

Higher National Unit Specification

General information for centres

Unit title: Aircraft Propellers

Unit code: DP5N 34

Unit purpose: This Unit is designed to allow candidates to acquire an in-depth knowledge of the operation, function and maintenance requirements of an aircraft propeller as applied to aircraft maintenance engineering. The Unit will also provide the knowledge element requirement to meet EASA IR part 66 aircraft maintenance license (module 17) for propeller systems.

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

- 1 Explain the fundamental principles of how a propeller produces thrust.
- 2 Explain how control and pitch change of a propeller is achieved.
- 3 Explain how propellers are synchronised and protected against ice formation.
- 4 Explain the construction and materials used in the manufacture of a propeller.
- 5 Explain how propellers are maintained and preserved.

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 GO/AP (Intro to Propulsion) 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.

This is an optional Unit that is included in the framework of the HNC/HND Aircraft Engineering Group Awards. It is recommended that it is taught and assessed within the context of the particular Group Award to which it contributes.

General information for centres (cont)

Unit title: Aircraft Propellers

Assessment: This Unit is assessed by two assessments events covering all the individual Outcomes. The first assessment will cover Outcomes 1 to 3 and carried out on a sampling basis composed of a number of appropriate structured short answer restricted response questions, each of approximately 75 words. The second assessment will cover Outcomes 4 and 5 and be a case study investigation requiring candidates to produce a report of approximately 750 words. Assessment 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.

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: Aircraft Propellers

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

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 assessments of this Unit are given at the end of the statements of standards.

Outcome 1

Explain the fundamental principles of how a propeller produces thrust

Knowledge and/or skills

- ◆ propeller blade element theory
- ◆ propeller blade angle of attack and the effect of relative airflow on it
- ◆ propeller thrust
- ◆ propeller slip and torque
- ◆ forces acting on a propeller in flight
- ◆ propeller vibration and resonance

Outcome 2

Explain how control and pitch change of a propeller is

Knowledge and/or skills

- ◆ propeller speed and overspeed protection control
- ◆ pitch, feathering and reverse pitch control

Higher National Unit specification: statement of standards (cont)

Unit title: Aircraft Propellers

Outcome 3

Explain how propellers are synchronised and protected against ice formation

Knowledge and/or skills

- ◆ synchronising and synchrophasing of a propeller
- ◆ propeller de-icing systems

Outcome 4

Explain the construction and materials used in the manufacture of a propeller

Knowledge and/or skills

- ◆ materials used in: wooden, composite and metal propellers
- ◆ construction of propeller: blade stations, blade face, shank, back and hub assembly
- ◆ construction of fixed pitch, controllable pitch and constant speed propellers
- ◆ installation of: propeller, spinner and hub assemblies

Outcome 5

Explain how propellers are maintained and preserved

Knowledge and/or skills

- ◆ static and dynamic balancing
- ◆ propeller blade tracking
- ◆ impact damage, delamination, corrosion and erosion
- ◆ propeller treatment/repair schemes
- ◆ propeller engine running

Evidence requirements

Evidence for this Unit will be generated through two assessments events. The first assessment event will be carried out on a sampling basis of the knowledge and/or skills requirements of Outcomes 1 to 3 requiring the candidates to respond to four sampled questions by structured short answer, restricted response questions; two from Outcomes 1, and one from each of Outcome 2 and 3. 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 event covering Outcomes 4 and 5 should be a case study investigation in propeller construction and maintenance. The assessment will require the candidates to produce a report of approximately 750 words and in generating the evidence, candidates will need to show that they can evaluate the information to produce a balanced report explaining 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: Aircraft Propellers

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:

- ◆ identify different parts of a propeller explaining how a propeller blade produces thrust
- ◆ explain how propeller blade angle of attack is measured and how relative airflow to the propeller affects the effective angle
- ◆ explain how the type and amount of thrust generated by a propeller is effected by rotational speed, reverse angle and high/low blade angle
- ◆ explain how a propeller produces torque and slip
- ◆ identify different types of forces acting on a propeller during flight and explain how they act
- ◆ explain how propeller vibration and resonance occurs and its effect on the aircraft performance
- ◆ explain the methods used to provide speed control and overspeed protection of a propeller by means of mechanical control system
- ◆ explain the methods used to provide speed control and overspeed protection of a propeller by means of an electrical/ electronic control system
- ◆ explain how on a mechanical control system, control the forward pitch, reverse pitch and feathering of a propeller is achieved
- ◆ explain how on a mechanical control system, control the forward pitch, reverse pitch and feathering of a propeller is achieved
- ◆ explain how propellers, spinners and hub assemblies are assembled explain propeller synchronising and synchrophasing
- ◆ explain how synchronising and synchrophasing is achieved and the equipment used to carry it out
- ◆ explain how a fluid de-icing system operates to provide ice protection to a propeller
- ◆ explains how an electrical de-icing system operates to provide ice protection to a propeller

