



National Unit Specification: general information

UNIT Process Measurement and Control: An Introduction (SCQF level 6)

CODE F6X8 12

SUMMARY

This Unit may form part of a National Certificate Group Award or may be used as a freestanding Unit.

This Unit is designed to enable candidates to develop an introductory knowledge, understanding and skills in measurement and control principles as applied in engineering and process industries for a wide range of prime applications.

The Unit will introduce candidates to the principles and applications of the measurement of the prime process variables of temperature, pressure, flow and level, together with fundamental knowledge and skills of checking the calibration of measurement instrumentation. It will also introduce candidates to a range of fundamental methods for the control of process systems using both open and closed loop techniques incorporating of on/off and continuous control. Candidates will develop their knowledge and skills through practical tasks to investigate the operation of fundamental process measurement and control systems.

The Unit is devised to provide progression to further in-depth studies in the measurement and control disciplines at SCQF level 6 and SCQF level 7.

The Unit is particularly suitable for those candidates who are progressing toward employment as process or system engineering technicians in a wide range of applications within the energy industries sector.

OUTCOMES

- 1 Explain open and closed loop process control systems.
- 2 Explain the measurement of the four main process variables.
- 3 Apply measurement systems to process control used in the process industries.
- 4 Apply process control as used in process industries.

Administrative Information

Superclass: VE

Publication date: June 2009

Source: Scottish Qualifications Authority

Version: 01

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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 at General/Credit level
- ◆ Standard Grade Technology and/or science subjects at General/Credit level

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.

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

- ◆ *Numeracy* (SCQF level 6)
- ◆ *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 open and closed loop process control systems

Performance Criteria

- (a) Correctly define the component parts of a process control system to include transmitter, controller, actuator and the process.
- (b) Correctly explain transfer and distance velocity lags as applied to the positioning of measurement points on a process control system.
- (c) Correctly explain the information change circulating in a closed loop control system.
- (d) Correctly explain manual and automatic systems.

OUTCOME 2

Explain the measurement of the four main process variables

Performance Criteria

- (a) Correctly explain the measurement of Temperature using thermocouples and resistance temperature detectors.
- (b) Correctly explain the measurement of Pressure using capacitance and strain gauge type detectors.
- (c) Correctly explain the measurement of Flow using differential pressure, turbine meters and magnetic flow meters.
- (d) Correctly explain the measurement of level using pressure type detectors and displacement type sensors.

OUTCOME 3

Apply measurement systems to process control used in the process industries.

Performance Criteria

- (a) Investigate the operation of a measurement transmitter as used in a single loop process control system.
- (b) Correctly check and record accurately the calibration data of a process measurement instrument.

National Unit Specification: statement of standards (cont)

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OUTCOME 4

Apply process control as used in process industries

Performance Criteria

- (a) Investigate the operation of a single loop on/off control system.
- (b) Correctly apply manual and automatic control to a single loop control system.
- (c) Investigate the operation of a single loop continuous control system.

EVIDENCE REQUIREMENTS FOR THIS UNIT

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

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

Outcomes may be assessed on an individual basis. However Outcomes 1 and 2 may lend themselves to being combined into a single assessment exercise. Outcomes 3 and 4 may also lend themselves to being integrated into a single assessment task.

Written and/or oral evidence is required which demonstrates that the candidate has achieved **Outcome 1 and Outcome 2** to the standard specified in the Outcome and Performance Criteria. The evidence should be obtained in assessments carried out under controlled, supervised conditions.

Performance evidence, supplemented with an assessor observation checklist and written, graphical and/or oral evidence is required which demonstrates that the candidate has achieved **Outcome 3 and Outcome 4** to the standard specified in the Outcome and Performance Criteria. The evidence for these outcomes should be obtained under controlled, supervised conditions. An assessor observation/checklist should record the correct set up and operation of the test system and equipment. The assessor observation checklist must also be used to record evidence that candidates have complied with relevant safety regulations and safe working procedures and practices while undertaking the practical work.

Total assessment time for the Unit must not exceed six hours.

Outcome 1

The assessment will be closed-book and should last approximately one hour.

Outcome 2

The assessment will be closed-book and should last approximately one hour.

National Unit Specification: statement of standards (cont)

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Outcome 3

The candidate will measure the output of a measurement system at a number of loads recording both the input and output data and produce a graph of this data. Candidates are also required to carry out a calibration check of a process measurement instrument.

The assessment for this outcome should be carried out towards the end of the Unit. The assessment should last no more than two hours.

Outcome 4

The candidate will investigate the operation of one suitable process using on/off and one using continuous control. The candidate will measure the output of two control systems at a number of loads recording both the input and output data and producing a graph of this data. The candidate given a selection of measurement transmitters will have to choose a suitable transmitter and fit it to the system and run the system both in manual/automatic control, recording input and output data and producing graphs of this data.

The assessment for this Outcome should be carried out towards the end of the Unit. The assessment should last no more than two hours.

General

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: statement of standards (cont)

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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 Unit may form part of a National Certificate Group Award but can also be taken as a free-standing Unit.

This Unit introduces candidates to the fundamental concepts of Process Measurement and Control. Emphasis in the delivery of the Unit should be on basic concepts using fundamental principles along with the terminology associated with process measurement and control rather than detailed justification of concepts.

