



National Unit Specification: general information

UNIT Pneumatics and Hydraulics (SCQF level 6)

CODE F5JB 12

SUMMARY

This Unit may form part of a National Qualification Group Award or may be offered on a free standing basis.

This largely practical Unit is designed to provide candidates with knowledge, understanding and skills of pneumatic and hydraulic circuits. During delivery of the Unit candidates will learn how to interpret pneumatic and hydraulic components and component symbols and describe the operation of fluid power components. They will develop the knowledge and skills to draw and simulate pneumatic and hydraulic circuits. Candidates will also learn how to design, assemble and test pneumatic or hydraulic circuits as well as developing the knowledge and skills to perform basic fault finding techniques on pneumatic or hydraulic circuits and rectify faults. Candidates will develop practical skills and safe working practices whilst assembling and testing pneumatic or hydraulic systems.

This Unit is suitable for candidates training to be maintenance, mechanical or multi-disciplinary engineering technicians.

OUTCOMES

- 1 Interpret pneumatic and hydraulic symbols and describe the operation of fluid power components.
- 2 Draw and simulate fluid power circuits.
- 3 Design, assemble and test fluid power circuits that conform to given specifications.
- 4 Fault find and rectify faults in fluid power circuits.

Administrative Information

Superclass: XH

Publication date: March 2009

Source: Scottish Qualifications Authority

Version: 01

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National Unit Specification: statement of standards

UNIT Pneumatics and Hydraulics (SCQF level 6)

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

Interpret pneumatic and hydraulic symbols and describe the operation of fluid power components.

Performance Criteria

- (a) Identify correctly pneumatic and hydraulic components used in engineering systems.
- (b) Identify correctly pneumatic and hydraulic component symbols that conform to current standards.
- (c) Identify correctly the functions of pneumatic and hydraulic components used in engineering systems.
- (d) Describe, with the aid of given diagrams, the operation of pneumatic and hydraulic components used in fluid power systems.

OUTCOME 2

Draw and simulate fluid power circuits.

Performance Criteria

- (a) Draw and simulate correctly a pneumatic circuit that performs a given function.
- (b) Draw and simulate correctly a hydraulic circuit that performs a given function.

OUTCOME 3

Design, assemble and test a fluid power circuit that conforms to given specifications.

Performance Criteria

- (a) Design correctly a fluid power circuit to meet a given specification using current standard symbols.
- (b) Assemble correctly the designed fluid power circuit in accordance with safe working procedures and practices.
- (c) Test the assembled fluid power circuit correctly for functionality.
- (d) Calculate correctly the actuator requirements for specific conditions in a given fluid power circuit.

National Unit Specification: statement of standards (cont)

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OUTCOME 4

Fault find and rectify faults in fluid power circuits.

Performance Criteria

- (a) Locate correctly faults using appropriate diagnostic techniques.
- (b) Identify correctly causes of failure.
- (c) Rectify faults in accordance with current industrial practice.
- (d) Carry out all fault finding activities in accordance with safe working procedures and practices.

EVIDENCE REQUIREMENTS FOR THIS UNIT

Evidence is required to demonstrate that candidates have achieved all Outcomes and Performance Criteria.

Written and/or recorded oral, product and performance evidence supplemented with an assessor observation checklist(s) should be produced to demonstrate that a candidate has achieved all Outcomes and Performance Criteria.

Outcome 1

Outcome 1 must be assessed by a single assessment designed to ensure that candidates can generate sufficient evidence to satisfy the Outcome and Performance Criteria. Candidate evidence must be in the form of written and/or recorded oral evidence. Assessment must be conducted under supervised, closed-book conditions in which candidates are not allowed to bring their own notes, handouts, textbooks or other materials into the assessment. Total assessment time for Outcome 1 must not exceed 1 hour.

With regard to Outcome 1

- ◆ candidates must identify four pneumatic and four hydraulic components
- ◆ candidates must identify four pneumatic and four hydraulic component symbols
- ◆ candidates must identify correctly the function of three pneumatic and three hydraulic components
- ◆ candidates must describe the operation of one pneumatic component and one hydraulic component

Outcome 2

Outcome 2 must be assessed by two assessments: one designed to generate evidence of candidates' abilities to draw and simulate a pneumatic circuit and the other designed to assess candidates' abilities to draw and simulate a hydraulic circuit. Candidate evidence must be in the form of product and performance evidence. Candidates must undertake assessment on their own. Assessment must be conducted under supervised conditions. An observation checklist must be used to record evidence of whether candidates have satisfied all the Performance Criteria in the Outcome or not.

