

Higher National Unit Specification

General information for centres

Unit title: Aircraft Structures and Materials

Unit code: DP5P 34

Unit purpose: This Unit is designed to allow candidates to acquire an in-depth knowledge and understanding of the types of materials, fastening devices and basic structures used in modern aircraft construction. The Unit will also provide part of the knowledge element required to meet EASA IR part 66 aircraft maintenance license for module 6 (materials and hardware) and modules 11, 12 or 13 (aerodynamics, structures and systems).

On completion of the Unit the candidate should be able to:

- 1 Explain the characteristics and properties of materials and fabrics used in aircraft construction their testing and respective heat treatment processes.
- 2 Explain the types and causes of corrosion that can occur in aircraft materials.
- 3 Explain the types of fasteners, locking devices and rivets used in aircraft construction.
- 4 Explain the general concepts of aircraft structure, its classification and structural strength requirements necessary to meet airworthiness requirements.
- 5 Explain the construction methods of major components of an aircraft structure.

Credit points and level: 2 HN Credit at SCQF level 7: (16 SCQF credit points at SCQF level 7*)

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from Access 1 to Doctorates.*

Recommended prior knowledge and skills: Access to this Unit will be at the discretion of the centre. The Unit has no mandatory prerequisites, however it is recommended that the candidates have completed Unit (Aerodynamics) before commencing this Unit.

Core skills: There are opportunities to develop the Core Skills of communications, working with others and problem solving at Higher level in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

Context for delivery: If this Unit is delivered as part of a Group Award, it is recommended that it should be taught and assessed within the subject area of the Group Award to which it contributes.

General information for centres (cont)

Unit title: Aircraft Structures and Materials

Assessment: This Unit is assessed by three assessment events covering all of the individual Outcomes. The first and third assessments event will be carried out on a sampling basis and be composed of a number of appropriate structured short answer restricted response questions, each of approximately 75 words. The first assessment will cover Outcome 1 and the third Outcomes 3–5. The second assessment event will be a case study investigation and will cover Outcome 2. Assessment for the Unit will be carried out under a mixture of both open-book and supervised, controlled conditions.

In order to achieve this Unit, candidates are required to pass all assessments events by presenting sufficient evidence that they have met the minimum evidence requirements, giving satisfactory response to the sample questions.

The assessment instruments used should follow the general guidelines offered by the Scottish Qualification Authority (SQA) assessment model and an integrative approach to assessment is encouraged.

Accurate records should be made of the assessment instruments used showing how evidence is generated for each assessment, giving marking schemes and/or checklists, etc. Records of candidates' achievements should be kept. These records will be available for external verification.

Higher National Unit specification: statement of standards

Unit title: Aircraft Structures and Materials

Unit code: DP5P 34

Acceptable performance in this Unit will be the satisfactory achievement of the standard set out in this part of the specification. All sections of the statement of standards are mandatory and cannot be altered without reference to the SQA.

Since the Outcomes for this Unit are assessed on a sampling basis, the whole of the contents listed in the knowledge and/or skill sections must be taught and available for assessment. Candidates should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

Assessment events for this Unit will be carried out under a mixture of both open-book and supervised, controlled conditions and any notes made by the candidates during closed-book assessment should be handed in at the end.

The evidence requirements and assessment guidelines for the Unit are given at the end of the statements of standards.

Outcome 1

Explain the characteristics and properties of materials and fabrics used in aircraft construction their testing and respective heat treatment processes

Knowledge and/or skills

- ◆ ferrous and non-ferrous materials their characteristics, properties and identification
- ◆ testing and heat treatments processes of aircraft materials
- ◆ composite, non-metallic, wooden and fabric materials used in aircraft
- ◆ detection and repair of defects/deterioration in aircraft
- ◆ sealant and bonding agents for composite and non-metallic materials
- ◆ preservation and maintenance of wooden structure
- ◆ inspection methods for fabric materials

Outcome 2

Explain and investigate the types and causes of corrosion that can occur in aircraft materials

Knowledge and/or skills

- ◆ chemical fundamentals of corrosion
- ◆ formation of corrosion by galvanic action, microbiological contamination and stress
- ◆ types and causes of corrosion and their identification
- ◆ materials and their susceptibility to types of corrosion

