

Higher National Unit Specification

General information for centres

Unit title: Aircraft Systems: Flight Controls

Unit code: DR03 34

Unit purpose: This Unit is designed to introduce candidates to the main concepts of Aircraft Flight Controls. It will allow the candidate to gain an understanding of the principles and operations of the Primary and Secondary Flight Controls on an aircraft and their associated operating systems for progression into the areas of aircraft design, manufacture and maintenance.

This Unit is aligned to Chapter 27 of the ATA Specification 100 and will provide the knowledge element to partly meet EASA 66 Module 13 of the aircraft maintenance licence requirements for aircraft flight control systems.

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

- 1 Describe the principles and operations of aircraft primary and secondary flight controls.
- 2 Describe the principles and operations of aircraft lift and drag inducement devices.
- 3 Describe the flight control systems layout and operations.
- 4 Describe the requirement for and operation of stall protection systems.

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 is at the discretion of the centre. The Unit has no prerequisites; however, it would be beneficial if the candidate has a basic understanding of aeronautical engineering. This may be evidenced by possession of National Certificate modules: Aircraft Systems: Flight; Theory of Flight; Aircraft Aerodynamics: General; or similar qualifications and/or experience.

Core skills: There may be opportunities to gather evidence towards Core Skills 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 Systems: Flight Controls

Assessment: The assessment covering the first three Outcomes will be carried out on a sampling basis. The assessment could be composed of short answers, restricted response questions, should last approximately 1 hour for each Outcome and cover the stipulated knowledge and/or skills requirements. In order to gain an assessment pass, candidates will need to demonstrate that they can achieve at least 60% of the total marks available.

For the fourth Outcome the candidate will be required to research the requirement for and operation of stall protection systems. A report covering all of the knowledge and/or skills requirements for this Outcome must be presented orally along with a hard copy of their findings. The oral report should be approximately 10–15 minutes and include visuals. The written report should be approximately three pages, using a standard short report format, with references.

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

The assessment instruments used should follow the general guidelines offered by the Scottish Qualification Authority (SQA) assessment model.

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 Systems: Flight Controls

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The sections of the Unit stating the Outcomes, knowledge and/or skills, and evidence requirements are mandatory.

Where evidence for Outcomes is assessed on a sample basis, the whole of the content listed in the knowledge and/or skills section 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.

Outcome 1

Describe the principles and operations of aircraft primary and secondary flight controls

Knowledge and/or skills

- ◆ the three axis's of aircraft movement
- ◆ primary flight controls
- ◆ the principles of operation and movement of the primary controls
- ◆ the requirements for trim control and the movement of Centre of Gravity and Centre of Pressure
- ◆ the principles of operation and movement of trim controls

Evidence requirements

Outcomes 1, 2 and 3 could be assessed as a single holistic assessment. Evidence for Outcome 1 will be generated through sampling of the knowledge and/or skills requirements for this Outcome, all of which must be taught and available for assessment. The sampled questions should contain four of the five knowledge and/or skills requirements for this Outcome. In order to gain an assessment pass, candidates will need to demonstrate that they can achieve at least 60% of the total marks available.

Outcome 2

Describe the principles and operations of aircraft hi lift and drag inducement devices

Knowledge and/or skills

- ◆ the requirements for high lift devices
- ◆ the types of high lift devices and their principles of operation
- ◆ the requirements for drag inducement devices
- ◆ the types of drag inducement devices and their principles of operation

Evidence requirements

Outcomes 1, 2 and 3 could be assessed as a single holistic assessment. Evidence for Outcome 2 will be generated through sampling of the knowledge and/or skills requirements for this Outcome, all of which must be taught and available for assessment. The sampled questions should contain three of the four knowledge and/or skills requirements for this Outcome. In order to gain an assessment pass, candidates will need to demonstrate that they can achieve at least 60% of the total marks available.

Higher National Unit specification: statement of standards (cont)

Unit title: Aircraft Systems: Flight Controls

Outcome 3

Describe the flight control systems layout and operations

Knowledge and/or skills

- ◆ the operation of a manually operated flight control system
- ◆ the operation of electro-mechanically operated flight control system
- ◆ the operation of hydraulically operated flight control system
- ◆ the operation of a fly by wire control flight system

Evidence requirements

Outcomes 1, 2 and 3 could be assessed as a single holistic assessment. Evidence for Outcome 3 will be generated through sampling of the knowledge and/or skills requirements for this Outcome, all of which the must be taught and available for assessment. The sampled questions should contain three of the four knowledge and/or skill requirements for this Outcome. In order to gain an assessment pass, candidates will need to demonstrate that they can achieve at least 60% of the total marks available.

Assessment guidelines

Outcomes 1–3: For these assessments the candidates will need to respond to sampled questions. The sampling for this Outcome will be derived from the knowledge and/or skills requirements, all of which the must be taught and available for assessment.