National Unit Specification: statement of standards (cont)

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With regard to Outcome 2

- ◆ the pneumatic circuit must control sequentially at least two actuators and contain one flow control device
- ◆ the hydraulic circuit must comprise of a minimum of five components which must include at least one actuator and one fluid control method

Outcome 3

Outcome 3 must be assessed by a single assessment designed to generate evidence of candidates' abilities to design, assemble and test a pneumatic circuit or a hydraulic circuit. Candidate evidence must be in the form of product and performance evidence. Candidates must undertake assessment on their own. Assessment must be conducted under supervised conditions. An observation checklist must be used to record evidence of whether candidates have satisfied all the Performance Criteria in the Outcome or not.

With regard to Outcome 3

- ◆ the pneumatic circuits must control sequentially at least two actuators and contain one flow control device
- ◆ with regard to a pneumatic circuit candidates must also demonstrate an ability to deal with maintained signals
- ◆ the hydraulic circuit must comprise of a minimum of five components which must include at least one actuator and one fluid control method
- ◆ calculation of linear actuator requirements should include both forward and backward strokes of the actuator

Centres may choose to integrate the assessments for Outcomes 2 and 3 so that there is a logical flow to assessment in terms of design, simulate, assemble and testing of a pneumatic or hydraulic circuit.

Outcome 4

Outcome 4 must be assessed by a series of assessments designed to generate evidence of candidates' abilities to fault find and rectify faults in pneumatic or hydraulic circuits.

Candidate evidence must be in the form of performance and written and/or recorded oral evidence. Candidates must undertake assessment on their own. Assessment must be conducted under supervised conditions. An observation checklist must be used to record evidence of whether candidates have satisfied all the Performance Criteria in the Outcome or not.

With regard to Outcome 4

- ◆ candidates must fault find and rectify two constructional and two operational faults in a fluid power circuit(s)

The Assessment Support Pack for this Unit provides sample assessment material. Centres wishing to develop their own assessments should refer to the Assessment Support Pack to ensure a comparable standard.

National Unit Specification: support notes

UNIT Pneumatics and Hydraulics (SCQF level 6)

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.

GUIDANCE ON THE CONTENT AND CONTEXT FOR THIS UNIT

This Unit forms part of the National Qualification Group Award in Mechanical Engineering at SCQF level 6, but may also be offered on a free standing basis.

The aim of this Unit is to allow candidates to develop their knowledge, understanding and skills of pneumatic and hydraulic circuits including their design. On successful completion of the Unit candidates will be able to interpret pneumatic and hydraulic components and component symbols and describe the operation of fluid power components and their applications. They will also have developed the knowledge and skills to draw and simulate pneumatic and hydraulic circuits. Candidates will also be able to design, assemble and test pneumatic or hydraulic circuits and they will also be capable of performing basic fault finding techniques on pneumatic or hydraulic circuits and rectify faults.

In Outcome 1 candidates should learn how to interpret both pneumatic and hydraulic components and component symbols used in engineering systems. Components could include compressors, pumps, actuators (cylinders and motors), valves (relief, directional control, regulators, reducing etc.), filters, flow control devices etc. Candidates should be taught to identify the functions of pneumatic and hydraulic components. They should also learn to describe, with the aid of simple diagrams, the operation of certain pneumatic and hydraulic components such as pumps, compressors, filters, lubricators and pressure regulators.

In Outcome 2 candidates should be taught to draw and simulate pneumatic and hydraulic circuits using appropriate computer software. Such circuits may contain timers, flow control, sequential operation and three way flow control valves. In particular, hydraulic circuits may include the following: linear/rotary motion, metering-in, metering-out, bleed-off and pump unloading.

In Outcome 3 candidates should use the learning in Outcome 2 to design, assemble and test pneumatic or hydraulic circuits. In pneumatic circuits with regard to maintained signals the cascade method should not be covered in-depth but rather maintained signals should be dealt with at a basic level using a change over valve or an intuitive method comprising of timers and reservoirs. Circuits should be assembled and then tested for functionality and where appropriate tests should be carried out under load conditions. Where candidates carry out tests under load conditions they must be supervised by a person deemed qualified by the centre to deliver the Unit. The dangers of working with accumulators and pressurised pneumatic systems should be emphasised.

