

Higher National Unit Specification

General information for centres

Unit title: Aircraft Gas Turbine Engines

Unit code: F0M6 35

Unit purpose: This Unit is designed to allow candidates to acquire a knowledge and understanding of the operation and construction of a gas turbine engine that can be used to power an aircraft or helicopter. The Unit will also provide part of the knowledge element required to meet EASA IR part 66 aircraft maintenance license for module 15 (gas turbine engines).

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

- 1 Evaluate the performance criteria of a gas turbine engine.
- 2 Investigate the operating principles of a gas turbine engine.
- 3 Analyse a gas turbine fuel and lubrication system.
- 4 Analyse a gas turbine starting and indication system.
- 5 Analyse the installation of an engine and ground running operations.

Credit points and level: 2 HN Credits at SCQF level 8: (16 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. The Unit has no mandatory pre-requisites, however, it is recommended that candidates have completed Unit DR09 34 *Aircraft Propulsion Systems: Introduction* before commencing this Unit.

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

Communication (Written) at SCQF level 6

Problem Solving: (Critical Thinking) at SCQF level 6

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

Higher National Unit specification: statement of standards

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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

Evaluate the performance criteria of a gas turbine engine

Knowledge and/or skills

- ◆ Constructional arrangement of a gas turbine engine
- ◆ Working cycle for airflow through an engine
- ◆ Specific fuel consumption
- ◆ Relationship between thrust and equivalent shaft horsepower
- ◆ Engine efficiency and by-pass ratio
- ◆ Engine rating and thrust limitations
- ◆ Factors influencing thrust

Outcome 2

Investigate the operating principles of a gas turbine engine

Knowledge and/or skills

- ◆ Air intake configurations
- ◆ Axial and centrifugal compressors
- ◆ Compressor stall and surge
- ◆ Combustion chambers
- ◆ Impulse and reaction turbines
- ◆ Exhaust units
- ◆ Thrust reversers

Higher National Unit specification: statement of standards (cont)

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Outcome 3

Analyse a gas turbine fuel and lubrication system

Knowledge and/or skills

- ◆ Properties of lubricants and fuels
- ◆ Engine lubricating systems
- ◆ Engine fuel systems

Outcome 4

Analyse a gas turbine starting and indication system

Knowledge and/or skills

- ◆ Ignition systems and components
- ◆ Engine starting systems
- ◆ Flight deck engine indicating instruments

Outcome 5

Analyse the installation of an engine and ground running operations

Knowledge and/or skills

- ◆ Engine to airframe configuration
- ◆ Engine start up procedures
- ◆ Engine parameters
- ◆ Engine inspection

Evidence Requirements for the Unit

Evidence for this Unit will be generated through sampling the knowledge and/or skills of the individual Outcomes by three assessment 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 a candidate's response can be judged satisfactory where the evidence shows the candidate can:

- ◆ evaluate the arrangement of components in a gas turbine engine
- ◆ evaluate the working cycle of a gas turbine engine during its compression, combustion and exhaust phases
- ◆ evaluate how specific fuel consumption affects engine performance
- ◆ investigate the relationship between the thrust produced by a turbojet and a turbo-prop or turbo-shaft engine

Higher National Unit specification: statement of standards (cont)

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- ◆ evaluate the efficiency of a high and low by-pass ratio engine
- ◆ investigate the limitations imposed on engines due to thrust rating
- ◆ evaluate the factors that will influence the thrust produced by an engine

To ensure that candidates will not be able to foresee which items they will be questioned on, a different sample of three of the seven knowledge and/or skills items is required each time the Outcome is assessed. Candidates must provide a satisfactory response to all three items.

For the second assessment event covering Outcome 2 the evidence generated can be presented as part of a report covering an investigative study into construction or operating principles of one of the major components of a gas turbine engine. In generating evidence for the report, candidates will need to show that they can evaluate 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 a candidate's response can be judged satisfactory if the evidence generated shows that the candidate can in producing a report:

- ◆ investigate the effect an engine's intake has on engine performance
- ◆ investigate the operation and construction arrangement of either an axial or centrifugal compressor
- ◆ investigate airflow control mechanisms used to control compressor stall and surge
- ◆ investigate the constructional arrangements of a gas turbine combustion chambers
- ◆ investigate how either impulse or reactive turbines operate
- ◆ investigate the operation of a gas turbine exhaust systems
- ◆ investigate the operation and effect of a gas turbine thrust reversers systems

For the third assessment event covering Outcomes 3 to 5, evidence will be generated through sampling the knowledge and/or skill requirements of all three Outcomes, requiring 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 a candidate's response can be judged satisfactory where the evidence shows the candidate can:

- ◆ analyse the types of fuels and lubricants used in a gas turbine engine
- ◆ analyse an engine lubricating systems and its operation
- ◆ analyse an engine fuel system its control and operation
- ◆ analyse the ignition system of a gas turbine during ground and flight operation
- ◆ analyse the starting cycle of a gas turbine engine and its limits
- ◆ analyse engine indicating instruments fitted on a flight deck
- ◆ analyse the engine to airframe connections during engine installation
- ◆ analyse the procedures and precautions used during engine running
- ◆ analyse engine parameters used to maintain engine integrity
- ◆ analyse engine inspection procedure to identify internal damage

To ensure that candidates will not be able to foresee which items they will be questioned on, a different sample of three of the ten knowledge and/or skills items is required each time the Outcomes are assessed. Candidates must provide a satisfactory response to all three items.

