SCOTTISH QUALIFICATIONS AUTHORITY

National Unit Specification: general information

UNIT Electropneumatics (Advanced Higher)

NUMBER D8XM 13

COURSE Mechatronics (Advanced Higher)

SUMMARY

The candidate will develop the knowledge and skills required to design, construct and test a simple electro-pneumatic circuit. Candidates will develop the ability to select cylinders, use BS symbols and understand the working operation of electropneumatic components.

OUTCOMES

1 Demonstrate the theory and standards used in electropneumatic systems.
2 Design, construct and test an electropneumatic circuit to specific requirements.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have attained one of the following:

a) Higher Grade in Mechatronics or Technological Studies
b) A Scottish Group Award at Higher level in an appropriate area
c) An appropriate grouping of national units or an NC Group Award.

Centres should note that this unit requires the use of basic ladder diagrams in the control of the electro-pneumatic systems.

CREDIT VALUE

0.5 Credit at Advanced Higher.

Administrative Information

Superclass: XL

Publication date: June 2003

Source: Scottish Qualifications Authority

Version: 01

National Unit Specification: general information (cont)

UNIT Electropneumatics (Advanced Higher)

CORE SKILLS

There is no automatic certification of core skills or core skills components in this unit.

Additional information about core skills is published in the *Catalogue of Core Skills in National Qualifications* (SQA, 2001).

National Unit Specification: statement of standards

UNIT Electropneumatics (Advanced Higher)

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 the Scottish Qualifications Authority.

OUTCOME 1
Demonstrate the theory and standards used in electropneumatic systems.

Performance Criteria

a) Identification of current BS symbols for pneumatic and electrical components is correct.
b) The functional operation of electropneumatic components is correctly demonstrated.
c) Calculation of cylinder sizes and forces for pneumatic systems is correct.

Note on Range for the Outcome
Calculations: pressure=force/area, single and double acting actuators.

Evidence Requirements

Written/oral or practical evidence that the candidate can identify 5 BS symbols giving their component name.

Written/oral or practical evidence that the candidate can identify 5 BS components giving their BS symbol.

Written or graphical evidence of the functional operation, within a circuit, of one electropneumatic component from each section in the table of symbols. (See Support Notes for details).

Graphical evidence that the candidate can describe the operational sequence of an electropneumatic circuit containing two actuators using BS symbols.

Written evidence of calculations for two different actuators.

OUTCOME 2
Design, construct and test an electro-pneumatic circuit to specific requirements.

Performance Criteria

a) Simulation software is correctly used to design and test an electropneumatic circuit.
b) An electropneumatic circuit is constructed to a given specification.
c) An electropneumatic circuit is tested to a given specification.

Note on Range for the Outcome
Design: circuit should contain two actuators. Schematic diagram showing pneumatic and electrical components of the circuit.

Evidence Requirements

Written or graphical evidence that a candidate can accurately produce a functional circuit diagram from a given specification for an electropneumatic circuit containing two actuators.

Performance evidence that the candidate can correctly use software to design and test an electropneumatic circuit which must contain 2 actuators.

National Unit Specification: statement of standards (cont)

UNIT Electropneumatics (Advanced Higher)

Practical evidence that the candidate can construct a circuit to given requirements. Candidates will use sensors for feedback detecting the position of the actuator, (position, or proximity).

Written and graphical evidence that a candidate can accurately produce a test report for the constructed circuit, report should include: schematic circuit diagram, a stage by stage description of the electropneumatic circuit operation, test procedure and an analysis/evaluation of the circuit.

National Unit Specification: support notes

UNIT Electropneumatics (Advanced Higher)

This part of the unit specification is offered as guidance. None of the sections of the support notes is mandatory.

While the time allocated to this unit is at the discretion of the centre, the notional design length is 20 hours.

It is recommended that the allocated time is split as follows, 35% for Outcome 1 and 65% for Outcome 2

GUIDANCE ON CONTENT AND CONTEXT FOR THIS UNIT

Outcome 1
Demonstrates the theory and standards used in electropneumatic systems.

BS symbols should be introduced and circuit diagrams drawn for the exercises which could be constructed in Outcome 2. Candidates should demonstrate that they understand how the components being used function and how this would impact on the rest of the pneumatic circuit. This however should not include a detailed internal description of the component.

Candidates should be able to convert between Pascal's (Pa), Bar, kNm^{-2} and Atmosphere (Atm). The candidates should calculate forces, pressures and areas to allow them to calculate required cylinder sizes from forces in the system. This should include practical aspects such as considering the RAM area in a double cylinder and the need to overcome frictional forces and losses that occur in an electro-pneumatic system.

The mass of the components and the forces that they are to overcome, raising and lowering loads and overcoming the differential forces encountered when using on double acting cylinders (due to the area of the rod) should also be discussed. Candidates will be expected to know the difference between mass and force.

Ladder type diagrams are to be used for the electrical side of the control circuits and candidates will be expected to be able to interpret these so as to establish the sequence of operations within a circuit.

