



Higher National Unit specification

General information

Unit title: Aircraft Hydraulic and Pneumatic Systems (SCQF level 7)

Unit code: H94H 34

Superclass: XP

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Unit purpose

This Unit is designed to give learners an introduction to the principles of pneumatics and hydraulics. This is subsequently developed to allow the application of these principles to aircraft to be explored. Finally the common aircraft systems on which these two sources of power are employed are analysed.

This Unit is primarily aimed at learners who wish to work in the aircraft engineering industry.

Outcomes

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

- 1 Explain the principles and generation of hydraulic and pneumatic power.
- 2 Describe the operation of aircraft hydraulic and pneumatic power systems.
- 3 Analyse the function and operation of aircraft hydraulically and pneumatically powered systems.

Credit points and level

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

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 knowledge of aircraft and/or engineering theory.

Higher National Unit specification: General information (cont)

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Core Skills

There are opportunities to develop the Core Skill of *Communication* (Written Communication) and *Numeracy* (Using Number) 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.

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 Hydraulic and Pneumatic Systems (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 and generation of hydraulic and pneumatic power.

Knowledge and/or Skills

- ◆ Hydraulic fluids
- ◆ Hydraulic power generation
- ◆ Emergency generation of hydraulic power
- ◆ Force; pressure; area; differential areas; Bramah's press
- ◆ Fluid requirements: properties; types; identification; hazards
- ◆ Power generation methods: main system; emergency standby system
- ◆ Characteristics of compressed air: ideal gas equation; Charles' Law; Boyle's Law; Gay-Lussac's Law
- ◆ Safety precautions: hydraulics and pneumatics
- ◆ Considerations for the selection of hydraulic or pneumatic power

Outcome 2

Describe the operation of aircraft hydraulic and pneumatic power systems.

Knowledge and/or Skills

- ◆ Layout
- ◆ Hydraulic and pneumatic system components
- ◆ Hydraulic and pneumatic system symbols and schematics
- ◆ The operation of typical aircraft hydraulic and pneumatic power systems
- ◆ The operation and interfacing of emergency standby systems
- ◆ Warning and indication systems for hydraulic and pneumatic systems

Higher National Unit specification: Statement of standards (cont)

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Outcome 3

Analyse the function and operation of aircraft hydraulically and pneumatically powered systems.

Knowledge and/or Skills

- ◆ Landing gear: extension, retraction, downlock, uplock and steering
- ◆ Braking: normal and emergency
- ◆ Thrust reverse
- ◆ Primary and secondary flight control
- ◆ Pneumatic anti-icing and de-icing systems
- ◆ Pneumatic engine start
- ◆ Ancillary uses of pneumatic power

Evidence Requirements for this Unit

Evidence for this Unit could be generated on an Outcome by Outcome basis or as a combined assessment event.

Outcome 1

Learners will need to provide written and/or oral recorded evidence, generated under closed-book supervised conditions, to demonstrate their Knowledge and/or Skills by showing that they can:

- ◆ identify the characteristics of hydraulic fluids.
- ◆ explain the principles of hydraulic power generation.
- ◆ explain the principles of the emergency generation of hydraulic power.
- ◆ explain in relation to fluids the principles of Force; pressure; area; differential areas; Bramah's press.
- ◆ explain fluid requirements: properties; types; identification; hazards.
- ◆ explain the power generation methods: main system; emergency standby system.
- ◆ explain the characteristics of compressed air: ideal gas equation; Charles' Law; Boyle's Law; Gay-Lussac's Law.
- ◆ identify the safety precautions associated with hydraulics and pneumatics.
- ◆ explain the considerations for the selection of hydraulic or pneumatic power.

Higher National Unit specification: Statement of standards (cont)

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Outcome 2

Learners will need to provide written and/or oral recorded evidence, generated under closed-book supervised conditions, to demonstrate their Knowledge and/or Skills by showing that they can:

- ◆ describe the layout of basic hydraulic and pneumatic systems.
- ◆ identify hydraulic and pneumatic system components.
- ◆ identify hydraulic and pneumatic system symbols and schematics.
- ◆ describe the operation of typical aircraft hydraulic and pneumatic power systems.
- ◆ describe the operation and interfacing of emergency/standby systems.
- ◆ describe the warning and indication systems for hydraulic and pneumatic systems.

Outcome 3

Learners will need to provide written and/or oral recorded evidence, generated under closed-book supervised conditions, to demonstrate their Knowledge and/or Skills by showing that they can:

- ◆ analyse the function and operation of landing gear: extension, retraction, downlock, uplock and steering.
- ◆ analyse the function and operation of braking systems: normal and emergency.
- ◆ analyse the function and operation of pneumatic and hydraulic thrust reversers.
- ◆ analyse the function and operation of primary and secondary flight controls.
- ◆ analyse the function and operation of pneumatic anti-icing and de-icing systems.
- ◆ analyse the function and operation of pneumatic engine start.
- ◆ describe uses of ancillary pneumatic power.



Higher National Unit Support Notes

Unit title: Aircraft Hydraulic and Pneumatic Systems (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

The Unit is intended to give learners an in-depth knowledge of hydraulic and pneumatic systems together with their control and indication systems encountered on an aircraft. The Unit is structured so that the principles of hydraulics and pneumatics in Outcome 1 are developed in Outcome 2 to relate them to aircraft. Outcome 3 considers the function and operation of systems where hydraulic and pneumatic power is utilised.

Wherever possible the delivery of this Unit should utilise practical examples of where the concepts may be found on an aircraft.