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:

- ◆ identify the types of materials used to construct different types of propellers and explain why they are used
- ◆ explain the construction methods used to manufacture different parts of a propeller
- ◆ explain why different types of propellers: fixed pitch, controllable pitch and constant speed propellers are constructed
- ◆ explain how and why propeller is static and dynamic balanced
- ◆ explain how and why propeller blade tracking is carried out
- ◆ identify the different types of propeller damage, delamination, corrosion and erosion
- ◆ identify and explain different propeller treatment/ repair schemes
- ◆ explain why there are rules and limitations for propeller engine running
- ◆ explain how and why propeller preservation and de-preservation is carried out

Higher National Unit specification: statement of standards (cont)

Unit title: Aircraft Propellers

Assessment guidelines

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

The first event should cover Outcomes 1 to 3 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.

The second assessment event should cover Outcomes 4 and 5 and be a case study investigation. This assessment should be carried out under open-book conditions and candidates can support their submission with sketches and diagrams. Sufficient time to complete the report should be given to candidates, with five hours of course time set aside for study research. The overall time allowed for completed submission of reports 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 do not achieve the minimum evidence requirement for each assessment, centres may allow candidates to re-sit the assessments at an appropriate time using different sampled questions or another case study.

Administrative Information

Unit code:	DP5N 34
Unit title:	Aircraft Propellers
Superclass category:	XP
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Higher National Unit specification: support notes

Unit title: Aircraft Propellers

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

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 one day at the centres discretion for industrial visit. The notional design length for each Outcome is seven hours plus five hours set aside for case study research.

Guidance on the content and context for this Unit

This is an optional Unit devised for the principals and technology section of the HNC/HND Aircraft Engineering Group Award. The Unit is intended to give candidates an in-depth knowledge of the operation and construction of an aircraft propeller, along with the maintenance requirements of a propeller that is carried out by an aircraft engineer.

The Unit will also provide the knowledge element requirement to meet EASA IR part 66 aircraft maintenance license (module 17) for propeller systems, 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 Principles of how a propeller blade produces thrust along with an understanding of how aerodynamic, centrifugal and thrust forces that act on a propeller during flight. The effect that relative airflow has on the angle of attack of a propeller and how high/low blade angle, angle of attack and rotational speed alters the amount of thrust produced by a propeller. How a propeller produces torque and how propeller slip occurs. An industrial visit to engine manufacture along with access to ground running facilities would be beneficial to this Outcome.
- 2 Methods and mechanisms, both mechanical and electrical that are used for propeller pitch control, feathering, reverse pitch, torque control and over-speed protection. Industrial visit to engine manufacture along with access to ground running facilities would be beneficial to this outcome
- 3 Principles of propeller synchronising and how propeller synchrophasing is achieved. Propeller deicing systems both fluid and electrical icing and how they operate. Access to system diagrams and typical systems along with industrial visit to aircraft service Unit would be beneficial to this Outcome.
- 4 Techniques and materials used in fixed pitch propeller construction, controllable pitch propeller construction and constant speed propeller construction. How hub assemblies, propellers and spinner are installed and how blade stations and other component parts are identified. An industrial visit to a propeller manufacture or aircraft service Unit using propeller aircraft would be beneficial to this Outcome.

Higher National Unit specification: support notes (cont)

- 5 Maintenance method used to identify propeller damage, erosion, corrosion, delamination and impact damage. Repair schemes and treatment carried out during maintenance, propeller dynamic balancing and blade tracking. Method and treatment for propeller storage and preservation and maintenance limits of propeller engine running. Access to propeller maintenance manuals and examples of damaged propeller equipment along with an industrial visit to engine manufacturer and aircraft service Unit would be beneficial to this Outcome.

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 equipment and publications is recommended, as is a visit to an engine manufacturer or aircraft maintenance facility. Course work and assignment reports must be the work of individuals. It is recommended that this Unit be delivered using both imperial and metric Units as appropriate to normal practices in the aviation industry.

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.

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 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: Aircraft Propellers

This Unit is designed to enable you to acquire the knowledge and understanding the principles, function, operation and maintenance of an aircraft propeller. The Unit is intend for candidates who are interested in aircraft engineering and is offered as an optional Unit in the HNC/HND Aircraft Engineering Group Award.

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 17 (Propellers) of EASA IR Part 66 aircraft licensing requirements for mechanical engineers.

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

- 1 The fundamental principles of how a propeller produces thrust.
- 2 How control and pitch change of a propeller is achieved.
- 3 How propellers are synchronised and protected against ice formation.
- 4 Construction and materials used in the manufacture of a propeller.
- 5 Propellers maintenance and preservation.

Assessment of the Unit will be by two assessment examinations. The first paper will cover Outcomes 1 to 3 and be a closed-book examination made up of structured restricted response questions. The second will be a case study investigation covering Outcomes 4 and 5 requiring you to compile a report in propeller construction and maintenance.

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