

Higher National Unit Specification

General information for centres

Unit title: Aerodynamics

Unit code: DR0C 34

Unit purpose: This Unit is designed to allow candidates to acquire a knowledge and understanding of the basic aerodynamics of an aircraft. In particular the Unit will look at how an aircraft flies and how the aerodynamic forces produced in flight apply and affect an aircraft.

The Unit will also provide the knowledge element requirement to meet EASA IR part 66 aircraft Maintenance License (Module 8) Basic Aerodynamics.

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

- 1 Explain the physics of the atmosphere and how it affects flight.
- 2 Explain basic aerodynamics in relation to an aircraft in flight.
- 3 Explain the principles of the theory of flight of an aircraft.
- 4 Explain the static and dynamic stability of an aircraft in flight.

Credit points and level: 1 HN Credit at SCQF level 7 (8 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 DROA 33 (Mathematics and Physics for Aviation) before commencing this Unit.

Core skills: There are opportunities to develop the Core Skill of communications 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.

Assessment: This Unit is assessed by two assessments events covering all the Outcomes. The first assessment will cover Outcomes 1 and 2 and be carried out on a sampling basis composed of a number of appropriate structured short answer, restricted response questions, each of approximately 75 words.

General information for centres (cont)

Unit title: Aerodynamics

The second assessment will cover Outcomes 3 and 4 and be an investigation case study into aerodynamic factors. The assessments 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 both assessments by presenting sufficient evidence that they have met the minimum evidence requirements, giving satisfactory response to the sample questions and a satisfactory compilation and of the report.

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/examination, 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: Aerodynamics

Unit code: DR0C 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 assessment should be handed in at the end.

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

Outcome 1

Explain the physics of the atmosphere and how it affects flight.

Knowledge and/or skills

- ◆ composition of the atmosphere and its layers
- ◆ pressure, density, temperature and humidity
- ◆ International Standard Atmosphere
- ◆ atmospheric instruments used within an aircraft

Outcome 2

Explain basic aerodynamics in relation to an aircraft in flight.

Knowledge and/or skills

- ◆ pressure distribution around an aerofoil surface
- ◆ boundary layer, laminar and turbulent airflow
- ◆ wing camber, chord, shape and washout
- ◆ generation of lift and drag
- ◆ centre of pressure and angle of attack
- ◆ fineness and aspect ratio
- ◆ relationship between thrust, weight and aerodynamic resultant
- ◆ aerofoil contamination
- ◆ relationship between lift, weight, thrust and drag
- ◆ stalling in flight

Higher National Unit specification: statement of standards (cont)

Unit title: Aerodynamics

Outcome 3

Explain the principles of the theory of flight of an aircraft.

Knowledge and/or skills

- ◆ steady state flight performance
- ◆ climb performance
- ◆ gliding performance
- ◆ theory of forces in a turn
- ◆ load factor, flight envelope and structural limitations
- ◆ lift augmentation

Outcome 4

Explain the static and dynamic stability of an aircraft in flight

Knowledge and/or skills

- ◆ passive stability about an the longitudinal, lateral and directional axis's of an aircraft
- ◆ active stability of an aircraft in flight

Evidence requirements

Evidence for this Unit will be generated through two assessments events. The first assessment will cover Outcomes 1 and 2 and be carried out on a sampling basis of the knowledge and/or skills requirements of these Outcomes. The sampling basis being one from the knowledge and/or skills requirements Outcome 1, and three from Outcome 2 and will require the candidates to respond to the four 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.

The second assessment covering Outcomes 3 and 4 should be an investigation case study regarding the aerodynamic factors that affect an aircraft in flight and will require the candidates to produce a report of approximately 1,000 words. The topic of the report should cover at least one from each of the knowledge and/or skills requirements of Outcomes 3 and 4. In generating the evidence requirements for this assessment, candidates will need to show that they evaluate information from a variety of sources such as wind tunnel experiments, computer-based software and textbooks, in order to produce a balanced report that relate all the sampled subjects and can explain 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.

Higher National Unit specification: statement of standards (cont)

Unit title: Aerodynamics

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 both assessment events.

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

- ◆ explain the composition of air and the different layers of the atmosphere
- ◆ explain how pressure, density, temperature and humidity change with increasing altitude
- ◆ explain why we have an international standard atmosphere and state its value
- ◆ explain how atmospheric instruments operate within an aircraft
- ◆ explain how pressure is distribution around an aerofoil
- ◆ explain an aerofoils boundary layer both laminar and turbulent
- ◆ explain the terms wing camber, chord, shape and washout
- ◆ explain how lift and drag is generated
- ◆ explain the terms angle of attack and centre of pressure
- ◆ explain an aerofoil fineness and aspect ratio
- ◆ explain the relationship of the aerodynamic resultant in terms of thrust and weight
- ◆ explain how aerofoil contamination affects an aircrafts lift and drag
- ◆ explain the relationship between the couples of lift / weight, and thrust / drag
- ◆ explain how an aircraft stalls in flight

For the second event, a candidate's response can be judged satisfactory if the evidence generated shows that the candidate can in the investigation report;

- ◆ explain the reasons for an aircraft steady state flight performance
- ◆ explain an aircraft climb performance
- ◆ explain an aircrafts glide performance
- ◆ explain the forces acting on an aircraft in a turn
- ◆ explain how an aircraft flight envelope is affected by load factor and structural limitations
- ◆ explain how an aircrafts lift can be augmented
- ◆ explain how aircraft design affect the passive stability about an the longitudinal, lateral and directional axes of an aircraft
- ◆ explain how different the designs affect the active stability of an aircraft in flight

Assessment guidelines

The assessment of this Unit should be carried out by two assessment events covering all four Outcomes of the Unit.