Higher National Unit specification: statement of standards (cont)

Unit title: Aircraft Structures and Materials

Outcome 3

Explain the types of fasteners, locking devices and rivets used in aircraft construction

Knowledge and/or skills

- ◆ screw thread nomenclature, thread forms and tolerances for standard threads
- ◆ specification, identification and marking of aircraft bolts
- ◆ self locking, anchor and standard types nuts
- ◆ locking devices and the different types used to secure aircraft components
- ◆ specification, identification and heat treatment of rivets used on aircraft

Outcome 4

Explain the general concepts of aircraft structure, its classification and structural strength requirements necessary to meet airworthiness requirements.

Knowledge and/or skills

- ◆ airworthiness requirements for structural strength, fail safe, safe life and damage tolerance concepts
- ◆ structure classification of primary, secondary and tertiary structure along with zones and station identification
- ◆ types of forces acting on an aircraft structure
- ◆ system installation along with drainage and ventilation provision
- ◆ lightning strike protection and aircraft bonding

Outcome 5

Explain the construction methods of major components of an aircraft structure.

Knowledge and/or skills

- ◆ stressed skin fuselage, floors and reinforcement items
- ◆ formers, stringers, longerons, bulkheads and frames
- ◆ doublers, struts, ties and beams
- ◆ skinning and anti-corrosive protection
- ◆ attachments of wings, empennage and engines

Evidence requirements

Evidence for this Unit will be generated through three assessments events. The first assessment event will be carried out on a sampling basis of the knowledge and/or skills requirements of Outcomes 1 requiring the candidates to respond to three sampled questions by structured short answer, restricted response questions. This assessment must be carried out under closed-book supervised conditions and last one and a half hours, the candidates' response to each question being approximately 75 words.

Higher National Unit specification: statement of standards (cont)

Unit title: Aircraft Structures and Materials

The second assessment event covering Outcome 2 should be a case study investigation regarding the causes of corrosion that can occur in aircraft materials. The assessment will require the candidates to produce a report of approximately 1,000 words and in generating the evidence, candidates will need to show that they can evaluate the information from a variety of sources such as experiments, the internet and textbooks in order to produce a balanced report explaining the reasons for their conclusions. This assessment is to be carried out under open-book conditions and all submissions should be the candidate's own work.

The third assessment event will be carried out on a sampling basis of the knowledge and/or skills requirements of Outcomes 3 to 5 and require the candidates to respond to three sampled questions by structured short answer, restricted response questions. This assessment must be carried out under closed-book supervised conditions and last one and a half hours the candidates' response to each question being approximately 75 words.

In order to gain an assessment pass, candidates must submit sufficient evidence that they have met the minimum evidence requirements by giving satisfactory responses to all the assessment events.

For the first assessment, a candidate's response can be judged satisfactory if the evidence generated shows that depending upon the sampled questions the candidate can explain the:

- ◆ characteristics, properties and identification of different types of ferrous and non-ferrous materials
- ◆ different types of heat treatments and testing of ferrous and non-ferrous materials
- ◆ characteristics, properties and identification of composite, non-metallic, wooden materials and types of fabric used in aircraft
- ◆ detection methods and repair of defects/deterioration in composite, non-metallic, wooden and fabric material used in aircraft
- ◆ sealant and bonding agents used in composite and non-metallic materials
- ◆ preservation and maintenance of wooden structure
- ◆ inspection methods for fabric material

For the second assessment, a candidate's response can be judged satisfactory if the evidence generated shows that the candidate can in producing a report can explain the:

- ◆ chemical fundamentals of corrosion
- ◆ formation of corrosion by galvanic action, microbiological contamination and stress
- ◆ different types of corrosion and their identification
- ◆ different causes of corrosion
- ◆ susceptibility of different materials to different types of corrosion

For the third assessment, a candidate's response can be judged satisfactory if the evidence generated shows that depending upon the sampled questions, the candidate can explain the:

- ◆ screw thread nomenclature, thread forms and tolerances for standard threads
- ◆ specification, identification and marking of aircraft bolts
- ◆ different types of self locking, anchor and standard types nuts
- ◆ different types of locking devices used to secure aircraft components
- ◆ specification, identification and heat treatment of rivets used on aircraft

