Unit 72: Aircraft Maintenance Practices

Unit code: L/600/7174

QCF Level 3: BTEC Nationals

Credit value: 10

Guided learning hours: 60

Aim and purpose

This unit will give learners an understanding of aircraft handling and first line maintenance safety precautions, procedures and related documentation. Learners will also carry out a range of aircraft ground handling and first line maintenance activities, in a safe and efficient manner.

Unit introduction

Aircraft require careful preparation before each flight, for example, the replenishment of fuel and checks for leaks and structural and system damage. When the aircraft engines are started, the ground crew must be in visual and/or radio contact with the aircrew and be able to operate the relevant ground equipment. Therefore, an understanding of aircraft handling and first-line maintenance activities is essential for anyone wishing to practice as an aircraft maintenance technician.

This unit has been designed to provide learners with the knowledge, skills and understanding needed to carry out a range of aircraft maintenance procedures in a safe, efficient and timely manner.

Safety is vital during aircraft maintenance, to protect both individuals and the integrity of the aircraft. Therefore this unit will cover the health and safety issues relating to all aspects of aircraft ground handling and first line maintenance. The practice and procedures to be followed for aircraft ground handling, weighing and after an abnormal occurrence are then introduced.

The unit will look at a range of general maintenance activities, such as working in confined spaces and marshalling and chocking aircraft, as well as specialist activities that would normally be undertaken by line mechanics or avionic or mechanical aircraft maintenance technicians.

Learners will also be introduced to the requirements and use of maintenance documents, manuals and administrative procedures. This will include maintenance planning and related documentation, stores procedures and quality processes.

The unit also covers part of the knowledge requirements for those taking the European Aviation Safety Agency (EASA) Part-66 examinations.

Learning outcomes

On completion of this unit a learner should:

1 Understand the health and safety precautions directly associated with aircraft handling and first line maintenance

2 Understand the practice and procedures necessary for aircraft ground handling, weighing and balancing and in the event of abnormal occurrences

3 Be able to carry out selected aircraft maintenance activities in accordance with laid down procedures and safety precautions

4 Understand the procedures and requirements for the planning, documentation, stores systems and quality processes associated with aircraft maintenance.

Unit content

1 Understand the health and safety precautions directly associated with aircraft handling and first line maintenance

Aircraft handling safety precautions: aircraft engine running safety zones; radio transmission electro-static hazards and safety zones; earthing; bonding; ground use fire extinguishers (carbon dioxide, dry powder, foam)

Aircraft first line maintenance safety precautions: general maintenance eg highway staging and working at height, working in confined spaces, hoisting and lifting operations; specialist maintenance eg aircraft refuelling/de-fuelling, oxygen/Lox replenishment, application of electrical ground power, application of hydraulic/pneumatic ground power, replenishment of engine and hydraulic system oils and gases, ground de-icing/anti-icing, fitment of static blanks, flying control locks and undercarriage locks, cold weather precautions

2 Understand the practice and procedures necessary for aircraft ground handling, weighing and balancing and in the event of abnormal occurrences

Ground handling: practice and procedures eg aircraft taxiing and towing, marshalling, jacking and trestling, chocking, static blanks engine starting and running, aircraft earthing and bonding, using appropriate first-aid fire appliances, anti-deterioration checks, cold weather checks, inhibiting, storage

Inspection procedures after abnormal occurrences: procedures eg lightning strike, tyre burst, heavy landing, bird strike, flight through turbulence

Aircraft weight and balance: general terms (basic weight, basic load, variable load, disposable load, maximum take-off weight, balance limits, reaction, moment arm); equipment and procedures eg use of weighbridge, weighing units, aircraft weight and centre of gravity determination, weight and balance documentation

3 Be able to carry out selected aircraft maintenance activities in accordance with laid down procedures and safety precautions

Selected aircraft maintenance activities: following laid down procedures and observing safety precautions; general maintenance eg assist with jacking and trestling aircraft, remove/fit highway staging, ladders and platforms, fit aircraft static blanks and covers, chock and secure aircraft, operate air stairs, operate fuselage and cargo bay doors, marshal aircraft, inhibit aircraft component or system; specialist maintenance eg apply electrical ground power, carry out pitot-static checks, apply pneumatic and/or hydraulic ground power, earth and bond an aircraft, replenish engine oils, replenish hydraulic system oils, charge system air/nitrogen gas bottles, carry out anti-deterioration checks, ground de-icing/anti-icing procedures, oxygen replenishment, Lox replenishment, navigation light bulb change; other activities eg assist in weighing an aircraft and determining its centre of gravity, carry out abnormal occurrence inspection/s, operate cabin doors, clean transparencies, check security of canopies, hatches and/or servicing access doors

