

Higher National Unit Specification

General information for centres

Unit title: Aircraft Electrical Power Systems

Unit code: F0YB 35

Unit purpose: This Unit is designed to give candidates a further knowledge of AC electrical principles and to introduce a range of aircraft electrical systems. This Unit also provides part of the underpinning knowledge components for the EASA Part 66 Module 3, Chapters Part 3.4, 3.12, 3.13, 3.14, 3.15, 3.17.

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

- 1 Solve single-phase AC parallel network problems.
- 2 Analyse the principles of aircraft DC generators.
- 3 Analyse the function and operation of aircraft three-phase generators and connections.
- 4 Investigate aircraft power conversion and regulation systems.

Credit points and level: 1 HN Credit at SCQF level 8: (8 SCQF credit points at SCQF level 8*)

**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. However it is recommended that the candidates have completed Unit DR0A 33 *Mathematics and Physics for Aviation* and DR06 34 *Electrical Fundamentals for Aviation* before commencing this Unit.

Core Skills: There are opportunities to develop the Core Skills of:

Problem Solving:	Critical Thinking at	SCQF level 5
Problem Solving:	Planning and Organising at	SCQF level 5
Communication:	Reading at	SCQF level 6
Communication:	Writing at	SCQF level 6
Numeracy:	Using Number at	SCQF level 5
Numeracy:	Using Graphical Information at	SCQF level 5

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)

Assessment: Candidates could be assessed in two ways — either on an Outcome by Outcome basis or by a single assessment combining all four Outcomes. The assessments could be composed of an appropriate balance of short answer, restricted response and structured questions. Assessment should be carried out under supervised, controlled conditions.

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.

Higher National Unit specification: statement of standards

Unit title: Aircraft Electrical Power Systems

Unit code: F0YB 35

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

Solve single-phase AC parallel network problems

Knowledge and/or skills

- ◆ Voltage drop, current, resistance, reactance, impedance and power (true, reactive and apparent)
- ◆ Parallel RC circuits
- ◆ Parallel RL circuits
- ◆ Parallel RLC circuits
- ◆ Frequency response

Evidence Requirements

In any assessment of this Outcome all of the knowledge and/or skills items should be tested. Candidates will need to provide evidence to demonstrate their knowledge and/or skills by showing that they can:

- ◆ calculate voltage: drop, current, resistance, reactance, impedance and power (true, reactive and apparent) in one each of the following types of parallel AC circuit: RC, RL and RCL
- ◆ calculate, one of each: resonant frequency of and ideal parallel circuit and impedance for a given circuit

Assessment guidelines

This assessment may be combined with other Outcomes. Questions used to elicit candidate evidence may take the form of appropriate structured questions. Evidence for this Outcome could be provided by a closed-book examination taken at a single assessment lasting 40 minutes and carried out under supervised, controlled conditions.

Higher National Unit specification: statement of standards (cont)

Unit title: Aircraft Electrical Power Systems

Outcome 2

Analyse the principles of aircraft DC generators

Knowledge and/or skills

- ◆ Main components of a generator
- ◆ DC output of aircraft power systems.
- ◆ Series generators
- ◆ Shunt generators
- ◆ Compound wound generators.

Evidence Requirements

In any assessment of this Outcome a sample within the knowledge and/or skills items will be tested. Candidates will need to provide evidence to demonstrate their knowledge and/or skills by showing that they can:

- ◆ identify and describe the function of the main components of a generator
- ◆ describe two options for producing DC power for an aircraft electrical system
- ◆ analyse and discuss the advantages and disadvantages of each option for producing DC power
- ◆ analyse the difference in characteristic of series, shunt and compound wound generators

Where sampling is used a different sample must be used on each assessment occasion. Assessment should take place under controlled conditions.

Assessment guidelines

Questions used to elicit candidate evidence may take the form of appropriate structured questions. The assessment of this Outcome can be combined with Outcome 3, details of which are given under Outcome 3 below. The assessment, lasting 80 minutes, should be carried out under supervised, controlled conditions.