Higher National Unit specification: statement of standards (cont)

Unit title: Aircraft Structures and Materials

- ◆ airworthiness requirements for structural strength, what are fail safe, safe life and damage tolerance
- ◆ structures are classified as either primary, secondary or tertiary, how structures are split into zones and different structural stations identified
- ◆ forces that act on an aircraft structure during flight and ground operations
- ◆ aircraft system installation along with drainage and ventilation provision
- ◆ aircraft are protected from lightning strike and how aircraft are electrically bonded
- ◆ construction of stressed skin fuselage, floors and reinforcement items
- ◆ constructional methods used to manufacture formers, stringers, longerons, bulkheads and frames
- ◆ constructional methods of doublers, struts, ties and beams
- ◆ methods of skinning and applying anti-corrosive protection
- ◆ methods of attachments of wings, empennage and engines

Assessment guidelines

The assessment of this Unit should be carried out by three assessment events covering all five Outcomes of the Unit. The first event should cover Outcome one and be carried out under supervised control conditions and last one hour and a half hours. The sampled questions used to elicit candidates' evidence should take the form of structured, restricted response questions. For the second assessment event should cover Outcome two and be based upon a case study investigation. This assessment should be carried out under open-book conditions and candidates can support their submission with sketches, computer printouts and diagrams. Sufficient time to complete the report should be given to candidates, with ten hours of course time set aside for study research, the overall time allowed for completed submission being at the discretion of the centre. The third event should cover Outcomes three to five and be carried out under supervised control conditions and last one hour. The sampled questions used to elicit candidates' evidence should take the form of structured, restricted response questions.

The assessment instruments used for assessing this Unit should follow the general guidelines offered by the Scottish Qualification Authority (SQA) assessment model. Each centre should make a model answer as a marking guide for each sampled question asked and candidates awarded marks for key points and presentation of answers. Candidates can supplement written answer with sketches and diagrams to clarify points and be allowed to use scientific calculators to carry out any calculation. For candidates who do not achieve the minimum evidence requirement for each assessment, centres may allow candidates to re-sit the assessments at an appropriate time using different sampled questions based upon the same or another case study.

Administrative Information

Unit code:	DP5P 34
Unit title:	Aircraft Structures and Materials
Superclass category:	XP
Date of publication:	July 2005
Version:	01
Source:	SQA

© Scottish Qualifications Authority 2005

This publication may be reproduced in whole or in part for educational purposes provided that no profit is derived from reproduction and that, if reproduced in part, the source is acknowledged.

SQA acknowledges the valuable contribution that Scotland's colleges have made to the development of Higher National qualifications.

Additional copies of this Unit specification can be purchased from the Scottish Qualifications Authority. Please contact the Customer Contact Centre for further details, telephone 0845 279 1000.

Higher National Unit specification: support notes

Unit title: Aircraft Structures and Materials

This part of the Unit specification is offered as guidance. The support notes are not mandatory.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 80 hours, with each Outcome given a notional design length of fourteen hours. The Unit is also designed to have ten hours set aside for the investigation case study.

Guidance on the content and context for this Unit

This is a mandatory core Unit devised for the principals and technology section of the HNC/HND Aircraft Engineering Group Award. The Unit is intended to give candidate with an in-depth knowledge and understanding of the types of materials, fastening devices and basic structures used in modern aircraft construction.

The Unit will also provide part of the knowledge element required to meet EASA IR part 66 aircraft maintenance license for module 6 (materials and hardware) and modules 11, 12 or 13 (aerodynamics, structures and systems).

