



Higher National Unit specification

General information

Unit title: Aircraft Propulsion Systems: Introduction (SCQF level 7)

Unit code: H94K 34

Superclass: XP

Publication date: September 2015

Source: Scottish Qualifications Authority

Version: 02

Unit purpose

This Unit is designed to introduce learners to the main concepts of Aircraft Propulsion. It will allow the learner to gain an understanding of the basic propulsive processes regarding both piston and gas turbine cycles. In addition, learners will also achieve a working knowledge of aircraft gas turbine and piston engine ancillary systems.

This Unit is primarily intended for learners who are interested in pursuing a career within the aircraft engineering industry or for progression to HND Aircraft Engineering. It may also be of interest to other engineering students who are interested in different types of piston and gas turbine systems.

Outcomes

On successful completion of the Unit the learner will be able to:

- 1 Explain the principles of operation of aircraft gas turbine and piston engines.
- 2 Explain the principles of thrust production for aircraft gas turbine and piston engines used on fixed and rotary wing aircraft.
- 3 Explain the layout and operation of fuel and lubrication systems used in both piston and gas turbine engines.
- 4 Explain the layout and operation of starting and ignition systems used in both piston and gas turbine engines.

Credit points and level

1 Higher National Unit credit at SCQF level 7: (8 SCQF credit points at SCQF level 7)

Higher National Unit specification: General information (cont)

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Recommended entry to the Unit

Access to this Unit is at the discretion of the centre. The Unit has no pre-requisites; however, it would be beneficial if the learner has a basic understanding of aeronautical engineering. This may be evidenced by possession of the Unit F5GX 12 *Aircraft Power Plant* and/or engineering experience.

Core Skills

Opportunities to develop aspects of Core Skills are highlighted in the Support Notes for this Unit specification.

There is no automatic certification of Core Skills or Core Skill components in this Unit.

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.

The Assessment Support Pack (ASP) for this Unit provides assessment and marking guidelines that exemplify the national standard for achievement. It is a valid, reliable and practicable assessment. Centres wishing to develop their own assessments should refer to the ASP to ensure a comparable standard. A list of existing ASPs is available to download from SQA's website (<http://www.sqa.org.uk/sqa/46233.2769.html>).

Equality and inclusion

This Unit specification has been designed to ensure that there are no unnecessary barriers to learning or assessment. The individual needs of learners should be taken into account when planning learning experiences, selecting assessment methods or considering alternative evidence.

Further advice can be found on our website www.sqa.org.uk/assessmentarrangements.

Higher National Unit specification: Statement of standards

Unit title: Aircraft Propulsion Systems: Introduction (SCQF level 7)

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

Outcome 1

Explain the principles of operation of aircraft gas turbine and piston engines.

Knowledge and/or Skills

- ◆ Aircraft engine operating principles
- ◆ Aircraft engine constructional arrangement and operation of major components
- ◆ Piston and gas turbine engine operating cycles

Outcome 2

Explain the principles of thrust production for aircraft gas turbine and piston engines used on fixed and rotary wing aircraft.

Knowledge and/or Skills

- ◆ Principles of thrust production from a turbojet, low bypass turbojet and high bypass turbofan engine.
- ◆ Principles of thrust production from propellers and rotors driven by piston, turboprop, and turboshaft engines.
- ◆ Production of thrust of an aircraft engine related to Newton's laws

Outcome 3

Knowledge and/or Skills

Explain the layout and operation of fuel and lubrication systems used in both piston and gas turbine engines.

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

Outcome 4

Knowledge and/or Skills

Explain the layout and operation of starting and ignition systems used in both piston and gas turbine engines.

- ◆ Engine ignition systems
- ◆ Engine starting systems

Higher National Unit specification: Statement of standards (cont)

Unit title: Aircraft Propulsion Systems: Introduction (SCQF level 7)

Evidence Requirements for this Unit

Outcome 1

Learners will need to provide written and/or oral recorded evidence to demonstrate their Knowledge and/or Skills by showing that they can explain:

- ◆ operating principles of a gas turbine engine
- ◆ operating principles of a piston engine
- ◆ piston engine configuration: In line, horizontally opposed, radial
- ◆ functions of major piston engine components
- ◆ turbine engine types
- ◆ functions of major gas turbine components and assemblies
- ◆ operating cycle of piston engine during its induction, compression, combustion and exhaust phases
- ◆ operating cycle of gas turbine engine during its inlet, compression, combustion and exhaust phases

Evidence for the Knowledge and/or Skills in this Outcome can be done on an Outcome by Outcome basis or as part of a combined assessment event, under closed-book supervised conditions.

