Unit 76: Aircraft Maintenance Practices

NQF Level 3: BTEC National

Guided learning hours: 60

Unit abstract

Aircraft require careful preparation before each flight. Essential replenishment of fuel and oil, checks for leaks and structural and system damage must all be carried out prior to flight. 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.

This unit will give learners 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 those required 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. These will be covered in detail either from a military or civil perspective, depending on learners' interests or chosen vocational area.

The unit will benefit those undertaking a modern apprenticeship in aircraft maintenance, members of the armed forces, and those employed by civil and general aviation operators and third party maintenance organisations.

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 Know about 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 hazard, safety zones); earthing; bonding; ground use fire extinguishers (carbon dioxide, dry powder, foam)

Aircraft first line maintenance safety precautions: general (highway staging and working at height, working in confine spaces, hoisting and lifting operations) specialist 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

2 **Know about 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, engine starting and running, aircraft earthing and bonding, using appropriate first-aid fire appliances, anti-deterioration checks

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: general eg assist with jacking and trestling aircraft, remove/fit highway staging, ladders and platforms, fit aircraft static blanks and covers, chock and secure aircraft, marshal aircraft; specialist 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 eg assist in weighing an aircraft and determining its centre of gravity, carry out abnormal occurrence inspection/s; application of safety precautions; use of related documentation for the activity

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 (such as, 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/equipments eg hard-time, on-condition, condition monitoring

Grading grid

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

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 aircraft handling safety precautions P2 identify and explain the importance of general first line maintenance safety precautions and two given specialist safety precautions P3 describe two ground handling practices and procedures and one inspection procedure after an abnormal occurrence P4 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 P5 carry out three general, three specialist and one other aircraft maintenance activity in a safe manner using related documentation	M1 assist in carrying out an aircraft weight and balance check and determine the aircraft weight and centre of gravity position M2 explain the need for and nature of two civil or military aircraft maintenance activities M3 explain the procedures and methods of tracking, issuing and recording major parts and life-limited items within a civil or military stores system.	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 D2 explain the requirements, documentation and procedures necessary for raising, carrying out and completing a civil or military duplicate/independent maintenance check.

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:**
P6 state the purpose of and describe a typical civil or military check cycle or equalised servicing cycle planned for an additional aircraft maintenance requirement P7 describe the content and state the purpose of civil or military maintenance manuals, repair manuals and work recording documents P8 define and explain the need for quarantine and bonded stores when used in a civil or military system P9 explain the role and functions of a civil or military quality department P10 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.		

Essential guidance for tutors

Delivery

This unit will give learners an understanding of the safety precautions, procedures and documentation associated with aircraft ground handling and first line/hangar maintenance activities.

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 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 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.

Next, 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. 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 theory 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 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.

Note that the use of 'eg' in the content is to give an indication and illustration of the breadth and depth of the area or topic. As such, not all content that follows an 'eg' needs to be taught or assessed.

Assessment

The following assessment strategy for this unit is based on the suggested delivery guidance above.

An appropriate assessment method for P1 and P2 (knowledge and understanding of safety precautions) might be a formal written assessment.

In order to satisfy P1, learners must explain the reasons for the aircraft handling precautions listed in the unit content. This means, for example, 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. They will also need to explain the fairly obvious importance of these precautions.

The choice of specialist safety precautions enables learners to concentrate on those associated with their individual specialism. For example, those with an avionic bias might concentrate on the safety associated with the connection of electrical ground power and the fitting of Pitot static blanks and other instrument bungs.

P3 and P4 cover learning outcome 2. As mentioned in the delivery section learners will need to explain the content and use of associated documentation when describing handling and maintenance practices and procedures. This links to P7, which could also be assessed at the same time.

An appropriate form of assessment might be a theoretical assignment in which learners describe the ground handling practices and procedures, the procedure after an abnormal occurrence (P3) and weight and balance terms and procedures (P4). They could then describe the purpose and content of the documentation required to undertake and complete these procedures (P7).

As part of a separate theoretical assignment learners could be set a number of questions to satisfy P6, P8, P9 and P10.

For example, for P6 learners might be required to produce and explain a flow diagram for a typical check cycle system or equalised servicing system. This would incorporate typical additional maintenance requirements such as the embodiment of modifications, the satisfaction of servicing instructions, airworthiness directives or special technical instructions.

In order to satisfy P8 learners need to define and explain the need for quarantine and bonded stores within a typical aircraft maintenance environment.

