National Unit Specification: general information

UNIT Engineering: Control Valves and Positioners (SCQF level 6)

CODE F5KL 12

SUMMARY

This Unit can be delivered as part of a National Qualification Group Award but can also be taken as a free-standing Unit. The Unit is designed to enable candidates to develop knowledge and understanding of control valves, their characteristics, construction and the associated positioners/digital valve position controllers (smart positioners). It will also develop the candidates practical ability in setting up control valves and their positioners.

This Unit is suitable for candidates studying the subject for the first time and acts as a basis for progression to employment and/or further study.

OUTCOMES

1 Explain the construction and principle of operation of control valves.
2 Investigate the flow/lift characteristics of control valves.
3 Explain the principle of operation of valve positioners.
4 Calibrate a control valve with positioner.

RECOMMENDED ENTRY

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

- Standard Grade Mathematics — General/Credit Level
- Standard Grade Technological Studies and/or Science subjects — General/Credit Level

Administrative Information

Superclass: VE

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National Unit Specification: general information (cont)

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CREDIT VALUE

1 credit at SCQF level 6 (6 SCQF credit points at SCQF level 6*).

**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.*

CORE SKILLS

There is no automatic certification of Core Skills in this Unit.

This Unit provides opportunities for candidates to develop aspects of the following Core Skills:

Problem Solving (SCQF level 6)
Communication (SCQF level 6)

These opportunities are highlighted in the Support Notes of this Unit Specification.

National Unit Specification: statement of standards

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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 construction and principle of operation of control valves.

Performance Criteria

(a) Identification of the component parts of control valves is correct.
(b) Principle of operation of control valves are correctly explained.
(c) Control valve applications are correctly explained.

OUTCOME 2

Investigate the flow/lift characteristics of control valves.

Performance Criteria

(a) The production of flow/lift characteristics is correct.
(b) The comparison of the results is correct with respect to the ideal flow conditions.
(c) The identification of the flow/lift characteristic is correct.

OUTCOME 3

Explain the principle of operation of valve positioners.

Performance Criteria

(a) The identification of component parts of valve positioners is correct.
(b) The explanation of the advantages of a valve positioner is correct.
(c) The explanation of the principle of operation of analogue pneumatic and digital valve positioners are correct.

OUTCOME 4

Calibrate a control valve with positioner.

Performance Criteria

(a) The calibration of the positioner is correct.
(b) The production of graphs is accurate with respect to the input signal and the valve stem position.

National Unit Specification: statement of standards (cont)

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EVIDENCE REQUIREMENTS FOR THIS UNIT

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

Written and/or oral evidence is required which demonstrates that the candidate has achieved Outcome 1 and Outcome 3 to the standard specified in the Outcome and Performance Criteria.
The evidence for these Outcomes should be obtained in a combined assessment and obtained under controlled supervised conditions and last approximately 1 hour 30 minutes.

Performance evidence and written and/or oral evidence is required to demonstrate that the candidate has achieved Outcome 2 to the standard specified in the Outcome and Performance Criteria.

The evidence is recorded in a report which should include two types of flow/lift characteristics.
An assessor observation/checklist should record the correct set up and operation of the valve and flow test equipment and last approximately 1 hour.

Performance evidence and written and/or oral evidence is required which demonstrates that the candidate has achieved Outcome 4 to the standard specified in the Outcome and Performance Criteria.
Evidence can be obtained under open-book conditions, the performance evidence is based on traditional and SMART positioners. An assessor observation/checklist should record the correct set up and operation of the control valve/positioner and test equipment.

National Unit Specification: support notes

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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 is an optional Unit within the National Certificate in Measurement and Control Engineering but can also be delivered on a free-standing basis.

This Unit has been written in order to allow candidates to develop knowledge, understanding and skills in the following areas.

The range of topics that will be covered in the delivery of the Unit will be as follows:

Outcome 1

- Control valve types: ball, butterfly, fishtail, V-ball, cage type valves
- Motor types: pneumatic, hydraulic, electric
- Construction: bonnet, actuator, yoke, stuffing box, body, trim, plug, seat, stem, valve, spring
- Fail safe: air to open/air to close
- Valve trims: single/double seats, top/bottom seats, shutoff characteristics

Outcome 2

- Valve characteristics: equal percentage, quick opening, linear
- Butterfly and ball valves
- Ideal flow characteristics (constant pressure drop across the valve)

Outcome 3

- Force balance operation of valve positioners and digital valve positioners
- Non-standard outputs from valve positioner
- Volume/pressure boosters, ‘stay put’ relays
- Advantages: feedback control of the valve stem, increases speed of response and accuracy of stem position, confirmation of valve position

Outcome 4

- Valve positioner alignment/calibration for single valve (open/closed on air failure), direct/reverse action
- Valve positioner alignment for split range operation and open/closed on air failure
- Digital (SMART) valve positioners and their alignment/calibration
- Alignment/calibration of valve motion with software

National Unit Specification: support notes (cont)

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GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

This Unit should be delivered in a way that includes a mixture of lecturer led and candidate-centred activities.

In this Unit the Outcomes should be delivered in order.

The use of ICT (Information and Communication Technology) should be used to support the delivery of this Unit. This could take the form of candidates researching different types of control valves and positioners as used in process controls on the internet. Computer simulation packages could also be used.

This Unit requires access to a measurement and control engineering laboratory with a range of control valves and positioners, flow systems and test equipment. Demonstrations and laboratory exercises can be used to improve the candidates understanding of control valves/positioners and their application in process control. This will help to relate theory to practice.

OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

Aspects of the Core Skill of *Problem Solving*, that is, critical thinking, planning, organising, reviewing and evaluating, will be naturally developed in this Unit, which requires application of knowledge to a practical task. Candidates identify, explain and consider principles and characteristics of operation before calibrating a control valve with positioner. Discussion and evaluation of the effectiveness of set up and operation would enhance oral communication skills in a work related environment.

Candidates could be encouraged to read and evaluate a range of complex technical information to support underpinning knowledge. Written evidence produced should be formally presented to industry standards and include accurate and correctly annotated graphs.

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 communications 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).*

National Unit Specification: support notes (cont)

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Achievement of this Unit requires the Evidence Requirements for each Outcome to be met. A candidate who does not initially achieve the specified standard can have a further opportunity, attempting only the Outcome(s) not previously achieved.

Outcome 1 and 3 could be assessed by a 1 hour 30 minute closed-book test which consists of a series of short answer, restricted response and structured questions.

Outcome 2 could be assessed by a practical exercise that involves the production of a flow/lift characteristic and identification of two others. An observation checklist should be used to record candidate performance. The assessment also requires the production of a suitable report containing the test data and its interpretation.

Outcome 4 could be assessed by a practical exercise that involves the calibration of a control valve with its positioner. Positioners can be pneumatic or digital with associated signal conditioner boosting. An observation checklist should be used to record candidate performance. The assessment also requires the production of a suitable report containing the test data and its interpretation.

CANDIDATES WITH DISABILITIES AND/OR ADDITIONAL SUPPORT NEEDS

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. Further advice can be found in the SQA document *Guidance on Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs* **(www.sqa.org.uk)**.