Wherever possible you should endeavour to provide the learner 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 Outcome 1 provides the foundations for the *Aircraft Hydraulic and Pneumatic Systems* Unit by introducing the key fundamental concepts of; characteristics of hydraulic fluids, principles of hydraulic power generation, principles of the emergency generation of hydraulic power, the principles of Force; pressure; area; differential areas; Bramah's press, fluid requirements: properties; types; identification; hazards, power generation methods: main system; emergency standby system, characteristics of compressed air: ideal gas equation; Charles' Law; Boyle's Law; Gay-Lussac's Law, safety precautions associated with hydraulics and pneumatics and the selection of hydraulic or pneumatic power.

Some of these fundamental principles lend themselves to numerical description and this is encouraged as a means of adding variety to what is a largely qualitative Unit. This Outcome covers the fundamentals of both hydraulics and pneumatics and therefore it concludes with a comparison between the selection of the two fluid types as a choice of power. This element of the Knowledge and/or Skills should focus on the advantages and disadvantages of each system and therefore enable learners to understand the reasons why a particular source is commonly used in a particular application.

Higher National Unit Support Notes (cont)

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- 2 Outcome 2 extends the fundamental knowledge presented in the first Outcome to its application to aircraft. Initially a basic layout of both hydraulic and pneumatic systems utilising system symbols and schematics is discussed in terms of the relative positioning of components and the operation of each of the main components. This is developed to show how the basic system architecture is expanded to encompass the more complex requirements associated when aircraft certification regulations are complied with, introducing the concepts of emergency and standby systems. The final element of this Outcome describes the warning and indications normally associated with hydraulic and pneumatic systems on an aircraft.
- 3 The final Outcome in this Unit analyses the function and operation of systems commonly powered by the hydraulic and pneumatic power on an aircraft. The main hydraulic and pneumatic systems explored will include landing gear: extension, retraction, downlock, uplock and steering, braking: normal and emergency, thrust reversers, primary and secondary flight controls, anti-icing and de-icing, engine start and ancillary pneumatic power. Examples of ancillary pneumatics could for example include hydraulic tank pressurisation and pneumatic door seal operation.

Guidance on approaches to delivery of this Unit

It is logical to deliver this Unit sequentially by Outcome, as the fundamental principles of hydraulics and pneumatics explored in the first Outcome are developed throughout the second and third Outcomes.

Whilst the mode of delivery is at the discretion of the centre it is anticipated that traditional lectures could be supplemented by a range of media, for example videos, simulations and actual aircraft components. The delivery of the numerical analysis element of hydraulic and pneumatic principles in Outcome 1 could be reinforced with a number of tutorial questions presented in a variety of ways to ensure that depth of understanding is confirmed in a formative manner prior to the summative assessment at or near the end of the Unit.

Outcome 2 relates the fundamental principles, presented in Outcome 1, to an aircraft environment. The delivery of Outcome 2 could commence with the explanation of a basic aircraft hydraulic and pneumatic power generation and distribution system. This could then be expanded on to encompass additional system architecture associated with, for example, the concepts of emergency and standby systems as a by-product of certification requirements.

Outcome 3 will enable the uses of the less 'visible' hydraulic and pneumatic power generation systems to be explored by demonstrating the function and operation of the most commonly found aircraft systems utilising either fluid power source. The learning for this Outcome could be enhanced through the use of videos and simulations and this should be explored wherever possible to support any traditional learning strategy.

Higher National Unit Support Notes (cont)

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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.

Holistic assessment is encouraged and learners could be assessed by a single one and a half hour closed book assessment covering all three Outcomes after completion of the teaching of the Unit. The assessment could be comprised of a number of multiple-choice and extended response questions enabling Unit Evidence Requirements to be met and breadth and depth of learner knowledge to be demonstrated. This assessment approach should reduce the frequency of assessment/re-assessment events and ensure more time is afforded for teaching and learning whilst meeting the Evidence Requirements of the Unit.

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 learners' achievements should be kept. These records will be available for external verification.

Learners should not know in advance the questions on which they will be assessed and different questions should be set on each assessment occasion. This assessment 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.

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

There are opportunities to develop the Core Skill of *Communication* (Written Communication) and *Numeracy* (Using Number) at SCQF level 5 in this Unit, although there is no automatic certification of Core Skills or Core Skills components. This could be achieved through accurate written and numeric answers to formative and summative assessment questions.

History of changes to Unit

Version	Description of change	Date

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General information for learners

Unit title: Aircraft Hydraulic and Pneumatic Systems (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 principles of pneumatics and hydraulics. This is further developed to allow you to explore the application of these principles to aircraft. Finally you will analyse the common aircraft systems which these two sources of power are employed on.

This Unit is included in the HNC and HND Aircraft Engineering qualifications. It may be of particular interest if you are interested in pursuing a career in Aircraft Engineering, either in a practical maintenance role or if you intend to look to undertake an Engineering function such as design.

The Unit has three main areas, each area covered by a separate Outcome. At the end of the unit you will be able to:

- 1 Explain the principles and generation of hydraulic and pneumatic power.
- 2 Describe the operation of aircraft hydraulic and pneumatic power systems.
- 3 Analyse the function and operation of aircraft hydraulic and pneumatic powered systems.

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

You will have opportunities to develop the Core Skill component of *Communication* (Written Communication) and *Numeracy* (Using Number) at SCQF level 5 in this Unit. This could be achieved through accurate written and numeric answers to formative and summative assessment questions.