Sample	Outcome 1	four of five knowledge and/or skills
	Outcome 2	three of four knowledge and/or skills
	Outcome 3	three of four knowledge and/or skills

These assessments should be composed of short answers, restricted response questions and last approximately one hour for each Outcome, covering the stipulated knowledge and/or skills requirements. Candidates should not know in advance the questions on which they will be assessed and different questions should be set on each assessment occasion. These assessments must be carried out under closed book supervised conditions. In order to gain an assessment pass, candidates will need to demonstrate that they can achieve the minimum evidence requirements.

Outcome 4

Describe the requirement for and operation of stall protection systems

Knowledge and/or skills

- ◆ stalling of an aircraft including stall angle and stall speed
- ◆ methods used for sensing of impending stall
- ◆ systems used for stall warning and protection

Higher National Unit specification: statement of standards (cont)

Unit title: Aircraft Systems: Flight Controls

Evidence requirements

The candidate is required to research the requirement for and operation of stall protection systems; then present an oral and hard copy report of their findings. This report will cover all of the knowledge and/or skills for this Outcome, with the candidate being able to answer question regarding their report. The oral report should be approximately 10–15 minutes and include visuals. The written report should be approximately 600 words, using a standard format, with references.

Assessment Guidelines

Outcome 4: For this assessment the candidate will be required to research the requirement for and operation of stall protection systems. A report covering all of the knowledge and/or skills for this Outcome must be presented orally along with a hard copy of their findings. The oral report should be approximately 10–15 minutes and include visuals. The written report should be approximately 600 words, using a standard short report format, with references.

- ◆ title page
- ◆ introduction
- ◆ discussion
- ◆ conclusion
- ◆ attachments

Assessment guidelines for the Unit

The assessment of this Unit should be carried out with three separate or combined assessments covering Outcomes 1–3 and a report covering Outcome 4. All assessments should be carried out under supervised controlled conditions. Sampled questions used to elicit candidates' evidence should take the form of short answers, 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 fail to meet the minimum evidence requirements, centres may allow candidates to re-sit the assessments at an appropriate time using different sampled questions.

Administrative Information

Unit code: DR03 34

Unit title: Aircraft Systems: Flight Controls

Superclass category: XP

Date of publication: August 2005

Version: 02 (October 2013)

History of changes:

Version	Description of change	Date
02	Clarification of evidence requirements and minor amendments made to support notes.	25/10/13

Source: SQA

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Higher National Unit specification: support notes

Unit title: Aircraft Systems: Flight Controls

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

This Unit should be delivered sequentially by Outcome. A mix of formal assessment and assignment using aircraft manuals or aircraft design drawings is recommended. Coursework and assignment reports must be the work of the individual.

The assessment of this Unit should be carried out with three separate or combined assessments covering Outcomes 1–3 and a report covering Outcome 4. All assessments should be carried out under supervised controlled conditions and last approximately 1 hour for each Outcome. Sampled questions used to elicit candidates' evidence should take the form of short answers, restricted response questions.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 40 hours.

Guidance on the content and context for this Unit

The candidate should achieve a level of competence of someone who may be expected to install, set up and test the operational aspect of an aircraft flight control system within an engineering environment. Safe practices to aerospace standards should be stressed throughout.

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

- 1 Describe the principles and operations of aircraft primary and secondary flight controls.
- 2 Describe the principles and operations of aircraft lift and drag inducement devices.
- 3 Describe the flight control systems layout and operations.
- 4 Describe the requirement for and operation of stall protection systems.

This Unit is at SCQF level 7 and has been incorporated within the first year of the new HNC/D Aircraft Engineering award (effectively the HNC award) as a mandatory Unit.

Outcome 1: The candidate should be able to describe and identify of each individual primary flight control; inboard and outboard ailerons, elevators, rudder, all flying tail plane, lateral spoiler control is given. Movement and operation of the controls giving control about the axes of an aircraft. Control surface aerodynamic balance is explained. Control surface mass balance is explained. The requirement for and need for trim systems is explained to include; changes in centre of gravity and centre of pressure positions, changes in aircraft speed and angle of attack. Trimming methods used; trim tabs, variable incidence tail plane, mach trim are identified and explained.

Outcome 2: The candidate should be able to give a full description of and identification of high lift devices; trailing edge devices — slotted flap, extension flap, multi-element slotted extension flap, leading edge devices — extending slat, Kruger flap, dropped leading edge. Movement and principle of operation of the high lift devices described and identified; effect on – stalling angle, stalling speed, lift formula $L = \frac{1}{2}PV^2S$, take off and landing speeds, take off and landing distances. Requirements, description, and identification of drag inducement devices; lift dumpers, spoilers, speed brakes is demonstrated. Movement and principle of operation of the drag inducement devices described and identified.

Higher National Unit specification: support notes (cont)

Unit title: Aircraft Systems: Flight Controls

Outcome 3: Aircraft flight control system diagrams should be used to explain the system operation and to indicate the system inputs and outputs with the role of the system components being explained. The system diagrams selected could be from aircraft manuals or design drawings and represent a wide representation of the controls discussed within learning Outcomes 1 and 2.