4 Understand the procedures and requirements for the planning, documentation, stores systems and quality processes associated with aircraft maintenance

Planning: civil or military maintenance planning eg approved maintenance programmes and schedules, check cycles, equalised servicing, opportunity servicing; additional maintenance requirements eg minor and major modifications, special technical instructions (STI), servicing instructions (SI), airworthiness directives (AD)

Documentation: content and purpose of civil or military maintenance documentation eg maintenance manuals, repair manuals, records/recording documents, historical record cards, serial and part numbers, logbooks, certificate of release to service (CRS), MOD Form 700

Stores: civil or military stores systems eg layout, procedures, parts/equipment tracking and record keeping, quarantine stores, bonded stores, parts classification (aircraft general spares AGS, A, B, C stores, consumables, life-limited items), issue of parts/equipments, parts manuals

Quality processes: function and role of civil or military quality departments (quality assurance/control systems, inspection department); function and role of inspection/checks eg military first, second, third and fourth line system, civil A, C, D, ramp and transit system, scheduled, unscheduled, authorisations, duplicate inspections, independent checks; control of life-limited components/equipment eg hard-time, on-condition, condition monitoring

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 explain the reasons for and detail the safety precautions to be observed during aircraft handling operations	**M1** using given data from an aircraft weight and balance check, determine the aircraft weight and centre of gravity position	**D1** explain the administrative procedure and detail all the requirements needed to clear the civil CRS or military aircraft log (MOD Form 700), prior to aircraft flight
P2 explain the need for and describe the safety procedures to be followed when, working at height, working in confined spaces and when carrying out hoisting/lifting operations	**M2** explain the need for and nature of two civil or military aircraft maintenance activities	**D2** explain the requirements, documentation and procedures necessary for raising, carrying out and completing a civil or military duplicate/independent maintenance check.
P3 explain the need for and describe the safety precautions and procedures for two specialist first line maintenance activities	**M3** explain the procedures and methods for tracking, issuing and recording major parts and life limited items within a civil or military stores system.	
P4 describe two ground handling practices and procedures and one inspection procedure after an abnormal occurrence, including all related safety precautions		
P5 define all the general terms associated with aircraft weight and balance and explain the need for the completion of the aircraft weight and balance documentation		
P6 carry out two general and one other given aircraft maintenance activity, following laid down procedures, using related documentation and observing all necessary safety precautions [IE1, SM3, SM4]		

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P7 carry out two specialist given maintenance activities, following laid down procedures, using related documentation and observing all necessary safety precautions and record actions taken [IE1, SM3, SM4]		
P8 state the purpose of and describe a typical civil or military check cycle or equalised servicing cycle that includes planned provision for an additional aircraft maintenance requirement		
P9 describe the general content and state the purpose of civil or military maintenance manuals, repair manuals and work recording documents		
P10 define and explain the need for quarantine and bonded stores when used in a civil or military system		
P11 explain the role and functions of a civil or military quality department		
P12 explain the function and role of a military or civil inspection/check system and describe how life-limited components/equipment are controlled within a quality process.		

PLTS: This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills applicable in the pass criteria. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

This unit has been designed to provide learners with an understanding of the safety precautions, procedures and documentation associated with aircraft ground handling and first line/hangar maintenance. When delivering the unit content, a real or realistic maintenance training environment should be used wherever possible.

Delivery should ensure that the theory relating to safety procedures and documentation is taught before the practical aspects of the unit. Safety issues and precautions associated with aircraft ground handling and first line/hangar maintenance activities should be delivered right at the start. Emphasis should be placed on the maintenance safety precautions directly associated with the specialisation of the cohort being taught, as well as on the mandatory safety precautions associated with aircraft ground handling.

When delivering the theory aspects of learning outcome 2, the associated documentation and recording procedures could also be taught. This will enable learners to become familiar with maintenance manuals, repair and parts manuals. This can also link to learning outcome 4 by covering the documents for recording work such as job cards and the status of the parts and consumables that might be required to complete associated handling and maintenance procedures.