Outcome 2

Learners will need to provide written and/or oral recorded evidence to demonstrate their Knowledge and/or Skills by showing that they can explain how thrust is produced by:

- ◆ a turbojet engine
- ◆ a low bypass turbojet engine
- ◆ a high bypass turbofan engine
- ◆ a turboprop engine driving a propeller
- ◆ a turboshaft engine driving a rotor
- ◆ a propeller driven by a piston engine
- ◆ a rotor driven by a piston engine
- ◆ using Newton's laws in relation to both piston and gas turbine engines

Evidence for the Knowledge and/or Skills in this Outcome can be done on an Outcome by Outcome basis or as part of a combined assessment event, under closed-book supervised conditions.

Higher National Unit specification: Statement of standards (cont)

Unit title: Aircraft Propulsion Systems: Introduction (SCQF level 7)

Outcome 3

Learners will need to provide written and/or oral recorded evidence to demonstrate their Knowledge and/or Skills by showing that they can explain:

- ◆ the types of fuels and lubricants used in a gas turbine and piston engines
- ◆ piston engine lubricating systems and its operation
- ◆ piston engine fuel systems, its control and operation
- ◆ lubricating systems and its operation of gas turbine engines
- ◆ fuel systems, its control and operation of gas turbine engines

Evidence for the Knowledge and/or Skills in this Outcome can be done on an Outcome by Outcome basis or as part of a combined assessment event, under closed-book supervised conditions.

Outcome 4

Learners will need to provide written and/or oral recorded evidence to demonstrate their Knowledge and/or Skills by showing that they can explain the:

- ◆ layout and operation of aircraft piston engine ignition system
- ◆ operation of piston engine starting systems during ground and flight operation
- ◆ layout and operation of aircraft gas turbine engine ignition system
- ◆ operation of gas turbine starting systems during ground and flight operation

Evidence for the Knowledge and/or Skills in this Outcome can be done on an Outcome by Outcome basis or as part of a combined assessment event, under closed-book supervised conditions.



Higher National Unit Support Notes

Unit title: Aircraft Propulsion Systems: Introduction (SCQF level 7)

Unit Support Notes are offered as guidance and 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

This is a mandatory Unit within the HNC/HND Aircraft Engineering Group Awards. The Unit is primarily intended to provide the learner with the essential underpinning knowledge of basic propulsion systems used in aircraft to prepare them for a career in the aircraft engineering industry or for progression to HND Aircraft Engineering (SCQF level 8).

Outcome 1

The emphasis for this Outcome is on the operating principles of piston and gas turbine engines that power an aircraft. The learner should be able to explain both piston and gas turbine engine theory along with the working cycles of both types of engines. Be able to explain the purpose of the major components found in piston and gas turbine engines; and be able to identify the different types of constructional arrangements found in both types of engines.

Outcome 2

The emphasis for this Outcome is on the production of thrust from an aircraft engine driven by either a gas turbine or piston engine. The learner should be able to explain for both a piston and gas turbine engine how thrust is produced by either jet efflux or through a propeller/rotor. How Newton's laws of motion and the appropriate engine/thrust formula can explain airflow through a gas turbine engine; and how horsepower or equivalent shaft horsepower is produced by a piston, turboprop, and turboshaft engine.

Outcome 3

The emphasis for this Outcome is on the lubricating and fuel system found in both a gas turbine and piston engines. The learner should be able to explain the types of fuels and lubricants used in both gas turbine and piston engines. The layout of fuel and lubrication systems and the function and operation of components used in a fuel and lubrication found in gas turbine and piston engines.

Outcome 4

The emphasis for this Outcome is on the ignition and starting systems found in both a gas turbine and piston engines. The learner should be able to explain the components found in

the ignition and starting systems of piston engine and gas turbine engines. The layout of systems and how they operate during an engine start on the ground and inflight.

Higher National Unit Support Notes (cont)

Unit title: Aircraft Propulsion Systems: Introduction (SCQF level 7)

Guidance on approaches to delivery of this Unit

This Unit is designed to provide learners 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 and exercises. Having access to relevant publications, diagrams, and engine components is recommended to assist in teaching and tutorial sessions.