P9 and P10 cover the quality processes element of learning outcome 4. 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. This assignment might best be set at a time when learners are about to start their practical activities in a real or simulated aircraft maintenance environment.

P5, M1 and M2 are associated with learning outcome 3. The most appropriate method for gathering evidence for the practical activities detailed in P5 is by 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. To satisfy M2, learners would be expected to produce a written report or similar that explains the need and nature of two of the maintenance activities carried out for P5.

For M1 centres will need access to a light aircraft and the associated lifting and weighing units. Again evidence can be gathered from expert witness statements and/or observation records, supplemented by annotated photographs.

The more in-depth requirements for learning outcome 4 are covered by M3, D1 and D2. These might be best assessed through an investigative assignment, ideally carried out towards the end of the unit. This could provide learners with the opportunity to determine and explain the procedures/methods used in a particular stores system for issuing, recording and tracking major parts and life-limited items (M3). Such methods might include historical record cards, serial and part numbers, records of related maintenance and life recording and tracking methods.

Assessment evidence for D1 and D2 might come in the form of a report detailing the procedure to be adopted prior to, during and after clearing the civil CRS or the military Mod Form 700 or their equivalents. Learner should also provide details of those personnel qualified to clear these documents. A report or key-point procedure should be provided to satisfy D2, including the legislative requirements, the documents used and the necessary process for raising, carrying out and completing independent/duplicate maintenance checks.

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

This unit provides an opportunity to practice some of the skills and understanding associated with the SEMTA Level 3 National Occupational Standards in Aeronautical Engineering, particularly:

- Unit 135: Carrying Out Tests on Aircraft Pitot Static Systems
- Unit 136: Carrying Out Tests on Aircraft Communication Systems
- Unit 155: Carrying Out Tests on Aircraft Fuel and Storage Systems
- Unit 159: Carrying Out Tests on Aircraft Power Transmission Systems.

The unit also contributes to the knowledge content of modules 6 and 7 in the EASA Part 66 syllabus when taken with *Unit 74*: *Metallic Aircraft Materials, Structures and Repair* and *Unit 75*: *Non-metallic Aircraft Materials, Manufacture and Repair*.

Essential resources

Centres will need to provide access to suitable training aircraft/light aircraft and associated ground support equipment. The ground support equipment should include:

- electrical and hydraulic/pneumatic ground power units
- lifting equipment such as winches/hoists
- platforms or staging for working at height
- replenishment equipment for oils and gases
- aircraft lifting jacks and trestles
- pitot-static test equipment
- trestles and weighing units
- harnesses and other necessary safety equipment and clothing
- aircraft ground locks and blanks
- electrical and mechanical parts
- tool kits
- aircraft first-aid fire appliances.

Where centres are not able to provide this level of resource provision they should consider partnership with an EASA 147 approved training organisation, a military training school, local aircraft operator or any other approved aircraft maintenance/repair organisation.

Learners will also need access to aircraft maintenance, repair and parts manuals, work-recording documents and technical logs.

Indicative reading for learners

Textbooks

Dingle L and Tooley M — *Aircraft Maintenance Practice* (Elsevier, 2007) ISBN 9780750650168

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

Specialist texts

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

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

Key skills

Achievement of key skills is not a requirement of this qualification but it is encouraged. Suggestions of opportunities for the generation of Level 3 key skill evidence are given here. Tutors should check that learners have produced all the evidence required by part B of the key skills specifications when assessing this evidence. Learners may need to develop additional evidence elsewhere to fully meet the requirements of the key skills specifications.

Communication Level 3	
When learners are:	**They should be able to develop the following key skills evidence:**
• explaining the reasons for the safety precautions when handling aircraft • explaining the importance of general first line maintenance and specialist safety precautions • describing ground handling practices and procedures • explaining the need for completing aircraft weight and balance documentation • describing the content of civil or military maintenance manuals, repair manuals and work recording documents • explaining the need for quarantine and bonded stores • explaining the role and functions of a civil or military quality department • describing how an inspection/check is carried out and how life-limited components/equipment are controlled.	C3.3 Write **two** different types of documents, each one giving different information about complex subjects. One document must be at least 1000 words long.

Problem solving Level 3	
When learners are:	**They should be able to develop the following key skills evidence:**
• carrying out three general, three specialist and one other aircraft maintenance activity.	PS3.1 Explore a problem and identify different ways of tackling it. PS3.2 Plan and implement at least one way of solving the problem. PS3.3 Check if the problem has been solved and review your approach to problem solving.