

SQA Advanced Unit specification

General information

Unit title: Marine Engineering: Pneumatics and Hydraulic Systems
(SCQF level 7)

Unit code: HW5A 47

Superclass: XQ

Publication date: November 2017

Source: Scottish Qualifications Authority

Version: 01

Unit purpose

This unit has been designed to give learners a knowledge and understanding of the operation and maintenance of pneumatic and hydraulic systems. The learners are expected to be going into sea-going employment with the Merchant Navy.

Outcomes

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

- 1 explain the operation of pneumatic and hydraulic systems
- 2 design, assemble and test a fluid power and control system
- 3 demonstrate fault-finding competence on a fluid power system

Credit points and level

1 SQA Credit at SCQF level 7: (8 SCQF credit points at SCQF level 7)

Recommended entry to the unit

Entry to this unit is at the discretion of the centre, however it would be an advantage if learners had possession of the following SQA Advanced Unit: *Engineering Drawing* (HT72 47).

SQA Advanced Unit Specification

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.

SQA Advanced Unit specification: Statement of standards

Unit title: Marine Engineering: Pneumatics and Hydraulic 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.

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. Learners 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

Explain the operation of pneumatic and hydraulic systems.

Knowledge and/or Skills

- ◆ Identification of component symbols to British Standards
- ◆ Operation of pneumatic circuit components
- ◆ Operation of hydraulic circuit components
- ◆ Properties of air as working fluid
- ◆ Properties of hydraulic fluids
- ◆ Safety precautions regarding pneumatic and hydraulic systems

Outcome 2

Design, assemble and test a fluid power and control system.

Knowledge and/or Skills

- ◆ Design of circuit for a given application
- ◆ Assembly of circuit using standard components
- ◆ Test of circuit to ensure correct operation

Outcome 3

Demonstrate fault-finding competence on a fluid power system.

Knowledge and/or Skills

- ◆ Interpretation of industrial drawings
- ◆ Diagnostic techniques
- ◆ Rectification of faults

SQA Advanced Unit Specification

Evidence requirements for this unit

Outcome 1

Evidence for the knowledge and/or skills in this outcome will be provided on a sample basis.

Written and/or recorded oral evidence for Learning Outcome 1 is required. In any assessment of this outcome, **three out of six** knowledge and/or skills items should be sampled. An alternative sample should be selected when reassessment is undertaken.

Where an item is sampled, a learner's response will be judged satisfactory where the evidence shows that the learner can:

- ◆ identify component symbols to British Standards
- ◆ identify the operation of the main features of a pneumatic system
- ◆ identify the operation of the main features of a hydraulic system
- ◆ explain the properties of air as a working fluid
- ◆ explain the properties of hydraulic fluids
- ◆ explain the safety precautions required when operating or working with pneumatic and hydraulic systems

This outcome should be assessed as one single assessment and should last no more than one hour. Written and/or oral recorded evidence is required. This assessment should be conducted under closed-book, controlled, supervised conditions and learner should not be allowed to bring any notes text books or other materials into the assessment.

Outcome 2

All knowledge and/or skills items in Outcome 2 should be assessed. The evidence should be presented in response to an assignment in which learners are asked to complete a series of tasks which will enable them to design, assemble and test a fluid power and control circuit to meet a given design specification. A pneumatic or hydraulic circuit should be chosen for the assignment.

A learner's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing that the learner is able to:

- ◆ design a fluid power and control circuit to satisfy a given performance specification
- ◆ select appropriate components to assemble the circuit
- ◆ prepare drawings and a parts list for the circuit
- ◆ assemble the circuit
- ◆ compare the performance of the assembled circuit with the design specification
- ◆ modify the circuit to meet the design specification if required

SQA Advanced Unit Specification

The assignment should be carried out under supervised and controlled conditions. Learner evidence should take the form of a functional circuit and a report containing the following details:

- ◆ the design specification
- ◆ the design process
- ◆ the results of the performance tests
- ◆ any circuit modifications required to meet the design specification

Outcome 3

All knowledge and/or skills items in Outcome 3 should be assessed. The evidence should be presented in response to an assignment in which the learner is set the task of undertaking fault finding on a practical or computer simulated faulty fluid power system. The system should contain a minimum of two constructional and two operational faults.

