Higher National Unit Specification

General information for centres

Unit title: Pneumatics and Hydraulics

Unit code: DT9X 34

Unit purpose: This Unit has been designed to give candidates a knowledge and understanding of the operation and maintenance requirements of pneumatic and hydraulic systems. Candidates will also be provided with the opportunity to design, assemble and test either a pneumatic or hydraulic system and to develop fault finding skills on a practical or simulated fluid power system containing faults. The Unit is particularly suitable for candidates training to be mechanical technicians or incorporated engineers.

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

1 Describe the operational and maintenance requirements of compressed air and hydraulic systems.
2 Design, assemble and test a fluid power and control circuit.
3 Demonstrate faultfinding competence on a fluid power system.

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: It would be an advantage if candidates had possession of the following HN Units: Engineering Principles, Thermofluids, Engineering Drawing and Materials Selection although this is not absolutely essential.

Core 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.

Critical Thinking	Higher
Written Communication	Intermediate 2

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.

General information for centres (cont)

Assessment: This Unit should be assessed on an outcome by outcome basis. 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. Outcome 2 should be assessed by means of an assignment in which the candidate designs, assembles and tests a pneumatic or hydraulic power and control circuit to meet a given design specification. Candidate evidence should take the form of a functional circuit and a written report. Outcome 3 should be assessed using an assignment in which the candidate 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. Candidates should provide written evidence in the form of a report.

Higher National Unit specification: statement of standards

Unit title: Pneumatics and Hydraulics

Unit code: DT9X 34

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

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. Candidates 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

Describe the operational and maintenance requirements of compressed air and hydraulic systems

Knowledge and/or skills

- Compressed air power system
- Hydraulic system
- Properties of air as working fluid
- Air compressors
- Properties of hydraulic fluids
- Hydraulic pumps
- Pneumatic accessories
- Hydraulic components
- Precautions when working with pneumatic and hydraulic systems

Evidence Requirements

Evidence for the knowledge and/or skills in this outcome will be provided on a sample basis. The evidence may be provided in response to specific questions. Each candidate will need to demonstrate that she/he can answer questions based on a sample of the items shown above. In any assessment of this Outcome **six out of nine** knowledge and/or skills items should be sampled.

In order to ensure that candidates will not be able to foresee what items they will be questioned on, a different sample of six out of nine knowledge and/or skills items are required each time the Unit is assessed.

Where sampling takes place a candidate's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to:

- identify the key features of a compressed air system
- identify the main features of a hydraulic system
- explain the properties of air as a working fluid
- describe the operation and performance of air compressors
- explain the properties of hydraulic fluids
- describe the operation and performance of hydraulics pumps
- explain the function of pneumatic accessories

- explain the function of hydraulic components
- describe the precautions required when operating or working with compressed air systems including safety requirements
- describe the precautions required when operating or working with hydraulic systems and fluids including safety requirements

This Outcome should be assessed by means of 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, controlled, supervised conditions and candidate should not be allowed to bring any notes text books or other materials into the assessment.

Assessment guidelines

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

Outcome 2

Design, assemble and test a fluid power and control circuit

Knowledge and/or skills

- Power and control circuit specification to satisfy design requirements
- Circuit Components
- Drawings and parts list
- Assembly of circuit
- Safety regulations for the assembly and testing of fluid power systems
- Apply test procedures
- Modify design in light of test results

Evidence Requirements

All knowledge and/or skills items in Outcome 2 should be assessed. The evidence should be presented in response to an assignment in which candidates 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 candidate's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing that the candidate 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
- record results of the performance of the assembled circuit
- apply safe working procedures to the assembly and testing of the circuit
- compare the performance of the assembled circuit with the design specification
- modify the circuit to meet the design specification if required

The assignment should be carried out under supervised and controlled conditions. Candidate evidence should take the form of a functional circuit and a written 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

Assessment guidelines

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 candidates 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.

Outcome 3

Demonstrate faultfinding competence on a fluid power system

Knowledge and/or skills

- Interpretation of industrial drawings
- Procedures to identify and locate defects
- Application of step diagrams and logic diagrams
- Safety procedures to permit the testing of systems
- Rectification of faults
- Confirmation of fault correction
- Clearance to return to normal operation

Evidence Requirements

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 candidate 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.