In Outcome 4 candidates should learn to fault find on pneumatic or hydraulic circuits. Faults should include both constructional and operational types with an emphasis being placed on identifying the cause of the fault and then rectifying and reporting faults.

National Unit Specification: support notes (cont)

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Centres are encouraged to integrate the delivery of Outcomes 2, 3 and 4 as far as is possible so that there is a logic flow from design/simulate/assemble/test to rectifying faults. In Outcomes 3 and 4 the application of good Health and Safety procedures and practices should be emphasised during the assembly and testing of pneumatic or hydraulic circuits and when fault finding and rectifying faults in such circuits.

For candidates in employment systems and procedures may be related to a candidate's work environment and practical exercises may be representative of actual systems or parts of systems in operation at a candidate's place of work.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

It is recommended that the Unit is delivered in the same sequence the Outcomes are presented in the National Unit Specification: statement of standards section of the Unit. The Unit may be delivered largely by a combination of lectures, computer simulation and practical work. The use of software for design and simulation will be required. It is recommended that the Unit is delivered in a laboratory equipped with 'didactic' units on which circuit elements can be assembled, connected and demonstrated. However, the pneumatic or hydraulic circuits assembled should be real so that the full range of faults may be identified.

The Internet contains a rich source of materials on compressors, hydraulic pumps and pneumatic and hydraulic components and circuits.

Good wall charts and videos/DVDs on compressors, hydraulic pumps and pneumatic and hydraulic components and circuits may also provide useful sources of learning (eg animations to illustrate the ways in which components operate).

OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

The Using Graphical Information Core Skill component at SCQF level 6 may be developed in Outcomes 1, 2 and 3 while candidates are identify and interpreting pneumatic and hydraulic component symbols including as part of computer simulation and design exercises and when assembling pneumatic or hydraulic circuits.

The Using Information Technology Core Skill at SCQF level 6 may be developed in Outcomes 2 and 3 while candidates are drawing, simulating and designing pneumatic or hydraulic circuits.

The Critical Thinking Core Skill component at SCQF level 6 may be developed in Outcomes 2, 3 and 4 while candidates are drawing, simulating and designing pneumatic or hydraulic circuits and when fault finding in such circuits.

The Planning and Organisation Core Skill component at SCQF level 6 may be developed in Outcomes 3 and 4 while candidates are designing, assembling and testing pneumatic or hydraulic circuits and when undertaking fault finding on such circuits.

The Working with Others Core Skill at SCQF level 5 may be developed in Outcomes 3 and 4 while candidates engage in practical work as they have to interact with their lecturers, support staff and other candidates, for example while sharing engineering laboratory areas, tools and equipment.

National Unit Specification: support notes (cont)

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GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Opportunities for the use of 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 e-checklists. Centres which wish to use e-assessment must ensure that the national standard is applied to all candidate evidence and that conditions of assessment as specified in the Evidence Requirements are met, regardless of the mode of gathering evidence. Further advice is available in *SQA Guidelines on Online Assessment for Further Education (AA1641, March 2003)*, *SQA Guidelines on e-assessment for Schools (BD2625, June 2005)*.

Centres are encouraged to use formative assessment extensively as it plays a particularly important role in allowing candidates to develop a sound knowledge, understanding and skills in interpreting pneumatic and hydraulic component and component symbols, drawing and simulating pneumatic and hydraulic circuits, designing, assembling and testing pneumatic or hydraulic circuits and when conducting fault finding in such circuits.

Outcome 1 may be assessed by an assessment paper comprising of short answer and restricted response questions and/or objective questions (eg multi-choice questions). This assessment may be suitable for on-line delivery.

Outcomes 2 and 3 may be assessed by means of an assignment. In the assignment candidates' should draw and simulate a pneumatic and a hydraulic circuit to meet given specifications. They should then assemble and test either the pneumatic or hydraulic circuit. Candidates may also perform calculations, as set out in performance criterion and Evidence Requirements for Outcome 3, on one of the actuators in the circuit they have assembled. Candidate evidence may include computer print outs, functional circuits and a test reports that could take the form of a checklist.

Outcome 4 should be assessed by practical exercises. In these exercises candidates should find, rectify and report at least two constructional and two operational faults in a pneumatic or hydraulic circuit(s).

DISABLED CANDIDATES AND/OR THOSE WITH ADDITIONAL SUPPORT NEEDS

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments, or considering whether any reasonable adjustments may be required. Further advice can be found on our website www.sqa.org.uk/assessmentarrangements