Outcome 3

Analyse the function and operation of aircraft three-phase generators and connections

Knowledge and/or skills

- ◆ Three-phase AC generation
- ◆ Constant frequency generators
- ◆ Frequency wild generators
- ◆ Brushless generators
- ◆ Star connections
- ◆ Delta connections

Higher National Unit specification: statement of standards (cont)

Unit title: Aircraft Electrical Power Systems

Evidence Requirements

In any assessment of this Outcome a sample within the knowledge and/or skills items will be tested. Candidates will need to provide evidence to demonstrate their knowledge and/or skills by showing that they can:

- ◆ describe how three-phase AC is generated
- ◆ analyse the advantages of three-phase generation with respect to single-phase
- ◆ analyse the differences in operation and suitable application of: Constant frequency generators, Frequency wild generators, Brushless generators. Candidates should cover two from the three generators listed.
- ◆ perform vector analysis by deriving line voltage for star connections or line currents for delta connections. Candidates should be assessed on star connections or delta connections.

Where sampling is used a different sample must be used on each assessment occasion. Assessment should take place under controlled conditions.

Assessment guidelines

Questions used to elicit candidate evidence may take the form of appropriate structured questions, this assessment may last 40 minutes.

The assessment of this Outcome can be combined with Outcome 2. When a single assessment is used, the assessment, lasting 80 minutes should be carried out under supervised, controlled conditions.

Outcome 4

Investigate aircraft power conversion and regulation systems

Knowledge and/or skills

- ◆ AC to DC conversion
- ◆ DC to AC conversion
- ◆ Transformers
- ◆ Voltage regulation
- ◆ Frequency regulation

Evidence Requirements

Candidates will need to provide evidence to demonstrate their knowledge and/or skills by showing that they can:

- ◆ investigate and report on common methods used in aircraft electrical systems. A sample should be taken from three of the five elements listed:
 - AC to DC conversion
 - DC to AC conversion
 - Voltage level conversion
 - Voltage regulation
 - Frequency regulation.

Higher National Unit specification: statement of standards (cont)

Unit title: Aircraft Electrical Power Systems

Where sampling is used a different sample must be used on each assessment occasion. Assessment should take place under controlled conditions.

Assessment guidelines

The centre should provide a series of structured questions to prompt the candidate to investigate the knowledge and skills section thoroughly. A case study approach may be adopted as a means of prompting the candidate to investigate types of aircraft electrical conversion and voltage regulation equipment. Candidates could submit a report of no less than 1,000 words.

Administrative Information

Unit code: F0YB 35

Unit title: Aircraft Electrical Power Systems

Superclass category: XJ

Original date of publication: August 2006

Version: 01

History of Changes:

Version	Description of change	Date

Source: SQA

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Higher National Unit specification: support notes

Unit title: Aircraft Electrical Power Systems

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.

Guidance on the content and context for this Unit

The Unit is intended to give candidates an introductory knowledge of aircraft generators and key electrical system components. The Unit also provides partial coverage of the EASA Module 3.

Whilst many approaches can be utilised for the delivery of the above material it is desirable to set them in the context of the aviation technician. Wherever possible delivery of the curriculum should be made by utilising examples of where the concepts may be found on an aircraft.

In aviation maintenance a technician must be familiar with aircraft electrical systems. By understanding the principles of simple AC and DC power generation systems, the technician can effectively diagnose, isolate and repair aircraft electrical problems.

Wherever possible you should endeavour to provide the candidate with practical examples to work with. Where this is not practicable or possible simulation software should be used to confirm / visualise concepts and results.

Content/context corresponding to Outcomes

- 1 Candidates should cover the concepts of parallel circuits. Moving on to calculating the circuit quantities voltage drop, current, resistance, reactance and power (true, apparent and reactive) on RL, RC and RLC parallel circuits. It is important to try and give the candidate as many examples as possible of these circuits and it would probably be appropriate to have a wide variety of tutorial examples for them to practise with. The concept of resonance should then be introduced with discussion of impedance/ frequency response curves.
- 2 Candidates should be introduced to basic generator theory, moving on to understand the basic construction of generators and the function of all the major components. This should be followed by discussion of the various options for achieving a DC output eg a DC brush system with smoothing or full wave rectification. The classification of DC generators should then be discussed with analysis of their individual characteristics. It is recommended that centres give the candidate a variety of tutorial examples to allow the candidate to practise providing responses which provide analysis.
- 3 This Outcome is designed to build on the knowledge and understanding, developed in Outcome 2 and expand it for AC generators. Candidates should be introduced to the concept of three-phase generation. Moving on to the construction and operation of the three main types of aircraft three-phase generation, constant frequency, frequency wild and brushless generators. The advantages and disadvantages of each type of generator should be discussed, including appropriate applications. The options for three-phase connection should then be covered using vector analysis to derive line voltages and currents. Again it is recommended that centres give the candidate a variety of tutorial examples to allow the candidate to practise providing responses which provide analysis.