The first event should cover Outcomes 1 and 2 and be carried out under supervised control conditions and last one and a half hours. Sampled questions used to elicit candidates' evidence should take the form of structured, restricted response questions.

Higher National Unit specification: statement of standards (cont)

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The second assessment event should cover Outcomes 3 and 4 and be an investigation case study. 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 eight hours of course time set aside for study research, the overall time allowed for completed submission being at the discretion of the centre.

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 fail to 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

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Superclass category:	RC
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Higher National Unit specification: support notes

Unit title: Aerodynamics

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 40 hours, with Outcome 1 given — five hours. Outcomes 2 and 3 — ten hours each and Outcome 4 — seven hours. The Unit is also designed to have eight hours set aside for the investigation case study.

Guidance on the content and context for this Unit

This is a mandatory Unit devised for the principals and technology section of the HNC/HND Aircraft Engineering Group Award. The Unit is intended to provide candidate with the knowledge of basic aerodynamics and in particular how an aircraft flies along with a study into how the aerodynamic forces produced in flight affect an aircraft.

The Unit will also provide the knowledge element requirement to meet EASA IR Part 66 Aircraft Maintenance License (Module 8) Basic Aerodynamics, so it would be possible for candidates to sit an additional multi-choice examination in an EASA 147 Organisation to gain an exemption to the EASA Aircraft Engineering Licensing Requirements.

Content/ context corresponding to outcomes

- 1 The composition of air in the atmosphere and how the atmosphere is split into different layers. The atmospheric conditions within the different layers and how pressure, density, temperature and humidity change within them. How and why the International Standard Atmosphere was established, its values and how it is used to assist aircraft in flight. How an aircraft pressure altimeter and airspeed indicator works along with the different types of airspeeds.
- 2 How pressure in flight is distribution around an aerofoil surface along with the different types of airflow over an aircrafts surface both laminar and turbulent and how its boundary layer is formed. The generation of lift and drag and how the movement of a surfaces centre of pressure and change in angle of attack affect the amount of lift or drag generated. How the shape of a wing its camber, chord and washout along with its fineness and aspect ratio and aerofoil contamination affect the aerodynamic performance of an aerofoil in producing both lift and drag. The stalling of an aircraft in flight and the relationship between the thrust, weight and aerodynamic resultant along with the aerodynamic couples of lift, weight, thrust and drag.
- 3 The steady state performance of an aircraft in level flight and the changes required that have to be made to maintain it. How the different forces act on an aircraft in a turn and the corrections that must be made to maintain a level and steady turn. The climbing and gliding performance of an aircraft, its glide and climb ratio and how their rates and ability are changed. The flight envelope of an aircraft, the reasons for its limits with regards to an aircraft structural limitations and safety and how different manoeuvres and changes in load factor affect both the safety and structural limits of the envelope.

Higher National Unit specification: support notes (cont)

Unit title: Aerodynamics

- 4 The definition of positive, negative and neutral stability. The passive stability of an aircraft about its longitudinal, lateral and directional axis's and the control surfaces that affect the aircrafts longitudinal, lateral and directional stability. The active stability of an aircraft in flight about its longitudinal, lateral and directional axis's. How spiral instability and Dutch roll occurs and the effect of weather cocking on an aircrafts directional stability.

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.

Opportunities for developing Core Skills

There are no opportunities to develop Core Skills in this Unit.

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 assessment event.

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: Aerodynamics

This Unit is designed to enable you to acquire a knowledge and understanding of the basic aerodynamics of an aircraft. In particular the Unit will look at how an aircraft flies and how the aerodynamic forces produced in flight apply and affect an aircraft.

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 the knowledge requirements for Module 8 (Basic Aerodynamics) of EASA IR Part 66 Aircraft Licensing Requirements for both mechanical and avionics engineers.

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

- 1 Explain the physics of the atmosphere and how it affects flight.
- 2 Explain basic aerodynamics in relation to an aircraft in flight.
- 3 Explain the principles of the theory of flight of an aircraft.
- 4 Explain the static and dynamic stability of an aircraft in flight.

Assessment of the Unit will be by two assessment examinations. The first assessment will cover Outcomes 1 and 2 and be a closed-book examination made up of structured restricted response questions. The second will be an investigation case study covering Outcomes 3 and 4 requiring you to compile a report on the aerodynamic factors that affect an aircraft in flight.

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