Outcome 4: The candidate should be able to research and present a report (oral and hard copy) on the requirement for and operation of stall protection systems. This report could include stalling of an aerofoil, stalling of aircraft, angle of attack, relative airflow, burbling of airflow, separation point, stalling angle, stalling speed. The aerofoil pressure distribution and centre of pressure movement at selected angles of attack up to the stalling angle is explained. Methods of sensing airflow pressure changes due to an impending stall and how these sensors are used to operate a stall warning and/or stall prevention system. The use of aircraft manuals or design drawings should be used to demonstrate the operation of typical stall warning and sensing systems used in aircraft.

The knowledge and/or skills for this Outcome could be discussed and the candidates given the opportunity to take notes but, care should be taken not to give too much info as part of the objective of this Outcome is to encourage research.

Guidance on the delivery and assessment of this Unit

Outcome 1: The candidate should be able to describe the principles and operations of aircraft primary and secondary flight controls. The candidate should also be able to identify the three axis's of aircraft movement and control.

For the assessments the candidate may be given a diagram and asked to identify all the primary flight controls and axis of control. Then asked to explain the operational principle and movement of a flight control surface, and identify the resulting movement of the aircraft. Depending on sampling basis they could also be asked to explain how the Centre of Gravity or Centre of Pressure moves during flight and how it is corrected. Satisfactory achievement of the assessment will be demonstrated by the student producing the minimum requirements for this Unit.

Outcome 2: The candidate should be able to describe the principles and operations of aircraft high lift and drag inducement devices. The candidate should also be able to identify the requirements for high lift and drag inducement devices.

For the assessments the candidate may be given a series of flap and/or slat diagrams and asked to identify the different types of flaps and/or slats. Then asked to explain the operational principle and movements of flaps and/or slats. Depending on sampling basis they could also be asked to explain one type of drag inducement devices. Satisfactory achievement of the assessment will be demonstrated by the student producing the minimum requirements for this Unit.

Outcome 3: The candidate should be able to describe the flight control systems layout and operations. The candidate should also be able to identify the requirements for redundant flight control systems.

Higher National Unit specification: support notes (cont)

Unit title: Aircraft Systems: Flight Controls

For the assessments the candidate may be given a series of diagrams for a single-engine General Aviation aircraft and asked to explain the operational principle of the flight control system. They may also use diagrams to explain how the electro-mechanical and hydraulically operated flight control systems function. Depending on sampling basis they could also be given a series of diagrams for the Airbus A320 aircraft and asked to explain the operating principles of a Fly-By-Wire flight control system. Satisfactory achievement of the assessment will be demonstrated by the candidate producing the minimum requirements for this Unit.

Outcome 4: For this assessment the candidate will *be required to research and present a report (oral and hard copy) on the requirement for* and operation of stall protection systems. This Outcome could be given to the candidate at the start of the block to allow them time to research the topic and also help in the scheduling of the presentations. A report covering all of the Knowledge and/or skills for this Outcome must be presented orally along with a hard copy of their findings. The oral report should be approximately 10–15 minutes and include visuals followed by a question answer session.

The knowledge and/or skills for this Outcome could be discussed and the candidates given the opportunity to take notes but, care should be taken not to give too much info as part of the objective of this Outcome is to encourage research.

The written report should be approximately three pages, using a standard short report format, with references

- ◆ title page
- ◆ introduction
- ◆ discussion
- ◆ conclusion
- ◆ attachments

Opportunities for developing Core Skills

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

Open learning

The study material and notes could be used and formatted for Open Learning. However, the assessments procedures must be conducted under supervised closed-book conditions, and as such candidates must not be allowed to use any textbooks, handouts or notes during the assessment.

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 Systems: Flight Controls

This Unit is designed to introduce candidates to the main concepts of Aircraft Flight Controls. It will allow the candidate to gain an understanding of the principles and operations of the Primary and Secondary Flight Controls on an aircraft and their associated operating systems for progression into the areas of aircraft design, manufacture and maintenance.

This Unit will also provide underpinning knowledge required for the study of specific aircraft types in detail.

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

- 1 Describe the principles and operations of aircraft primary and secondary flight controls.
- 2 Describe the principles and operations of aircraft lift and drag inducement devices.
- 3 Describe the flight control systems layout and operations.
- 4 Describe the requirement for and operation of stall protection systems.

The assessment of this Unit should be carried out with three separate or combined assessments covering Outcomes 1–3 and a report covering Outcome 4. The assessments consist of an appropriate balance of questions from each Outcome. For the report you are required to research aircraft fuel types and characteristics; then present an oral and hard copy report of their findings.

The Unit may be of particular interest to candidates who are interested in pursuing a career in aircraft maintenance engineering as it is aligned to Chapter 27 of the ATA Specification 100, and partially covers the knowledge requirements for module 13 (*Aircraft Aerodynamics, Structures and Systems*) of EASA part 66 aircraft licensing requirements for both mechanical and avionics engineers.