Guidance on approaches to assessment of this Unit

Evidence can be generated using different types of assessment. The following are suggestions only. There may be other methods that would be more suitable to learners.

Centres are reminded that prior verification of centre-devised assessments would help to ensure that the national standard is being met. Where learners experience a range of assessment methods, this helps them to develop different skills that should be transferable to work or further and higher education.

Evidence for this Unit could be generated on an Outcome by Outcome basis or as a combined assessment event. The assessment could consist of a mixture and balance of multiple-choice and restricted response questions covering all Knowledge and/or Skills items.

It is recommended that the total assessment time for all Outcomes should last approximately 2 hours. Learners should not know in advance the questions on which they will be assessed and different questions should be set on each assessment occasion. Assessments must be carried out under closed-book supervised conditions. In order to gain an assessment pass, learners will need to demonstrate that they can achieve the minimum requirements for this Unit.

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 question asked and learners awarded marks for key points and presentation of answers. Learners can supplement written answers with sketches and diagrams to clarify points and be allowed to use scientific calculators to carry out any calculation.

For learners who fail to achieve the pass mark for each assessment, centres may allow learners to re-sit the assessments at an appropriate time using a significantly different assessment(s).

Higher National Unit Support Notes (cont)

Unit title: Aircraft Propulsion Systems: Introduction (SCQF level 7)

Opportunities for e-assessment

E-assessment may be appropriate for some assessments in this Unit. By e-assessment we mean assessment which is supported by Information and Communication Technology (ICT), such as e-testing or the use of e-portfolios or social software. Centres which wish to use e-assessment must ensure that the national standard is applied to all learner evidence and that conditions of assessment as specified in the Evidence Requirements are met, regardless of the mode of gathering evidence. The most up-to-date guidance on the use of e-assessment to support SQA's qualifications is available at www.sqa.org.uk/e-assessment.

Opportunities for developing Core and other essential skills

Learners will have opportunities to develop the Core Skills of *Communication (Written)*, and *Numeracy (Using Number)*, at SCQF level 5 in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

Communication (Written) — this could be achieved through the answering of short restrictive response questions, where all essential ideas/information with some supporting detail are appropriately presented in a logical order. These entries would use a structure and/or conventions mainly appropriate to purpose and audience; and use spelling, punctuation and sentence structures which are mainly accurate.

Numeracy (Using Number) — this could be achieved through the calculations of formula to answer questions on engine theory, where the learner would need to use given information to calculate various factors in order to determine the level of thrust produced by either a gas turbine or piston engine.

History of changes to Unit

Version	Description of change	Date
02	Amend to Support Notes - Recommended total assessment time for all Outcomes should last approximately 2 hours.	14/09/2015

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General information for learners

Unit title: Aircraft Propulsion Systems: Introduction (SCQF level 7)

This section will help you decide whether this is the Unit for you by explaining what the Unit is about, what you should know or be able to do before you start, what you will need to do during the Unit and opportunities for further learning and employment.

This Unit is designed to introduce you to the main concepts of Aircraft Propulsion. It will allow you to gain an understanding of the basic propulsive processes regarding both piston and gas turbine cycles. In addition you will also achieve a working knowledge of aircraft gas turbine and piston engine ancillary systems.

On completion of this Unit you should be able to:

- 1 Explain the principles of operation of aircraft gas turbine and piston engines.
- 2 Explain the principles of thrust production for aircraft gas turbine and piston engines used on fixed and rotary wing aircraft.
- 3 Explain the layout and operation of fuel and lubrication systems used in both a piston and gas turbine engines.
- 4 Explain the layout and operation of starting and ignition systems used in both a piston and gas turbine engines.

You will be assessed under closed-book supervised conditions on all of the Knowledge and/or Skills contained in the four Outcomes and to complete the Unit successfully you will have to achieve a satisfactory level of performance in the assessment event/s.

The Unit may be of particular interest to those who are interested in pursuing a career in aircraft engineering, as it covers fundamental aspects of design and operation of aircraft gas turbine and piston engines. It may well be of interest to other engineering students who are interested in different types of piston and gas turbine systems.

Although there is no automatic certification of Core Skills or Core Skills components within the Unit, it may, through the undertaking of particular tasks allow you to develop the necessary Core Skills requirements at SCQF level 5 of *Communication* (Written) and *Numeracy* (Using Number).