Higher National Unit specification: support notes (cont)

Unit title: Aircraft Electrical Power Systems

- 4 Candidates should be introduced to the concept of AC to DC conversion and the options available to achieve this. This should be followed by methods of achieving DC to AC in aircraft systems. The candidate should cover the technology involved in both transformer operation, and voltage and frequency regulation.

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. 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 Qualifications Authority (SQA). All assessments should be carried out under controlled conditions and candidates should not be allowed to bring in textbooks, handouts or other prepared material.

Opportunities for developing Core Skills

There are opportunities to develop the following Core Skills:

- ◆ Problem Solving: Critical Thinking at SCQF level 5. This can be achieved by candidates demonstrating their ability to analyse difference in operation and performance of complex machines.
- ◆ Planning and Organising: SCQF level 5. This can be achieved by candidates demonstrating their ability to time plan and time manage completion of their report.
- ◆ Communication: Reading at SCQF level 6. This can be achieved by candidates demonstrating their ability to interpret and analyse written information on engineering concepts and data.
- ◆ Communication: Writing at SCQF level 6. This can be achieved by candidates demonstrating their ability to compose essay answers to questions requiring analysis, and description, and a written technical report.
- ◆ Numeracy: Using Number at SCQF level 5. This can be achieved by candidates demonstrating their ability to perform calculations using trig functions and algebra.
- ◆ Numeracy: Using Graphical Information at SCQF level 5. This can be achieved by candidates demonstrating their ability to perform vector analysis.

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 have to attend an approved centre for assessment events.

Higher National Unit specification: support notes (cont)

Unit title: Aircraft Electrical Power Systems

Candidates with disabilities and/or additional support needs

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 Alternative Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs*, which is available on SQA's website: **www.sqa.org.uk**.

General information for candidates

Unit title: Aircraft Electrical Power Systems

This Unit is intended for those who are interested in aircraft engineering and is offered as a mandatory Unit in the HNC/HND Aircraft Engineering Group Award. The Unit is designed to give you an enhanced knowledge of AC electrical principles and to introduce a range of aircraft electrical systems, and prepare you to assess the advantages and disadvantages of different systems in particular applications. This Unit is designed to follow on from the Unit *Electrical Fundamentals for Aviation* and is of particular interest to those wishing to pursue a career in avionics.

This Unit also provides part of the underpinning knowledge components for the EASA Part 66 Module 3, Chapters Part 3.4, 3.12, 3.13, 3.14, 3.15, 3.17.

The Unit has four main areas, each area covered by a separate Outcome. On completion of the Unit you should be able to:

1 Solve single-phase AC parallel network problems

You should demonstrate your ability to calculate voltage drop, current, resistance, reactance, impedance and power (true, reactive and apparent) in a range of parallel AC circuit combinations, including RC, RL and RCL circuits. In addition you should be able to determine the resonant frequency of an ideal parallel circuit and impedance for a given circuit.

2 Analyse the principles of aircraft DC generators

You should be able to identify and describe the function of the main components of a generator. You should also be able to offer options for producing DC power for an aircraft electrical system and analyse and discuss the advantages and disadvantages of each option. You should be able to analyse and demonstrate an understanding of the difference in characteristic of series, shunt and compound wound generators.

3 Analyse the function and operation of aircraft three-phase generators and connections

You should be able to describe how three-phase AC is generated. You should be able to name a range of AC generator types and analyse the differences in operation of two types, and complete vector analysis to derive line voltage for star connections or line currents for delta connections.

4 Investigate aircraft power conversion and regulation systems

Candidates should investigate and discuss common methods used in aircraft electrical systems to perform AC to DC conversion, DC to AC conversion, voltage level conversion, voltage and frequency regulation.