In order to put the maintenance documentation into context, it would be useful to teach the parts of learning outcome 4 relating to aspects of maintenance planning and quality control that affect the execution of maintenance. In this way the need for and identification of the different types of servicing and check cycles could be taught and their relationship to the actual work cards and job recording system could be explained. How the quality and integrity of aircraft components and systems are achieved could also be explained at this stage. Learners would then have sufficient underpinning knowledge to start on the practical activities for learning outcome 3. The range of practical activities listed in the content would best be undertaken in a real maintenance environment, although they could equally be carried out in a realistic training environment, providing the centre has the necessary physical resources and equipment.

Centres may be involved in partnerships with airline operators, third party maintenance organisations, Part 147 approved organisations or with Armed Services establishments where the required practical work can be undertaken. In all such environments, there is the further opportunity for learners to familiarise themselves with the associated reference and recording documentation directly applicable to their specialisation.

Finally the remainder of the content of learning outcome 4, necessary to meet the criteria M3, D1 and D2 may be taught.

Throughout delivery of the unit, emphasis needs to be placed on all associated safety issues and the mandatory documentation that needs to be followed and completed. For this reason it will be noted that these two vitally important elements make up the majority of the grading criteria.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way in planning the delivery and assessment of this unit.

Topic and suggested assignments/activities and/assessment
Whole-class teaching: • introduction to unit content, scheme of work and assessment strategy • in an aircraft maintenance environment, explain and familiarise learners with aircraft engine running zones, radio-transmission electro-static hazards and safety zones, earthing, bonding and personal protection, ground use fire extinguishers • explain and familiarise learners with general safety procedures and precautions and specialist safety precautions applicable to cohort. *Small-group activities:* • learners to investigate and familiarise themselves with the precautions associated with the safe use of equipment. *Individual activity:* • multiple-choice quiz on handling and maintenance safety.
Prepare and carry out **Assignment 1: Aircraft Handling and First Line Maintenance** (P1, P2, P3).
Whole-class teaching: • in an aircraft first line maintenance environment demonstrate and explain (with appropriate manuals and documentation) practices and procedures such as jacking and trestling, chocking, removal/fit of static blanks, gustlocks, use and application of appropriate first-aid fire appliances • in an aircraft maintenance environment (with associated manuals and documentation) explain inspection procedures applicable to cohort such as after a, lightning strike, tyre burst, heavy landing, bird strike, flight through turbulence • explain the general terms associated with aircraft weight and balance, the equipment used for weight and balance, the documentation associated with weight and balance and simple calculations to determine aircraft weight and centre of gravity position *Individual activity:* • investigate (using aircraft manuals and work recording documents), procedures and related safety issues for given ground handling, inspection and weight and balance tasks
Prepare for and carry out **Assignment 2: Ground Handling, Weight and Balance and Abnormal Occurrences** (P4, P5, P9, M1).
Whole-class teaching: • in an aircraft maintenance environment explain maintenance planning as associated with the military or civil cohort being taught • revise and consolidate previous learning on use of documentation • in real or simulated aircraft maintenance stores, explain and familiarise learners with military or civil aircraft maintenance engineering stores systems • explain the function of military or civil quality departments such as aircraft maintenance quality assurance and control, quality inspection, scheduled and unscheduled maintenance, duplicate/independent inspections, authorisations and paper trail, control of life-limited items.

Topic and suggested assignments/activities and/assessment
Group activity: • visit to aircraft maintenance, overhaul or repair facility to see first hand their planning, stores and quality departments and aircraft handling/maintenance activities. *Individual activity*: • multiple-choice quiz on procedure and requirements for aircraft maintenance, planning, documentation, stores and quality processes.
Prepare for and carry out **Assignment 3: Planning, Stores, Quality and Inspection Procedures** (P8, P10, P11, P12).
Prepare for and carry out **Assignment 4: Aircraft Maintenance Practice** (P6, P7, M2).
Whole-class teaching: • revise and expand on stores procedures, documentation and quality processes.
Prepare for and carry out **Assignment 5: Advanced Documentary Procedures and Requirements** (M3, D1 and D2).
Feedback on assessment and unit review.

Assessment

This unit could be assessed through the use of five assignments.

Evidence for P1, P2 and P3 might best be provided from the answers to a formal written assessment.