Outcome 2
Design, construct and test an electropneumatic circuit to specific requirements

This section encourages candidates to become familiar with electropneumatic components and their connections. Schematic diagrams (block type) should show the interconnection of the components. The control element of the electropneumatic circuit can be practically provided by hard-wired components, PIC microcontrollers, PLCs or PCs. If this unit is to be taught as part of the Advanced Higher Mechatronics a PIC microcontroller is an ideal controller to use as it complements the other units in the award.

The PLC is probably the simplest controller, but a PC could also be used. All four should be briefly discussed with candidates to emphasise their relative advantages and disadvantages.

Candidates are not expected to write any programs, or design the electronic/electrical side of these circuits. Candidates however will be expected to be able to interpret simple ladder diagrams that show the electrical side of the electropneumatic circuits.

National Unit Specification: support notes (cont)

UNIT Electropneumatics (Advanced Higher)

Candidates will use simulation software to design, construct and test circuits: this may involve the use of pre-constructed electrical circuits on the software. The candidates should construct/simulate a series of pre-designed circuits to allow them to build up a working knowledge of both single double acting and sequential applications. These circuits should allow discussion of open loop systems with timers: they should also include closed loop systems with reed switches, micro-switches and/or magnetic proximity switches.

They then should be given the specification for an electropneumatic circuit containing one or two actuators. From this they should be able to produce a pneumatic schematic diagram. Working from this they should be able to construct a circuit diagram using BS symbols and finally a functioning practical circuit to meet a given specification.

After constructing the circuit candidates should write a report. The report should include a circuit diagram, a description of the circuits operation, a test procedure, results, analysis and evaluation.

The test procedure should include a basic level of fault finding in design, construction and component failure faults. A candidate would not have to produce a "correct" and functioning circuit to pass but in the case of a non-functioning circuit the reasons for failure must be clear in the evaluation.

The British Fluid Power Association produce educational material. They can be contacted at:

Cheriton House
Cromwell Park
Chipping Norton
Oxfordshire OX7 5SR
Tel: 01608 644114 Fax: 01608 643738
Internet: http://www.BFPA.co.uk
E-mail: enquiries@bfpa.co.uk

National Unit Specification: support notes (cont)

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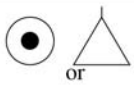
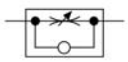
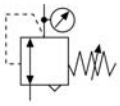
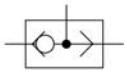
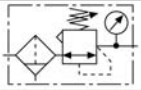
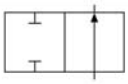
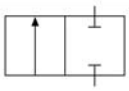
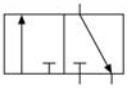
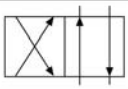
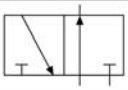
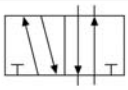
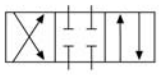
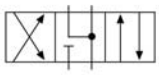
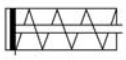
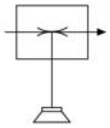
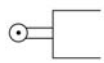
TABLE OF SYMBOLS					
Section A					**Ancillary component symbols**
Air Supply		One way flow control		Check valve	
Exhaust		Pressure Control Valve with pressure gauge		Restriction valve Choke valve (Arrow shows it is adjustable)	
Shuttle valve		Pressure Regulator (If adjustable arrow on spring)		Pressure gauge	
Flow line		Flow line connection		Air service Unit (containing Filter/water trap; Pressure control valve; pressure gauge)	
Pilot line		Limit switch		Proximity switch	
Section B					**Directional Control Valves (DCV)**
2/2 Directional Control Valve Normally Open		2/2 Directional Control Valve Normally Closed		3/2 Directional Control Valve Normally Closed	
4/2 Directional Control Valve				3/2 Directional Control Valve Normally Open	
5/2 Directional Control Valve		4/3 Directional Control Valve Mid-position Closed		4/3 Directional Control Valve Mid-position Vented	
Section C					**Actuators**
Single acting cylinder with spring return		Double acting cylinder		Vacuum suction nozzle and Suction cup	
Rotary Actuator		Fixed capacity motor (two directional)			
Section D					**Valve actuation methods**
Actuation by Push Button		Actuation by Solenoid		Actuation by Pressure Line or Pilot Line	
Detent (holds the position of the valve)		Actuation by Lever		Actuation by Roller Switch	
Actuation by Spring				Example of two actuators on one valve	

National Unit Specification: support notes (cont)

UNIT Electropneumatics (Advanced Higher)

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

The unit should be delivered in the order in which the outcomes are listed. This enables the basic theory to be dealt with prior to consideration of the practical aspects.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

It is recommendation that centres use National Assessment Bank material for this unit.

Summative assessment should be carried out at the conclusion of the delivery of the essential basic theory

SPECIAL NEEDS

This unit specification is intended to ensure that there are no artificial barriers to learning or assessment. Special 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 Special Assessment Arrangements* (SQA, 2001).