Health, Safety and Environmental (HSE) sustainability are integral and key to the Engineering and Process industries therefore throughout this Unit emphasis will be placed where appropriate on the relevant application of HSE sustainability aspects. During practical work, safe working practices should be followed in accordance with current relevant safety codes of practice, regulations and organisational requirements.

This Unit is designed to allow centres the flexibility to deliver knowledge and understanding based on the range of equipment available in a simulated or real work environment relevant to the process industries. The main areas to be covered are:

- ◆ The component parts of a process control system (transmitter, controller, actuator, process).
- ◆ Transfer and distance velocity lags as applied to the positioning of measurement points on a process control system.
- ◆ Open and closed loop systems and manual and automatic systems, with or without feedback.
- ◆ Measurement of temperature, pressure, flow and level in an engineering or process environment.
- ◆ Checking and recording accurately the calibration data of a process measurement instrument.
- ◆ Operation of manual and automatic control systems.
- ◆ Application of on/off and continuous control

The Unit may be delivered in the context of measurement and control within all energy and engineering industries where temperature, pressure, flow and level are prime process variables. Process systems may include applications for oil and gas, refining, petrochemicals, nuclear and appropriate renewable energy systems. Pipeline systems will especially provide comprehensive applications in which to contextualise this Unit.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

This Unit covers the fundamental knowledge required as an introduction to process measurement and control; it covers some basic theory and practical activities relevant to industry practices in this discipline field.

It is recommended that the Unit is delivered in the same sequence that the Outcomes are presented in the National Unit Specification: statement of standards section of the Unit.

National Unit Specification: statement of standards (cont)

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The Unit is both classroom and laboratory or workshop environment based. For Outcome 3 and Outcome 4, it is important that the learning take place in a supervised laboratory/workshop environment. Safe working practices will be included in the content as it is important that the candidates learn to adhere to these at all times.

While the use of case study material is particularly recommended for both the learning and teaching components of this Unit, other suggested teaching and learning methods for this Unit could include the use of visual aids, Information and Communication Technology (ICT), group lectures and discussion, practical demonstrations, question and answer sessions, directed study, and industrial/site visits.

Formative work for the Unit could specifically include group discussion and role play emphasising workplace health and safety issues and events specific to Process Measurements and Operations in different industrial sectors. Such an approach could be particularly beneficial to delegates with no industrial experience.

Exposing candidates to case studies of specific applications of process measurement and control will provide a substantially beneficial learning experience. Such cases studies could focus on the measurement and control requirements of specific sectors within the energy and engineering industries. They could include the use of simulated or realistic technical information of process systems such as system and equipment specifications, system operations, piping and instrumentation diagrams.

Case studies could be used as a stimulus to provide opportunities for completing appropriate documentation and reading and evaluating relevant legislation, policies and procedures. Role play of typical industry scenarios could additionally enhance the co-operative working of delegates.

OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

Delegates will develop skills in *Problem Solving*, which are in Critical Thinking, Planning and Organising, and Reviewing, as they undertake the Unit. They need to examine and take account of all issues affecting measurements and operations for specific processes before starting practical work. They will meet all health and safety requirements before and during carrying out any practical sessions. Review and evaluation of achievement with assessor support and guidance should be naturally occurring process in formative and summative work.

Group discussion of safety issues during formative work could enhance both problem solving and oral communication skills and ensure opportunities to practise the use of appropriate terminology and improve listening skills in a work related context.

Although skills in Written Communication are not formally assessed delegates should be given opportunities to develop their abilities to communicate to an acceptable standard for trainee engineering and process technicians. They need to be able to read, understand Operating Procedures and simple Piping and Instrumentation Diagrams and could also be encouraged to refer to and evaluate a range of background information and advice of safety issues and equipment. Reports should be technically accurate, with attention to spelling and punctuation.

National Unit Specification: statement of standards (cont)

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Numeracy skills may be developed around the requirement to make calculations related to the calibration of measurement instrumentation.

Outcome 3 and Outcome 4 particularly provide clear opportunities for developing *Problem Solving*, *Communication* and *Numeracy* Core Skills.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

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.

Assessment for Outcome 1 could take the form of a written and/or oral assessment in which the candidates are asked to explain the following component parts of a process control system: transfer and distance and velocity lags, information interchange in a closed loop system, and open and closed loop systems.

Assessment for outcome 2, could take the form of a written and/or oral assessment in which the candidate are asked to explain the following ways of measuring process variables, thermocouples, resistance thermometers, capacitance and strain gauge type pressure detectors, differential pressure, turbine meters and magnetic flow type detectors and level using pressure and displacement detectors.

The assessment for Outcome 3 is a practical assignment. The candidate could be given a working transmitter and investigate how the output changes for given input changes. A short report may be produced explaining the effect of the changes and how the detecting element changes are converted to a standard output signal and calibration sheet should be produced after the transmitter's calibration has been checked. Within the report the candidate should also correctly explain the primary and secondary elements of the transmitter.

The assessment for Outcome 4 is a practical assignment. The candidate could be given three working systems, manual control loop, automatic control loop and on/off control loop. A short report may be produced explaining the effects of load changes on the three different systems and how they performed. Candidates should also explain a typical application for on/off control and continuous control.

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: statement of standards (cont)

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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).