For P1 learners must explain the reasons for aircraft handling precautions. This means, that they must have knowledge of the safety zones when aircraft engines are running and understand the dangers associated with intake pulling forces and the implications of foreign object debris (FOD) ingestion. They will also need to explain the dangers associated with engine exhaust efflux when the aircraft is turning into or away from the parking area. Learners also need to explain the electro-static hazards associated with radio transmission and the reasons for earthing and bonding the aircraft. The use of fire extinguisher equipment should also be explained, including carbon dioxide, dry powder and foam.

For P2 learners will need to identify the necessary precautions when working at height, moving suspended loads, positioning highway staging and when working in confined spaces.

Learners must also explain the use and nature of the safety precautions and the related maintenance procedures for two specialist activities (P3). They will also have to explain the fairly obvious need for the precautions associated with these activities. Giving learners the choice of specialist safety precautions enables them to concentrate on those associated with their individual maintenance path. For example, those with an avionic bias might concentrate on the safety issues associated with the connection of electrical ground power and the fitting of pitot static blanks and other instrument bungs.

The second formal written assignment could cover P4, P5, P9 and M1. This would need to include tasks requiring learners to describe two ground handling practices and one inspection procedure after an abnormal occurrence (P4), detailing all related safety precautions. For P5 learners must be able to define all the general terms associated with weight and balance and explain the need for the completion of the aircrafts weight and balance documentation. Since learners will need to describe the content and use of associated documentation when detailing these handling practices and inspection procedures, then they will be covering the requirements of P9, which might therefore, be usefully assessed at the same time. A further written task could be used to assess M1.

A third written assignment could meet the requirements of P8, P10, P11 and P12 and should be set at a time when learners are about to start their practical activities.

Learners must be able to state the purpose and describe a typical check cycle or equalised servicing cycle, that also includes planning provision for an additional maintenance requirement, such as the embodiment of a modification or the satisfaction of a special technical instruction or service bulletin (P8). They will need to define and explain the need for quarantine and bonded stores, within a typical maintenance environment such as a hangar (P10). Tasks should also be included that require explanation of the role and functions of a civil or military quality department (P11) and the functions/role of inspection/check systems and how life-limited components/equipment are controlled (P12). When describing the control of life-limited items, learners need to include the appropriate maintenance actions necessary for continued airworthiness and integrity of the aircraft structure and systems.

The practical assignment will need to provide learners with an opportunity to carry out two given general maintenance activities, one other maintenance activity (P6), as well as two given specialist activities (P7). For the specialist activities, all actions must be recorded in accordance with laid down standards, using the correct documentation. The most appropriate method for gathering evidence for the achievement of P6 and P7 might be through use of expert witness statements and/or observation records. Annotated photographs could also supplement these statements/records. Tasks should be assessed not only in terms of practical competence but also to ensure all technical procedures, safety precautions and related documentation have been adhered to, as appropriate. Assessment evidence for the achievement of M2 could be obtained from a written report that explains the need and nature of two of the general/specialist maintenance activities carried out for P6 or P7.

The fifth assignment could cover M3, D1 and D2. Learners must be able to explain the procedures and methods for tracking, issuing and recording major parts and life limited items within a civil or military stores system (M3). Evidence of achievement of M3 might best be obtained from a written report resulting from an investigative assignment. The report might include, historical record cards, serial and part numbers, records of related maintenance and life recording and tracking methods. The report would need to include tasks for D1 and D2, which would need to contain detail on the procedure to be adopted prior to, during and after clearing the civil CRS or the military Mod Form 700 or their equivalent as well as details of those personnel qualified to clear these documents.

Programme of suggested assignments

The table below shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the assessment and grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Edexcel assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, P3	Aircraft Handling and First Line Maintenance	A formal written assignment requiring learners to respond to written tasks.	Written response to set tasks, carried out under controlled conditions.
P4, P5, P9, M1	Ground Handling, Weight and Balance and Abnormal Occurrences	A formal written assignment requiring learners to respond to written tasks.	Written response to set tasks, carried out under controlled conditions.
P8, P10, P11, P12	Planning, Stores, Quality and Inspection Procedures	An investigative assignment, undertaken in an aircraft maintenance environment. Set when learners are about to start their practical activities.	Written report produced by the learner, as a result of the investigative assignment.
P6, P7, M2	Aircraft Maintenance Practice	In a real or authentic aircraft maintenance training environment, carry out set practical aircraft handling/ maintenance activities and investigation.	Tutor reports and/or expert witness testimony and/or completed pre-prepared assessment sheets (P6, P7). Written report, produced by learner as a result of the investigation (M2).
M3, D1, D2	Advanced Documentary Procedures and Requirements	An investigative assignment, undertaken in an aircraft maintenance environment.	An investigative written assignment.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC Engineering sector suite. This unit has particular links with:

Level 1	Level 2	Level 3
		Aircraft Materials and Hardware
		Aircraft Workshop Principles and Practice
		Airframe Structural Concepts and Construction Methods

This unit has been mapped against the EASA Part-66 examinations and, together with *Unit 69: Aircraft Workshop Principles and Practice*, *Unit 70: Aircraft Materials and Hardware* and *Unit 79: Airframe Structural Concepts and Construction Methods* covers the knowledge requirements for Modules 6 Aircraft Materials and Hardware and Module 7 Aircraft Maintenance Practices.

This unit also contributes knowledge towards the SEMTA Level 3 National Occupational Standards in Aeronautical Engineering, particularly:

- Unit 301: Lifting and Trestling/Shoring Aircraft for Maintenance/Repair Operations
- Unit 302: Levelling and Weighing Aircraft
- Unit 303: Towing, Marshalling and Parking Aircraft
- Unit 304: Carrying out Flight Servicing and Routine Maintenance of Aircraft.

Essential resources

Access to the following resources is considered essential to meet the learning outcomes:

- real or training centre aircraft, in a real or training aircraft maintenance environment
- associated ground servicing and support equipment (such as jacks, trestles, ladders, staging platforms, test rigs, inspection equipment, ground handling and replenishment equipment, first aid fire appliances, hoisting and lifting equipment, shoring and levelling equipment)
- maintenance manuals, repair/overhaul manuals, servicing documentation, stores and serviceability records documentation, worksheets and job cards, quality processes documentation, certification and aircraft clearance documents, control and release documentation.

Employer engagement and vocational contexts

Liaison with employers would prove of immense benefit to centres, especially if they are able to offer help with the provision of resources that may not be available at the centre. Visits to military or civil aircraft maintenance, overhaul or repair facilities, to view first line maintenance activities on live aircraft would also be of great benefit to learners.

Much of the work for this unit can be set in the context of learners' work placements or be based on case studies of local employers. Further information on employer engagement is available from the organisations listed below:

- Work Experience/Workplace learning frameworks – Centre for Education and Industry (CEI – University of Warwick) – www.warwick.ac.uk/wie/cei/
- Learning and Skills Network – www.vocationallearning.org.uk
- Network for Science, Technology, Engineering and Maths Network Ambassadors Scheme – www.stemnet.org.uk
- National Education and Business Partnership Network – www.nebpn.org
- Local, regional Business links – www.businesslink.gov.uk
- Work-based learning guidance – www.aimhighersw.ac.uk/wbl.htm

Indicative reading for learners

Textbooks

Jeppesen Sanderson – *A&P Technician Airframe Textbook* (Jeppesen Sanderson Training Products 2003) ISBN 0884873315

Health and Safety Executive – *Health and Safety in Engineering Workshops* (Health and Safety Executive, 2004) ISBN 0717617173

Other publications

Air Publications – 101 series of manuals and aircraft engineering publications (Military)

ATA – 100 Series, specialist publications from the Joint Aviation Authority sanctioned by the European Aviation Safety Agency (Civil)

Delivery of personal, learning and thinking skills

The table below identifies the opportunities for personal, learning and thinking skills (PLTS) that have been included within the pass assessment criteria of this unit.

Skill	When learners are ...
Independent enquirers	identifying questions to answer and problems to resolve when carrying out maintenance activities
Self-managers	organising time and resources, prioritising actions and anticipating and managing risks when carrying out maintenance activities.

Although PLTS are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are ...
Creative thinkers	setting goals with success criteria for their development and work
Team workers	collaborating with other when carrying out aircraft maintenance activities.

Functional Skills – Level 2

Skill	When learners are ...
English	
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	researching and investigating aircraft workshop procedures and practice
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	explaining the safety precautions to be observed during aircraft handling and maintenance operations.