Candidates 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
- assess its effectiveness in locating the faults in the system
- rectify the faults in the system
- clear the system for normal operation
- undertake fault finding procedures in a safe and healthy manner

Higher National Unit specification: statement of standards (cont)

Unit title: Pneumatics and Hydraulics

The fault finding exercise should be carried out under supervised, controlled conditions. Candidates should provide written 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 written statement confirming that it is the candidate's own work
- essential documentation required to clear the system for testing and repair and for normal operation on completion of the rectification work

Assessment guidelines

The preference is for the assignment to 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 may reflect the candidate's own employment background. Centres may wish to prepare a checklist to confirm that the practical fault finding activity is the candidate's own work. The assessment for Outcome 3 may be combined with parts of that for Outcome 2. Centres may wish to issue candidates with suitable guidance notes giving advice on the best way to structure their reports. The report may be 250 to 500 words in length.

Administrative Information

Unit code: DT9X 34

Unit title: Pneumatics and Hydraulics

Superclass category: XH

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SQA acknowledges the valuable contribution that Scotland's colleges have made to the development of Higher National qualifications.

Additional copies of this Unit specification can be purchased from the Scottish Qualifications Authority. Please contact the Customer Contact Centre for further details, telephone 0845 279 1000.

Higher National Unit specification: support notes

Unit title: Pneumatics and Hydraulics

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

1 Description of the operational and maintenance requirements of compressed air and hydraulic systems.
2 Design, assembly and testing of a fluid power and control circuit.
3 Demonstration of faultfinding 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, and because the assessment exemplar pack for this Unit is based on the knowledge and/or skills and list of topics in each of the Outcomes.

A list of topics is given below. Lecturers are advised to study this list of topics in conjunction with the assessment exemplar pack so that they can get a clear indication of the standard of achievement expected of candidates in this Unit.

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

Candidates 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 and maintenance of air and hydraulic systems.

- selection criteria for compressed air power system; working loads, pressures, volume flow rates, reasons for selection of air as a working fluid
- selection criteria for a hydraulic system: working loads, pressures, volume flow rates, reasons for selection of hydraulic fluid as the power transmission medium
- properties of air as a working fluid: compressibility, moisture content, need for lubrication, filtration
- operation and performance of air compressors
- properties of hydraulic fluids
- operation and performance of hydraulic pumps
- operation and performance of filters, pressure regulators, lubricators, silencers, driers, accumulators, and actuators
- maintenance of compressors and compressed air systems
- maintenance of hydraulic components and systems

Higher National Unit specification: support notes (cont)

Unit title: Pneumatics and Hydraulics

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
- cascade principles
- sequencing principles

3 **Demonstrate faultfinding 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)
- clearance procedures to return to normal operation (final document)

Guidance on the delivery and assessment 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 candidate's work environment and practical exercises could be copies of actual systems or parts of systems in operation at a candidate's place of work. The use of computer models, simulation and /or design packages will be useful and should be encouraged.

The written assessment should take place after Outcome 1 has been completed and the Assignment for Outcome 2 would normally be undertaken before the assignment for Outcome 3 although there may be opportunities to combine parts of the two assignments.

Opportunities for developing Core 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.

Critical Thinking	Higher
Written Communication	Intermediate 2

Higher National Unit specification: support notes (cont)

Unit title: Pneumatics and Hydraulics

Open learning

The knowledge and/or skills parts of this Unit could be offered on an open learning basis. However, there is likely to be some difficulty with the practical aspects of the Unit unless the candidate can utilise equipment at her/his place of work and arrangements can be made to observe those aspects of performance that have to be assessed. This would depend on the safety and security needs of the company involved. It might be more appropriate to offer the practical parts of the Unit at a centre with a pneumatics and/or hydraulics laboratory.

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: Pneumatics and Hydraulics

Pneumatic and hydraulic systems are used extensively in many parts of industry, and are, therefore, systems about which mechanical technicians and incorporated engineers should have knowledge, understanding and skills.

In this Unit you will learn about the operational and maintenance requirements 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. If you are in employment you can design, assemble and test a system that specifically relates to your work. 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.