Higher National Unit specification: statement of standards (cont)

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Assessment guidelines for the Unit

The assessment of this Unit may be carried out by three assessment events covering all five Outcomes of the Unit. The first event should cover Outcome 1 and be carried out under supervised controlled conditions and last one and a half hours. The sampled questions used to elicit candidates' evidence should take the form of structured, restricted response questions. The second assessment event should cover Outcome 2 and be based upon a case study investigation into the operating principle of one of the major components of a gas turbine engine. The report should be of approximately 1,000 words and be carried out under open-book conditions. 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 3 to 5 and be carried out under supervised controlled conditions and last one and a half hours. The three sampled questions used to make up the assessment should be taken from one of each of the knowledge and/or skills requirements of the individual Outcomes and take the form of structured, restricted response questions.

Administrative Information

Unit code: F0M6 35
Unit title: Aircraft Gas Turbine Engines
Superclass category: XP
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 Gas Turbine Engines

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.

Guidance on the content and context for this Unit

This Unit is designed to allow candidates to acquire a knowledge and understanding of the operation and construction of a gas turbine engine that can be used to power an aircraft or helicopter. The Unit will also provide partial coverage of the knowledge element required to meet EASA IR part 66 aircraft maintenance license for module 15 (gas turbine engines), Chapters 15.1 to 15.7, 15.9 to 15.11, 15.13, 15.14, 15.19 and 15.21.

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 the delivery of the content of this Unit should utilise practical examples to supplement learning. Where this is not practicable or possible, simulation software could be used to confirm/visualise concepts and results.

Content/context corresponding to Outcomes

- 1 The constructional arrangement of turbojet, turbofan, turboshaft and turboprop engines along with the relationship between an engine's working cycle and the laws of motion including calculating gas formula for airflow through an engine. The effect specific fuel consumption has on engine performance and the relationship between the thrust produced by a turbojet's or turbofan's engine, and the horsepower or equivalent shaft horsepower produced by a turboprop or turboshaft engine. The efficiency of an engine along with its by-pass ratio, how it is thrust rated, its static thrust and thrust limitations along with the influence of speed, altitude and climate change on thrust produced.
- 2 The effect an intake or various inlet configurations has on engine performance, and the operation and construction of either an axial or centrifugal compressor. The arrangement and operation of airflow control mechanisms used to control compressor stall and surge. The constructional arrangements of a gas turbine combustion chamber along with any advantages and disadvantages between different types. The operation and construction of impulse and reactive turbine assemblies and the arrangement of engine exhaust systems along with engine thrust reversers systems
- 3 The types of fuels and lubricants used in a gas turbine engine along with the layout of components used in an engine lubricating systems and the engine fuel system operation including the use of electronic control (FADEC).
- 4 The components and layout of an engine ignition systems and its operation during an engine start on the ground and inflight along with the flight deck instruments that are used to indicate engine parameters.

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- 5 The configuration of engine to airframe connections during engine installation and the precautions used during engine start up and during ground running. The interpretation of engine parameters during ground and flight operation and the inspection of engines by visual and boroscope equipment to find different types of damage inside the internal components.

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 with access to relevant publications as recommended.

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 conditions, candidates should not be allowed to bring into assessment events textbooks, handouts or other prepared material.

Opportunities for developing Core Skills

There are opportunities in the Unit to develop the Core Skills of Communication (Written) at SCQF level 6. Candidates can achieve this by demonstrating in their investigative report that they can produce a balanced and well-structured report on a complex topic, such as the construction and operating principles of a gas turbine engine. There are also opportunities within the Unit to develop the Core Skill of Problem Solving (Critical Thinking) at SCQF level 6. Candidates can achieve this by demonstrating that they can analyse and evaluate complex issues such as engine performance data, the working cycle and the principles of airflow through a gas turbine engine.

Open learning

This Unit could be delivered by distance learning. However, it would require planning by the centre to ensure the sufficiency and authenticity of the candidate evidence. Arrangements would have to be made to ensure that the closed-book assessments for Outcomes 1 and 3 are delivered in a supervised environment.

For information on open and distance learning, please refer to SQA guide, Assessment and Quality Assurance of open and distance learning (www.sqa.org.uk).

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 Gas Turbine Engines

This Unit is designed to enable you to acquire a knowledge and understanding of gas turbine engines used to power aircraft and helicopters. In particular the Unit will look at how gas turbine engines operate in an aircraft engineering maintenance environment and it is primarily intended for candidates who are interested in aircraft engineering.

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 module 15 (gas turbine engines) of EASA IR part 66 aircraft licensing requirements mechanical engineers.

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

- 1 Evaluate the performance criteria of a gas turbine engine.
- 2 Investigate the operating principles of a gas turbine engine.
- 3 Analyse a gas turbine fuel and lubrication system.
- 4 Analyse a gas turbine starting and indication system.
- 5 Analyse the installation of an engine and ground running operations.

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 Outcome 2 requiring you to compile a report on the construction and operating principles of a gas turbine engine. 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 assessments you will not be permitted to bring textbooks, handouts or other material into the assessment event.