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

- ◆ correctly use industrial drawings to understand the operation of a system
- ◆ prepare a procedure to locate faults in the system
- ◆ demonstrate the procedure on a system
- ◆ rectify the faults in the system

The fault-finding exercise should be carried out under supervised, controlled conditions. Learners should provide evidence in the form of report plus diagrams and essential documentation.

The report should include:

- ◆ statement of the purpose of the exercise
- ◆ details of the procedures to locate faults
- ◆ an assessment of the effectiveness of the fault-finding procedure
- ◆ a statement confirming that it is the learner's own work

SQA Advanced Unit Support Notes

Unit title: Marine Engineering: Pneumatics and Hydraulic 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

This unit is part of the SQA Advanced Certificate/SQA Advanced Diploma in Marine Engineering. The competencies in this unit are required for Engineer Officer Certificates of Competency as issued by the Maritime and Coastguard Agency.

This unit has been written in order to allow learners to develop their knowledge, understanding and skills in the following areas:

- 1 explain the operation of pneumatic and hydraulic systems
- 2 design, assemble and test a fluid power and control system
- 3 demonstrate fault-finding competence on a fluid power system

In designing this unit, the unit writers have identified the range of topics expected to be covered by lecturers. The writers have also given recommendations as to how much time should be spent on each outcome. This has been done to help lecturers to decide what depth of treatment should be given to the topics attached to each of the outcomes. Whilst it is not mandatory for centres to use this list of topics it is strongly recommended that they do so to ensure continuity of teaching and learning.

A list of topics is given below.

1 Describe operational and maintenance requirements of compressed air and hydraulic systems (8 hours)

Learners will not require an in-depth understanding of the topics listed below but will find it useful to be aware of the significance of these in relation to the operation of pneumatic and hydraulic systems.

- ◆ component symbols as used in pneumatic and hydraulic system drawings to British Standards
- ◆ properties of air as a working fluid: compressibility, moisture content, need for lubrication, filtration
- ◆ operation and performance of pneumatic components
- ◆ properties of hydraulic fluids
- ◆ operation and performance of hydraulic components
- ◆ safety precautions to be followed when working with pneumatic and hydraulic systems

SQA Advanced Unit Specification

2 Design, assemble and test a fluid power and control circuit (14 hours)

- ◆ preparation of performance specifications for fluid power circuits
- ◆ identification of requirements of power and control circuits
- ◆ loads and pressures requirements
- ◆ actuators, control valves, and safety valves
- ◆ selection of components to meet the specification for the circuit
- ◆ circuit layout using standard notation
- ◆ methods of assembly
- ◆ safety regulations for the assembly and testing of fluid power systems
- ◆ test procedures for fluid power systems

3 Demonstrate fault-finding competence on a fluid power system (15-hours)

- ◆ interpretation of industrial drawings (statement)
- ◆ procedures to identify and locate defects (plan of action)
- ◆ application of step diagrams and logic diagrams (plan of action)
- ◆ safety procedures to permit the testing of systems (document)
- ◆ methods of rectifying faults (written statement of process)
- ◆ confirmation of fault correction (demonstration of satisfactory operation)

Guidance on approaches to delivery of this unit

When delivering this unit emphasis should be placed on a 'hands-on' approach wherever possible. Examples of systems and procedures should be related to a learner's work environment and practical exercises should be copies of actual systems or parts of systems in operation onboard a vessel. The use of computer models, simulation and/or design packages will be useful and should be encouraged.

It is expected that if Outcome 2 is assessed on a pneumatic system then Outcome 3 would be assessed on a hydraulic system (or vice versa) in order that the learners get an opportunity to experience both systems.

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.

SQA Advanced Unit Specification

Outcome 1 should be assessed using one single assessment paper taken at a single assessment event that should last no more than one hour. This assessment should be conducted under closed-book, supervised, controlled conditions.