Content/ context corresponding to Outcomes

- 1 The characteristics, properties and identification of ferrous, non-ferrous, composite, non-metallic, wooden materials and types of fabric used in aircraft materials. The testing of ferrous and non-ferrous material to determine hardness, tensile strength, fatigue strength and impact resistance along with their respective heat treatment and application. The types of sealant and bonding agents used in composite and non-metallic materials and the methods of detection and repair of defects/deterioration in composite and wooden material, and fabric along with their preservation.
- 2 The chemical fundamentals of corrosion along with the different types of corrosion experienced by different types of materials. The susceptibility of different types of material to corrosion and the identification of different types of corrosion. Formation of corrosion by galvanic action, microbiological contamination and stress in aircraft components and structures.
- 3 Screw threads nomenclature, thread forms, dimensions and tolerances for standard threads used in aircraft along with measuring screw threads. The International standards of specification, identification and marking of aircraft bolts and nuts including self-locking, anchor nuts. Machine screw specification, studs, dowels and self tapping screws and locking devices including locking plates, split pins, pal nuts, wire-locking, quick release fasteners, keys, circlips and cotter pins that are used to secure aircraft components and the specification, identification and heat treatment of aircraft rivets.
- 4 General concepts of aircraft structures and airworthiness requirements for structural strength, fail safe, safe life and damage tolerance. The classification of an aircraft structure as primary, secondary or tertiary and how structures are split into zones and different structural stations identified. Aircraft system installation along with drainage and ventilation provision, how aircraft are protected from lightning strike and how they are electrically bonded. The types of forces that act on an aircraft structure during flight and during ground operations.

Higher National Unit specification: support notes (cont)

Unit title: Aircraft Structures and Materials

- 5 The construction methods of stressed skin fuselage, floors and reinforcement items. The methods of manufacturing formers, stringers, longerons, bulkheads, frames, doublers, struts, ties and beams for use in aircraft structures. The methods of skinning and applying anti-corrosive protection to component parts of a structure and methods of attaching wings, empennage and engines.

Guidance on the delivery and assessment of this Unit

This Unit is designed to provide candidates with professional knowledge and skills for the specific occupational area of aircraft engineering. It is logical to deliver this Unit sequentially by outcome, with a mixture of assignments, exercises and case studies. Having access to relevant publications is recommended and course work and assignment reports must be the work of individuals.

Assessment of this Unit is to be carried out by centres using the assessment instruments they consider most appropriate, although assessment instruments used should follow the general guidelines offered by the Scottish Qualification Authority (SQA). For assessments that are carried out under controlled condition, candidates should not be allowed to bring into assessment events textbooks, handouts or other prepared material.

Open learning

The Unit would be suitable for open and distance learning. The mode of delivery would be the same as other distance-learning Units by a range of self-study and tutor based assignments. Candidates would need to attend an approved study centre to sit the first and third assessment events.

Candidates with additional support needs

This Unit specification is intended to ensure that there are no artificial barriers to learning or assessment. The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering alternative Outcomes for Units. For information on these, please refer to the SQA document *Guidance on Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs*, which is available on the SQA website www.sqa.org.uk.

General information for candidates

Unit title: Aircraft Structures and Materials

This Unit is designed to enable you to acquire a knowledge and understanding of the types of materials, fastening devices and basic structures used in modern aircraft construction. In particular the Unit will look at how basic aircraft structures and materials apply to an aircraft engineering maintenance environment. The Unit is primarily intended candidates who are interested in aircraft engineering and is offered as an optional Unit in the HNC/HND Aircraft Engineering Group Award, although it may be of interest to candidates of other disciplines.

The Unit may be of particular interest to candidates who are interested in pursuing a career in aircraft maintenance engineering as it covers part of the knowledge requirements for both module 6 (Materials and Hardware) and module 11/12/13 (aerodynamics, structures and systems) of EASA IR part 66 aircraft licensing requirements for both mechanical and avionics engineers.

The Unit has five main areas, each area covered by a separate Outcome. The five main areas the Unit covers are:

- 1 Explain the characteristics and properties of materials and fabrics used in aircraft construction their testing and respective heat treatment processes.
- 2 Explain and investigate the types and causes of corrosion that can occur in aircraft materials.
- 3 Explain the types of fasteners, locking devices and rivets used in aircraft construction.
- 4 Explain the general concepts of aircraft structure, its classification and structural strength requirements necessary to meet airworthiness requirements.
- 5 Explain the construction methods of major components of an aircraft structure.

Assessment of the Unit will be by three assessment events. The first assessment will cover Outcome 1 and be a closed-book examination made up of structured restricted response questions. The second will be a case study investigation covering Outcomes 2 requiring you to compile a report on the causes of corrosion that can occur in aircraft materials. The third assessment will cover Outcomes 3 to 5 and be a closed-book examination made up of structured restricted response questions.

In the closed-book you will not be permitted to bring textbooks, handouts or other material into the assessment event.