and aligned prior to securing them, and the tools and equipment to be used (such as use of jigs and fixtures, micrometers, Verniers, laser alignment techniques).

- K14 how to make adjustments to the replaced modules/assemblies to ensure that they function correctly (such as checking alignment, balancing of rotating components such as turbines, setting working clearance, setting travel, and pre-loading bearings).
- K15 the various mechanical fasteners that will be used and their method of installation (such as rivets, threaded fasteners, special securing devices).
- K16 the importance of using the specified mechanical fastening devices for the reassembly and why they must not use substitutes.
- K17 how to complete basic fitting practices, meeting regulatory and organisational requirements (such as torque tightening, wire locking, fitting wire thread inserts, fitting O-ring seals, fitting lock nuts, blue bedding, tab washers, cup washers and swage nuts).
- K18 dealing with components or fastening devices incorrectly assembled, damaged or having other faults.
- K19 the application of sealants and adhesives within the reassembly activities, and the precautions that must be taken when working with them.
- K20 the quality control procedures to be followed during the reassembly operations.
- K21 how to conduct any necessary checks to ensure the accuracy and quality of the gas turbine engine assemblies.
- K22 how to detect assembly defects and what to do to rectify them (such as ineffective fasteners, foreign object damage).
- K23 how to lift and move large engine modules and sub-assemblies; the methods and equipment used to transport, handle and lift the assemblies during the rebuilding activities.
- K24 the need to ensure that lifting and handling equipment is within its current certification dates.
- K25 how to check that the tools and equipment to be used are correctly calibrated and are in a safe and serviceable condition.
- K26 the importance of ensuring that all tools are used correctly and within their permitted operating range.
- K27 the importance of ensuring that the completed assembly is free from dirt, swarf and foreign objects.
- K28 the importance of ensuring that all tools, equipment and components are accounted for and returned to their correct location on completion of the assembly activities.
- K29 problems with the reassembly operations and the importance of informing appropriate people of non-conformances.
- K30 the procedure for the safe disposal of waste materials.
- K31 the recording documentation to be completed for the aircraft gas turbine engine rebuilding activities undertaken and, where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation.
- K32 the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

Unit 406

Rebuilding Aircraft Gas Turbine Engine Assemblies after Overhaul

Supporting Information

Unit guidance

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

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

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

Appendix 1 Useful contacts

UK learners

General qualification information

E: learnersupport@cityandguilds.com

International learners

General qualification information

F: +44 (0)20 7294 2413

E: intcg@cityandguilds.com

Centres

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

F: +44 (0)20 7294 2413

E: centresupport@cityandguilds.com

Single subject qualifications

Exam entries, Results, Certification, Missing or late exam materials, Incorrect exam papers, Forms request (BB, results entry), Exam date and time change

F: +44 (0)20 7294 2413

F: +44 (0)20 7294 2404 (BB forms)

E: singlesubjects@cityandguilds.com

International awards

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

F: +44 (0)20 7294 2413

E: intops@cityandguilds.com

Walled Garden

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

F: +44 (0)20 7294 2413

E: walledgarden@cityandguilds.com

Employer

Employer solutions, Mapping, Accreditation, Development Skills, Consultancy

T: +44 (0)121 503 8993

E: business@cityandguilds.com

Publications

Logbooks, Centre documents, Forms, Free literature

F: +44 (0)20 7294 2413

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

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

About City & Guilds

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

City & Guilds Group

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

Copyright

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

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

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

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

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

City & Guilds

1 Giltspur Street

London EC1A 9DD

T +44 (0)844 543 0000

F +44 (0)20 7294 2413

www.cityandguilds.com