A different sample of the skills and knowledge should be chosen when re-assessing the learner.

Outcome 2 should be assessed by means of an assignment in which the learner designs, assembles and tests a pneumatic or hydraulic power and control circuit to meet a given design specification. Learner evidence should take the form of a functional circuit and a report. This outcome may be assessed with Outcome 3.

Outcome 3 should be assessed using an assignment in which the learner is set the task of undertaking fault-finding on a practical or simulated faulty fluid power system. The system should contain a minimum of two constructional and two operational faults. Learners should provide evidence in the form of a report.

Outcome 1

The assessment paper may be composed of an appropriate balance of short-answer, restricted-response and structured questions.

Outcome 2

This assignment may be combined with some of the requirements of Outcome 3. Centres may develop a suitable checklist to confirm the functionality of the fluid power and control circuit. Centres may wish to issue learners with suitable guidance notes giving advice on the best way to structure their reports. The report may be 250 to 500 words plus diagrams containing the following details:

- ◆ a parts list for the circuit
- ◆ circuit diagram
- ◆ performance curves
- ◆ modifications

Outcome 3

This assignment may be carried out on a practical pneumatic or hydraulic system but where this not available a computer simulated system can be used. The type of pneumatic or hydraulic circuit selected for the fault-finding exercise should reflect the marine background in which the learner works. Centres may wish to prepare a checklist to confirm that the practical fault-finding activity is the learner's own work. The assessment for Outcome 3 may be combined with parts of that for Outcome 2. Centres may wish to issue learners with suitable guidance notes giving advice on the best way to structure their reports. The report may be 250 to 500 words in length.

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 may be opportunities to gather evidence towards the following core skills components in this unit, although there is no automatic certification of core skills or core skills components.

Communication (Reading and Writing) level 6 through report writing.

Working with Others (co-operatively) level 6 through working as a team to build a circuit or find faults in one.

Problem Solving (Critical Thinking) level 6 through designing a practical working system.

SQA Advanced Unit Specification

History of changes to unit

Version	Description of change	Date

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SQA acknowledges the valuable contribution that Scotland's colleges have made to the development of SQA Advanced Qualifications.

FURTHER INFORMATION: Call SQA's Customer Contact Centre on 44 (0) 141 500 5030 or 0345 279 1000. Alternatively, complete our [Centre Feedback Form](#).

General information for learners

Unit title: Marine Engineering: Pneumatics and Hydraulic 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.

Pneumatic and hydraulic systems are used extensively in onboard ships, and are, therefore, systems about which marine engineers should have knowledge, understanding and skills.

In this unit you will learn about the operation of pneumatic and hydraulic systems. You will also design, assemble and test either a pneumatic or hydraulic system. You will also undertake fault-finding exercises on an actual or computer simulated pneumatic or hydraulic system.

Delivery of this unit is likely to take place in a practical laboratory environment where you will be provided with the opportunity to undertake a significant amount of hands-on, practical work. Safety and health will be emphasised throughout the delivery of the unit.

Assessment will take place on an outcome by outcome basis. Outcome 1 will be assessed by means of a written test lasting no more than one hour which will be conducted under closed-book, controlled, supervised conditions. Outcome 2 will be assessed by an assignment in which you will be required to design, assemble and test a pneumatic or hydraulic system. Outcome 3 will also be assessed by an assignment in which you will be required to undertake some fault-finding exercises on a practical or computer simulated pneumatic or hydraulic system.

The three outcomes you will study are:

- 1 explain the operation of pneumatic and hydraulic systems
- 2 design, assemble and test a fluid power and control system
- 3 demonstrate fault-finding competence on a fluid power system

You may have opportunities to develop core skills in the teaching and assessment of this unit, as follows:

- ◆ *Communication* (Reading and Writing) level 6 through report writing
- ◆ *Working with Others* (Co-operatively) level 6 through working as a team to build a circuit or find faults in one
- ◆ *Problem Solving* (Critical Thinking) Level 6 through designing a practical working